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DEVELOPMENT
OF A BAKERY SNACK FOR EXPORT
FROM NEW ZEALAND TO MALAYSIA

A thesis
presented in partial fulfilment of
the requirement for the degree of
Doctor of Philosophy in Product Development

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ABSTRACT

The use of consumers in the product development system for developing a food product was investigated. The investigation studied the techniques suitable for use with consumers and how well the development system worked in a cross-cultural situation. A bakery snack was developed for export from New Zealand to Malaysia, targetted at two major ethnic groups, the Malays and Chinese.

Initial market research (including a consumer survey and a focus group) provided general information on the eating of snacks by the Malays and the Chinese. Multidimensional scaling also provided general information on their perceptions of bakery snacks and uncovered an area for further development work. The initial market research findings indicated that the Malays and Chinese were similar in their perceptions and preferences of bakery snacks. Their purchasing patterns of bakery products from bread and cake shops were somewhat different. Bread and cake were more popular among the Malays, while the Chinese bought more filled buns and currys puffs.

Consumers generated 100 new product ideas for bakery snacks using brainstorming and nominal group technique. Both techniques were found to be useful under different conditions. The product ideas were reduced to seven using a series of quantitative techniques. The final selection of a macaroni and minced meat pie for further development was made by Malay and Chinese consumer groups.

Formulation of the pie was studied, using sensory profiling with fixed "ideals", by a small panel in New Zealand. The panel consisted of Malaysian students who had been in New Zealand for one or two years. Data obtained from the sensory profiling were used to derive empirical equations relating sensory attributes and acceptability to ingredient levels, so that the formulation could be guided quickly and systematically. The final product was consumer tested in Malaysia using a central location test, focus groups and sensory profiling.

Consumer input was useful in every stage of the development of the product. Their input was particularly important during the initial market research, the formulation stage and product testing. It was concluded that consumers were best utilised in as many stages of the development of a consumer product as possible, using groups of 10-30 people. Most techniques were found suitable for cross-cultural research. Exceptions occurred where questionnaires were involved (i.e. the initial consumer survey and the central location test) where it was found that Malays were reluctant to answer questions. Results from the different techniques at the various stages of the project correlated well with few exceptions.

The pie developed was acceptable to Malaysians, both Malays and Chinese, but improvements are still necessary, particularly in the sensory properties before test marketing. The beef flavour was too strong and could possibly be reduced by decreasing the beef content and replacing it with textured vegetable proteins.

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CHAPTER 1

PRODUCT DEVELOPMENT AND THE CONSUMER

1.1 INTRODUCTION

Product development is the science of initiating and developing new products and modifying existing products for a market. As product development becomes an increasingly important activity in a company, due to competition and a changing environment, so too will the research into developing and refining the techniques for product development. The product development process can be applied in many different situations. In the most straightforward case, the product is developed for a local market and for only one target market segment. More complicated situations may involve the following factors:

- * a need for the product to be acceptable to more than one market segment, or cultural group.
- * pioneering of new technology, either from the point of view of processing or packaging.
- * compliance with governmental regulations, safety standards, and cultural requirements.

This thesis was a study of the product development process in a complex situation. The project was the development of an export product for a market with several cultural groups.

Peninsular Malaysia was chosen as the market for study as it has major ethnic groups which are distinctly different in both cultural and religious backgrounds. Although the Malaysian population is a complex mixture of ethnic groups, there are three main ones: Malays, Chinese, and Indians (see Figure 1.1). For the purpose of this project, only the two main ethnic groups, Malays and Chinese, were selected for detailed study. Together, these groups make up 89% of the total population. Consumer acceptance amongst these two groups will ensure a successful product in the market place.

Bakery products for export from New Zealand were chosen as the product area. Bakery products were identified as a growth market because Malaysians were becoming "westernised" in their eating patterns and were increasingly accustomed to western eating habits. Outlets for bakery products started appearing in Malaysia as recently as the early 1980's, selling products such as specialty breads, filled buns, pastry products, and cakes. Since bakery technology in New Zealand is more advanced than in Malaysia, there existed an opportunity for developing a bakery product for Malaysia using the production facilities in New Zealand.

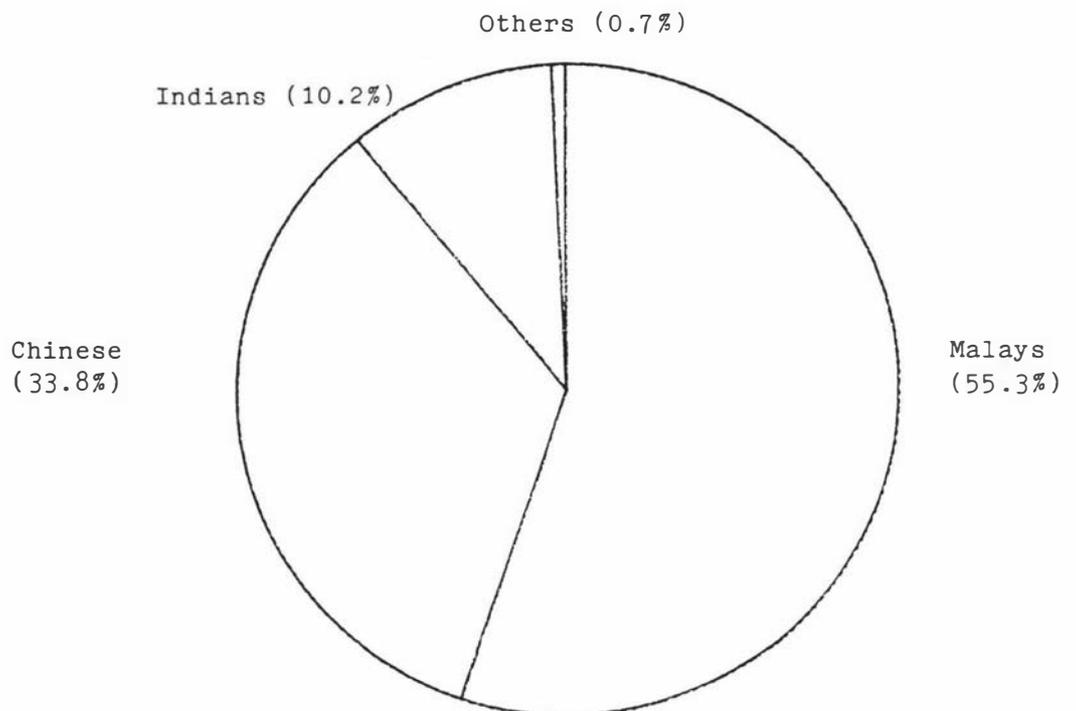


Figure 1.1: Population distribution of Malaysia by ethnic group

1.2 FOOD PRODUCT DEVELOPMENT

Although the principles of product development can be applied across different industries, there are specific requirements in the food industry which do not affect many other industries. These include the microbiological aspects of food, seasonality of raw materials, special dietary needs, the restrictions imposed by food regulations, and the vast differences in food acceptability between cultures. In this thesis, the focus was on food product development, although, many of the techniques used are undoubtedly pertinent to product development in other industries.

Booz et al. (1984) have shown the importance of a systematic programme in product development. These authors identified the implementation of a 7-step new product development process as vital to corporate growth, profit and survival. The product development process has been extensively studied and applied in industry, but publications related to the development of new food products have been few and far between (Mattson, 1970; Meyer, 1984).

Wilkinson (1985) pointed out that systematic food product development is even more important now than thirty years ago, when the number of food products for sale was small in comparison with today. At Massey University, there has been a continuing programme of research into systematic and quantitative methods for new food product development, initiated by Dr W. Edwardson in 1969 (Anderson, 1975). The system or process consists of several stages, integrating both marketing and technical research, followed by critical analysis of the project, which is recognised as important in the design of food products (see Figure 1.2). The Massey product development system outlined by Earle (1985) was used as a guideline for this project.

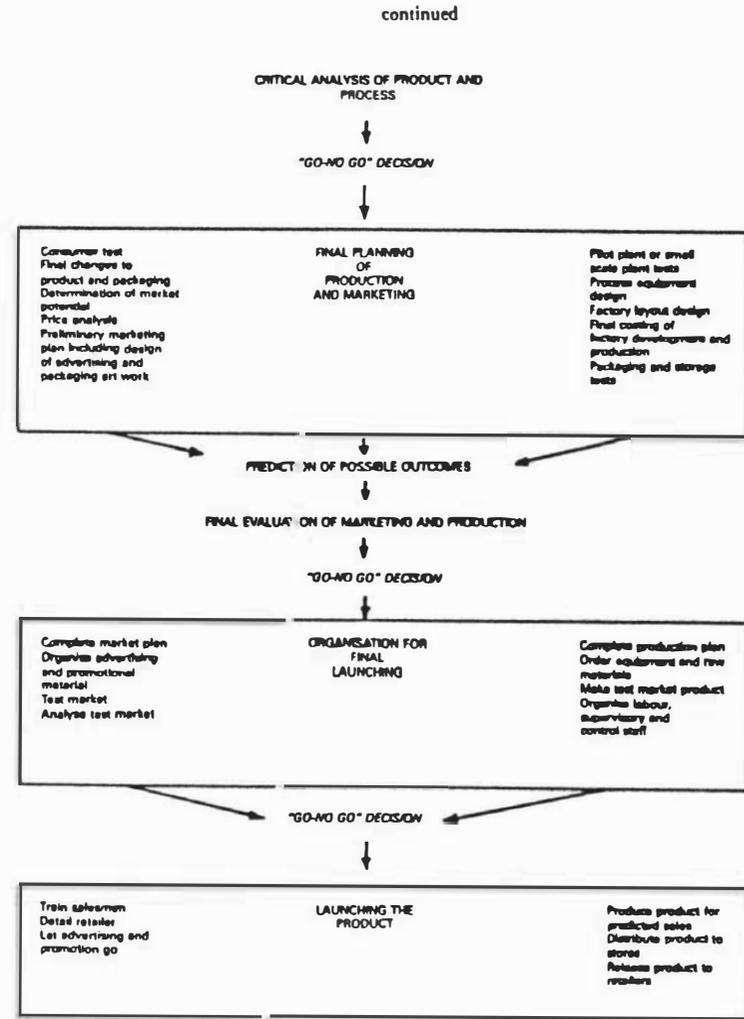
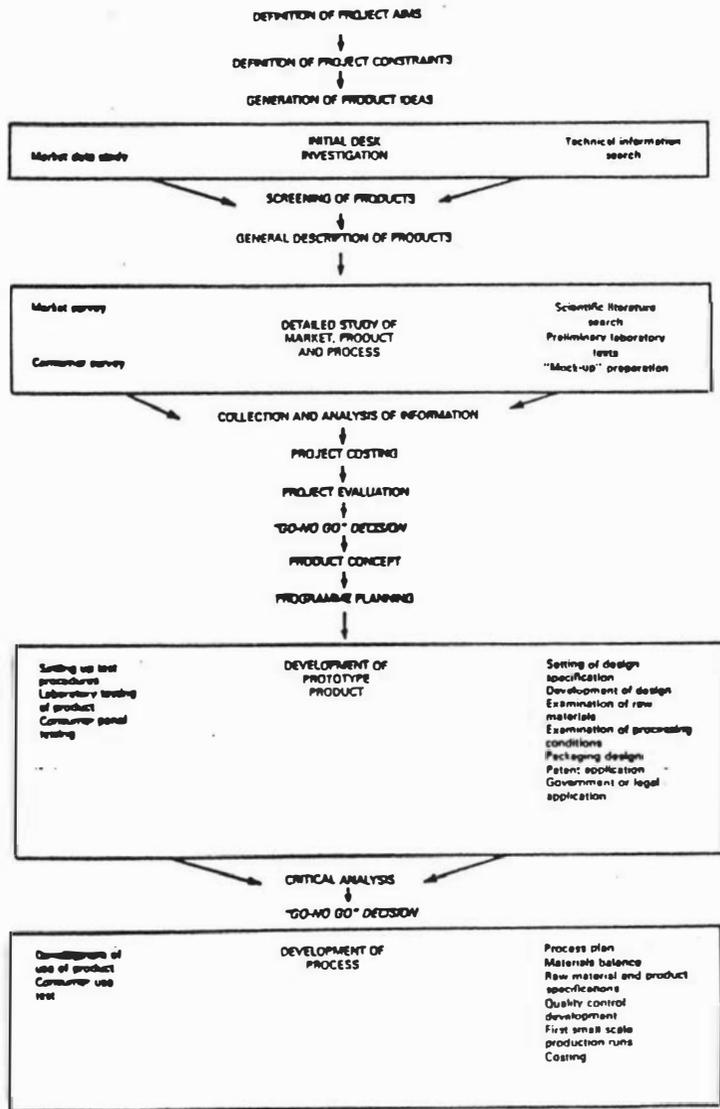


Figure 1.2: A systematic process for product development

1.3 CONSUMER INPUT IN THE PRODUCT DEVELOPMENT SYSTEM

Traditionally in food product development, there are three major stages at which consumer input was incorporated. These are the initial market research, sensory testing and the final market test.

For the initial market research, the technique most commonly employed is the consumer survey. Results from a single population are generalised to the population of interest. However, surveys are expensive and time consuming. In addition, consumer surveys are not entirely appropriate for exploratory research, where focus groups are being increasingly used. Focus groups cannot completely replace surveys, as they do not provide quantitative data used for determining market potential. Focus groups can be used to:

- * guide the design of quantitative survey questionnaires.
- * generate hypotheses to be tested in subsequent research.
- * generate, develop and test product concepts.

With the advent of focus groups, consumer input has been expanded to the product concept development phase, prior to the development of prototype products. Shocker and Srinivasan (1979) recognised that consumer input is usually not solicited until firms have already designed their products, while the textbook definition of the marketing concept demands that the reverse process be practised. With increasing use of multivariate techniques, it has become possible to link product features to perceptions, and attributes to preferences. This means that the features affecting product choice or preference can be taken into account in product design.

In their review of multivariate approaches for product concept evaluation and generation, Shocker and Srinivasan (1979) listed many multivariate techniques which were being used to model consumer decisions. The consumer decision models used in many product situations included the following:

- * determination of relevant product-markets.
- * identification of determinant attributes.
- * creation of an abstract representation of each submarket.

- * development of models of individual behaviour towards new concepts and existing brands.
- * evaluation of a prespecified new product concept.
- * search of the perceptual product space to generate "optimal" new concepts.

Three trends were becoming apparent. Firstly, there was a reliance on consumers in product development. Thus, consumer input in the early stages of concept evaluation and generation increased markedly with the increased use of multivariate techniques. Secondly, as multivariate techniques involve some form of rating or comparison of products by small groups of consumers, external validity became less of a critical criterion. Thirdly, consumers were usually oriented to perform the tasks required, and although they were not considered as "trained", the consumers were believed to be capable of performing a growing number of tasks.

Other than the multivariate techniques used in concept generation, there are analytical and non-analytical group techniques which have been adapted for use by the consumer. These include focus groups (Hussey, 1973; Urban and Hauser, 1980; Fern, 1982; Vichas, 1983), brainstorming and nominal group technique (Sampson, 1970; Lomax and McLeman, 1984). Apart from idea generation, the nominal group technique also appears to be suitable for exploratory research, and screening, although it is less popular than the focus group (Claxton et al., 1980).

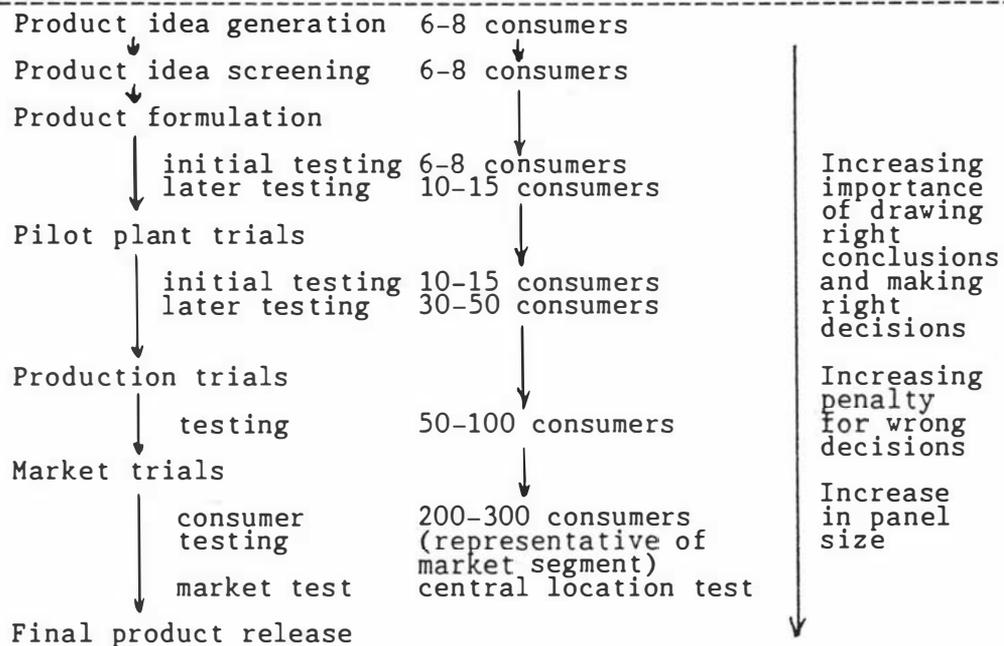
Sensory evaluation is another stage in product development where consumers have traditionally been used. Moskowitz (1985) noted that while marketing researchers work virtually 100% with consumers, sensory analysts have preferred to use expert panels. He distinguished between expert and consumer panels for product research (see Table 1.1). Laboratory or expert panels were used to determine the differences between samples, and the direction of differences while consumer panels were used to evaluate the acceptance or preference of foods (Amerine et al., 1965). This meant that consumer input was not solicited until the product had been made. With the increasing interest of marketing researchers in the early stages of the development process, consumer panels have emerged as a means of early stage guidance to replace the

more traditional expert panels. In 1981, Anderson noted that consumer panels could be applied throughout the full course of the product development process (see Table 1.2). Moskowitz (1985) who has worked extensively in the area of sensory evaluation had also started using consumer panels for many different purposes such as screening of ingredients, developing and optimising concepts, optimising products for acceptance, cost and stability, and determining attributes of importance to consumers. The size of these panels ranged from 42-150 consumers.

Table 1.1: Comparison of expert vs consumer panels for product research (Moskowitz, 1985)

| | |
|--|--|
| Panel size | Expert: 4-10 Consumer: 25-50 |
| Employment | Expert: Often in-house employees Consumer: Often local residents (generally non-employees, but sometimes companies use employees for broad scale testing) |
| Period of training | Expert: Usually weeks to months Consumer: Little if any (except for familiarisation) |
| Period of participation | Expert: Weeks to years Consumer: Generally once for a particular project |
| Specific sensory acuity | Expert: Often measured at start of study, sometimes a key qualifier Consumer: Rarely measured, not usually of interest |
| Category usage and purchase behaviour | Expert: May or may not use product at home Consumer: Generally a category user, qualified on basis of usage |
| Remuneration | Expert: Rare, participation a function of social and corporate dynamics Consumer: Frequent, participation motivated by remuneration |
| Ability to focus on task | Expert: High; interrupted quite often by conflicting corporate responsibility Consumer: High, because of payment; low if not paid |
| Actual cost per hour for participation | Expert: Real overhead (\$30-\$60/hour) and opportunity cost for interrupted work. Out of pocket costs do not show up on "bottom line", but real costs definitely exist Consumer: Approximately \$10/hour plus recruitment costs Initially, appears expensive, but actually costs less in real dollars (factoring in overhead, etc) |

 Table 1.2: Consumer panels in product development



 (adapted from Anderson, 1981)

The preceding discussion has highlighted several important trends in the use of consumers for product development. They are:

- * a growing use of consumers in an increasing number of phases of product development, particularly in the early stages of product development.
- * an increasing variety of tasks given to consumers such as rating the importance of attributes, generating and screening product concepts.
- * the use of consumers for extended periods of up to 4 hours in a single day and for 3-4 days.
- * the use of consumer panels ranging between 42-150 people.
- * the acceptance of the results as valid for the population.

1.4 THE PROJECT OBJECTIVES

In this project, consumer acceptance of the product was the vital key to its success. As bakery technology is well established in New Zealand, no major new processing technology was involved. An attempt was not made to introduce a completely novel product to the market but

to build the product into the existing eating habits of the Malays and Chinese.

Although consumers have been used in a variety of situations in product development, there has been no systematic investigation into the stages where their input is most useful, or indeed whether there is a need for consumers in the various stages of product development. The types of techniques and the size of groups useful for product development has not been researched throughout the process. Also, there has been little research into the applicability of various product development techniques to consumers, who - by and large - are untrained and not necessarily highly educated. Finally, with an increasing amount of international food marketing, as well as the rise in popularity of ethnic foods, the relevance of product development techniques in cross-cultural situations has become important.

Thus, the aim of this thesis was to determine the stages at which consumers are most useful in product development, and the techniques most suited for use by consumers - particularly in a cross-cultural situation. The objectives were to:

- * compare market research techniques in the initial stages of product development using a focus group, a consumer survey, and a multivariate model.
- * investigate the use of consumers for idea generation and screening of product ideas.
- * develop a sensory evaluation method using consumers to guide the formulation of food products.
- * compare a consumer survey, a focus group, and sensory testing for the evaluation of acceptability of the final product.

The following activities were carried out in the project:

| | |
|---|-------------|
| Preliminary desk study | New Zealand |
| Focus group with Malaysian students | New Zealand |
| Consumer survey with households | Malaysia |
| Multidimensional scaling with groups of women | Malaysia |
| Idea generation with groups of women | Malaysia |
| Screening with groups of women | Malaysia |
| Formulation with Malaysian students | New Zealand |
| Production trial in pie factory | New Zealand |
| Consumer testing using Focus groups using groups of students and women | Malaysia |
| Central location test in a supermarket | Malaysia |

CHAPTER 2

PROJECT METHODS

This chapter outlines the product development method used in the research and also describes in detail some of the stages in the project. These included the initial desk study, the screening of product ideas, product design specification, product formulation, the production trial, and the product costing. Therefore, this chapter describes briefly the other research that was being done at the same time as the consumer research which is described in the main chapters of the thesis.

2.1 THE METHOD OF PRODUCT DEVELOPMENT

The process of developing a new product from the identification of consumer needs to finalising the market plan involves skills drawn from both marketing and technical areas. These skills encompass market research, product design, product evaluation, food formulation, creative techniques for idea and name generation, sensory evaluation, packaging design, food processing, and economic analysis.

Thus, in the product development process, there are several distinct stages utilising different techniques and methodologies in a sequential manner. In this project, the major stages in the product development process are shown in Figure 2.1. The project started with an initial desk study of the market, focusing particularly on factors relevant to the design of a bakery snack for the Malaysian market. The study revealed several product areas which represented opportunities in the Malaysian market. As well as that; a focus group using Malaysian students living in New Zealand was used to find out the potential of these product areas.

From the desk study, it was found that existing information on the attitudes and behaviour of Malaysians towards snacking - and especially towards bakery snacks - was very sparse. Thus, it was decided to carry out a consumer survey in Malaysia. Also, since the product was meant

for two ethnic groups, the Malays and the Chinese, cultural differences in the perception and preferences towards bakery products was an important element to be considered. A multivariate technique (multidimensional scaling - MDS) was used to measure the perceptions of the two ethnic groups towards a range of bakery snacks. Information was also obtained on the differences between the ethnic groups. This showed that one product could be made to suit both groups.

The next stage was the generation of new bakery product ideas by consumer groups. The product idea generation was carried out by consumers using two different techniques: brainstorming and the nominal group technique. One hundred product ideas were obtained and quantitative screening techniques were used to reduce the number of product ideas. The method of quantitative screening is described in this chapter, as it did not have consumer input and thus is not discussed in detail elsewhere in this thesis. After the quantitative screening, seven product ideas remained. Consumers were then asked to select the product they preferred from the seven ideas and the top ranking product, a meat pie, was selected for development.

A discussion was held with consumers to find out the product characteristics desired in the meat pie. This information, together with the objectives and constraints in the project, were translated into product specifications which were then used to formulate the product.

A systematic formulation method was applied to formulate and optimise the product, using a pseudo-consumer panel of Malaysian students for the sensory testing of the different product prototypes. The final formulation from the laboratory experiments was used for a factory trial in a pie factory in Wanganui, New Zealand. The pies produced were frozen and air freighted to Malaysia for consumer testing.

The sensory quality of the product from the production trial was evaluated by both the panelists in New Zealand and consumers in Malaysia. To evaluate the acceptability of the product, a central location test was done in supermarkets in Malaysia. Focus groups were also used to find out how consumers perceived the product and how it should be positioned in the market.

Costing and pricing of the product was also investigated. There were two major cost components to the product. One was the manufacturing cost which included raw materials, processing, and packaging costs; and the other was the cost of transporting the product to Malaysia as well as distribution costs in Malaysia. A price was determined and this was compared with the price acceptable to the consumers in the consumer survey in Malaysia. Finally, the project was evaluated for the company.

Stages of product development

Preliminary desk study
 Market research
 Idea generation
 Screening
 Design of product specifications
 Formulation
 Production trial
 Product testing
 Product costing
 Product evaluation

Figure 2.1: Product development process in project

2.2 PRELIMINARY DESK STUDY IN NEW ZEALAND

A preliminary desk study was carried out in New Zealand to find out more about the marketplace, particularly factors that could be important in the design of a bakery snack for the Malaysian market. The study revealed several factors that were considered relevant to the project.

2.2.1 Product areas for further investigation

The Malaysian diet consists of two major types of foods: main meals (usually rice or noodle meals), and snack products. Main meals still follow a traditional pattern of consumption with a strong emphasis on local foods. On the other hand, snacks consist of both traditional and

western products. Most bakery products are eaten as snacks rather than at main meals. A general comparison between Malaysian and New Zealand bakery snacks indicated that there were major differences in the types of foods eaten as snacks, and also highlighted several product areas that were suitable for further investigation. These included local traditional cakes (kuihs), pastry products, cake/biscuit mixes, special variety breads, European-style cakes, and pastry dough for both consumers and caterers.

2.2.2 Food habits and taboos

With three major ethnic groups who maintain a largely traditional diet, there are definite differences in the food habits amongst the peoples in Malaysia. However, despite those differences, their food habits show similar patterns as there is one very strong unifying force: rice. Rice forms the basis of a meal to which other side dishes are added. Rice can be consumed for breakfast; it is usually consumed for lunch and almost always for dinner. In most parts of Peninsular Malaysia, rice is supplemented with fish, vegetables and meat. It is in the preparation and choice of the side dishes that the various ethnic groups differ. Food taboos of Malaysians are usually based on religious beliefs; this is clearly seen in the pattern of consumption of meat. Muslims avoid pork, Hindus do not eat beef, neither do a large number of Chinese. The Malays, who are largely Muslims, have a requirement for "halal" (suitable for Muslim consumption) foods which means that no alcohol is allowed, and animals have to be killed according to Muslim rites. Thus, it was important that the food beliefs and taboos of the two major ethnic groups were taken into consideration when designing the bakery product for Malaysians.

2.2.3 Image of local vs imported foods

There are numerous reasons why a non-Malaysian food has a better chance of success on the Malaysian market. As Yong noted in 1981, "image is becoming increasingly relevant to the consumer". The Malaysian mentality, through a life-long process of "culture borrowing", believes firmly that "foreign" (western) is better. Not only is it much easier for Malaysians to accept foreign foods rather than traditional foods due to a lack of racial connotations, but prestige and snob appeal

facilitate assimilation. This very important advantage cannot be capitalised on if local products are sold. "Imported traditional products" may not compete viably due to the fact that consumers are used to seeing the traditional foods being prepared in front of them and sold fresh, rather than ready-made and packed. In addition, the price has to be competitive with the local products and that may be difficult if the raw materials are expensive in New Zealand. Chilled or frozen transport is another extra cost.

2.2.4 Product form

As the population becomes more affluent and the standard of living increases, more time is devoted to leisure and recreation. Under these conditions, the consumer will favour a complete, ready-made product rather than one which requires further preparation.

Snacks are widely available and plentiful in Malaysia as well as being well suited to local tastes. It would be hard to envisage a consumer willing to pay a higher or the equivalent price of a local snack and have to spend time preparing the snack as well.

2.2.5 Lack of refrigeration and baking facilities

In 1979, a Media Index Survey carried out by Survey Research Malaysia estimated that 28% of the adults surveyed had a refrigerator in the home. Moreover, only supermarkets have the facilities for storing and displaying chilled or frozen products.

Baking facilities in the home are limited although no statistics are available; the techniques of cooking are usually steaming and frying, rather than baking. Thus, products that require refrigeration or baking at home would only be suitable for a small segment of the population.

2.2.6 Local competition

It is important that the product considered is not easily imitated by a local company, particularly bread and cake shops as they can react very rapidly.

2.2.7 Summary of desk study

The desk study indicated that there may be differences in taste between the Malays and Chinese for bakery snacks, and a convenient, imported product may be desirable. Local competition may pose a problem although a unique product could be achieved in either one of two ways: firstly, through incorporation of ingredients not easily available in Malaysia, e.g. New Zealand fruits, or secondly, through the appeal of an imported product image.

Several product areas were identified as feasible and were investigated further in Malaysia with consumers. The consumers identified products and product characteristics, and finally generated a number of product ideas.

2.3 SCREENING

Idea generation with the consumers produced 100 product ideas. Out of these, one product idea had to be selected for further development. Consumer input in the screening process was considered desirable to ensure the final product selected was acceptable to them. However, it was not feasible for the consumers to participate in an extensive screening exercise. Apart from that, product ideas that were not viable due to technical and economic considerations had to be discarded before consumer selection. Thus, quantitative techniques were used to reduce the initial number of 100 ideas to seven for screening by the consumers.

To set up a systematic screening methodology, the literature was reviewed to identify suitable techniques which could be adopted. This section includes a review of the literature as well as the methodology used for screening.

2.3.1 Literature review

An extensive review was made by Sinthavalai (1986) on the literature concerning screening of products and projects. The author identified the three principal characteristics of successful screening as:

- * a multistage sequential process,
- * ideas being subjected first to low-cost screens and then to higher cost screens, and
- * the number of surviving ideas diminishing by stages.

As Moore et al. (1969) noted, the sequential nature of the R & D process implies that most projects would be formally evaluated more than once during their life in the organisations. This is true, too, of the product development process. Both Moore et al. (1969) and Sinthavalai (1986) suggested the use of different models for different stages, which Sinthavalai classified into:

- * screening/preliminary evaluation stage: done in the product search phase.
- * analysis stage: done in the development phase.
- * final evaluation stage: done after test market phase.

In the following discussion, screening and project selection have been used interchangeably as most papers have been written to address the problem of project selection, particularly for R & D. However, the quantitative techniques used for project evaluation can equally be applied to screening of product ideas. Numerous models have been proposed by various authors for project selection and these have been classified into benefit measurement models, resource allocation models, and comparative approaches (see Table 2.1). These models, however, differ considerably in their requirements for input data and their degree of complexity.

 Table 2.1: Techniques for product selection and evaluation

| MODELS | REFERENCES |
|--|--|
| <u>Benefit measurement models</u> | |
| <u>Scoring models</u> | Mottley and Newton (1959) Moore et al. (1969) Souder (1972) Cooper (1985) |
| Economic models (including rate of return, net present value, payback period, breakeven analysis, discounted cash flow) | Dean and Nishry (1965) Sinthavalai (1986) |
| Risk analysis | Hertz (1964) Pessemier (1966) Malloy (1971) Souder (1978) |
| <u>Comparative approaches</u> | |
| <u>Qsort</u> | Nelin et al. (1975) |
| Qsort/nominal interacting process | Souder (1978) |
| <u>Resource allocation models</u> | |
| <u>Portfolio models</u> (including constrained optimisation models such as linear programming, integer programming, dynamic programming) | Charnes et al. (1966) Gear et al. (1971) |

Economic models are inherently unsuitable for preliminary stage screening, as there is usually very little sound financial data available. Cooper (1985) noted that such models are usually considered more relevant for "known" projects (e.g. line extensions, product modifications) or at later stages of the new product process. A similar disadvantage limits the use of resource allocation models. Although these screening models have the ability to analyse projects at several funding levels, they require substantial data inputs, including financial data, timing information, resource needs and availabilities. Because of this, they are rarely used (Cooper, 1985). Souder's method (1978) is only suitable for an organisation where several people are involved in screening. It combines the Q-sort process (QS) and the nominal-interacting process to overcome human behavioural factors such as emotions, departmental loyalties, conflicts in desires, coalitions, and divergencies in viewpoints.

Therefore, only scoring models were appropriate at the early stages of this project. According to Freimer and Simon (1967), scoring models are popular but plagued by difficulties. Scoring models are appealing because they permit one to combine quantitative (e.g. cost) and

qualitative (e.g. patentability rating) assessments into one convenient overall score (Souder, 1978). Cooper (1985) discussed the shortcomings of scoring models which included the subjectivity of managerial ratings, the oversimplifications involved, the arbitrariness of items or checklist questions used, and the inter-relation of some items with each other. In spite of these criticisms, Cooper concluded that the scoring model was perhaps the best product idea screening tool available. Proponents argue that such a model has utility for a number of reasons: it helps make a highly judgemental decision somewhat more objective, it systematises the various projects, it forces managers to subject each project to a large and consistent set of review criteria, it focuses attention on the most relevant issues, it requires management to state goals and objectives clearly, it is easy to understand and use, and it is generally applicable.

2.3.2 Selection of techniques for screening

For the purpose of this project, one out of a hundred product ideas had to be selected for further development. Additionally, very little data was available at this stage for financial evaluation. Under Sinthavalai's classification (1986), the product was in the screening/preliminary evaluation stage. Thus, a relatively low-cost screening technique was required. Complex models such as economic evaluation, risk analysis, and resource allocation models were judged to be unsuitable. Souder's (1978) Q-sort technique was not used as it required input from more than one person, and only the author was available for the screening process in Malaysia.

A scoring model was chosen. In part, this selection was due to a widespread use of the model for screening (Kotler, 1980). Another reason for the selection of this model was that scoring techniques had been developed at Massey University by Earle (1973) which satisfied the requirement of a multistage sequential process. In developing the technique, Earle suggested two steps for evaluating products. They were to:

- * decide on the important factors related to the project.
- * rate the factors for each product for comparison.

The screening technique included three different stages: sequential screening, checklist screening and probability screening. Sequential screening consisted of a simple pass/fail system, in which products with major flaws in them were rapidly screened out. The checklist screening consisted of rating the product on various factors which had predetermined weightings. This resulted in a total score for each product which could be compared across products. A cut-off score was selected below which products were discarded. The probability screening was more intensive as it took into consideration the probability distribution of each product achieving the different factors. The number of products were rapidly reduced from 100 to seven using this screening system (see Figure 2.2).

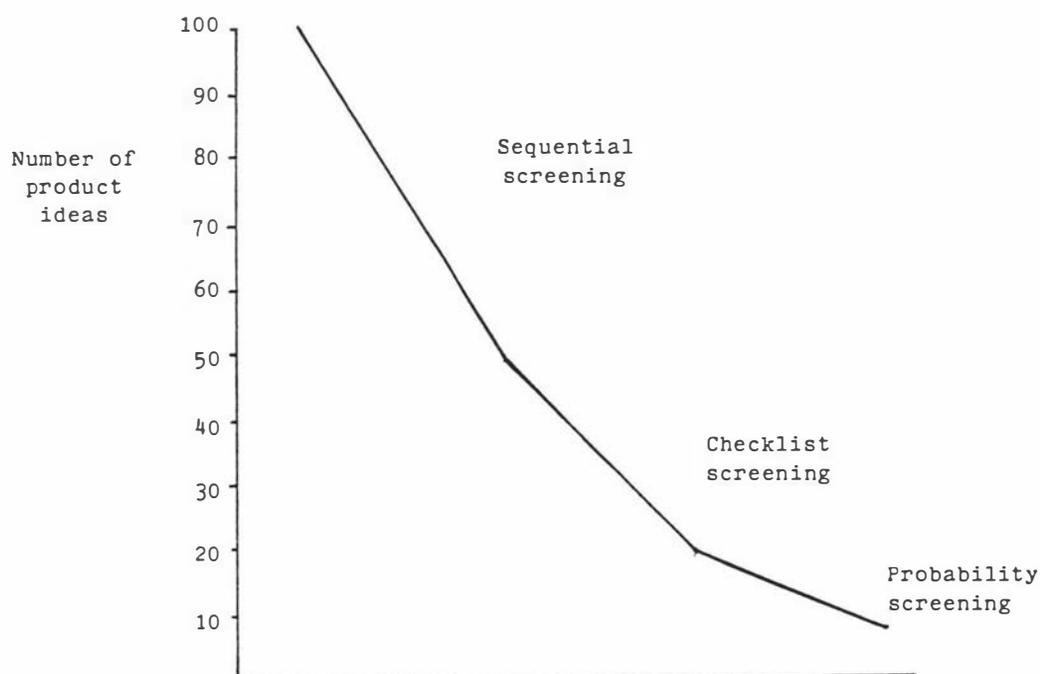


Figure 2.2: Reduction of number of product ideas through quantitative screening

2.3.3 Selection of factors for screening

A review of the literature produced many factors which were considered important for a successful product. The factors are presented in Appendix 2.1.

Apart from Earle (1973), none of the authors specifically concentrated on the food industry, referring instead to general projects. Mottley et al. (1959) and Cooper (1985) focused on industrial projects.

Basically, the factors could be categorised into the following groupings:

- * financial - whether the product meets company objectives.
- * product - need for product, product characteristics e.g. uniqueness, appeal.
- * technical and market compatibility with company resources - whether company has sufficient resources to develop the product, newness of product category, compatibility of marketing strategy to existing company strategies.
- * competition - number of competitors, possibility of competitive action, competing products.

As the screening technique involved three different stages of screening, the selection of factors is discussed with each technique.

2.3.4 Sequential screening

The purpose of this initial screening was to rapidly eliminate products which did not comply with the project constraints. The products were rated against the limiting constraints to check if they passed (P) or failed (F). Products that failed were dropped from further analysis. Those which passed were retained for further screening. The factors used for sequential screening were:

- * technical feasibility - this constraint was limiting for many products as present manufacturing facilities were to be used. The facilities included bread making equipment and pie making equipment.
- * raw material availability - as the idea generation process was carried out with Malaysians, local ingredients featured in many of the ideas generated. A large proportion of the ingredients were not available in New Zealand and securing

a stable source of supply was not possible for many ingredients.

- * cost of product - since the product was to be made in New Zealand and exported to Malaysia, the final cost of the product had to be competitive with other locally made snack products.
- * general acceptability - MDS revealed that consumers consider taste and texture as important characteristics in bakery snacks, and that there were slight differences in preferences between ethnic groups. Thus, the general acceptability of the product, particularly the sensory aspect of the product was important.

A product required a pass value for all the factors before it was retained. The sequential screening table is shown in Appendix 2.2 and the products remaining after sequential screening are listed in Appendix 2.3. Most products failed due to difficulties in obtaining the raw materials, particularly those not indigenous to New Zealand.

2.3.5 Checklist screening

At the next stage, checklist screening was used. This method involved the identification of factors relevant to the success of the product. From the four basic groups of factors, nine sub-factors were chosen. They were: product acceptability, product convenience, nutrition, uniqueness and appeal of product, raw material availability, utilisation of existing equipment, development difficulties, cost of raw material and competition from local manufacturers. The sub-factors were rated out of 100 points to reflect their relative importance. Two sub-factors, nutrition and uniqueness and appeal, were discarded as they were relatively unimportant.

Each product was scored for each factor and then multiplied by a factor weighting. The results for all factors were summed to give a total score. A range of total scores from 65-80 out of the maximum of 100

were obtained. A cut-off point of 75 was arbitrarily selected, and products scoring less than that were discarded. From this screening, 51 product ideas were reduced to 20. Appendix 2.4 lists the rating of the products and Appendix 2.5 contains the products remaining after checklist screening. The scores of the products remaining were very close.

2.3.6 Probability screening

In the previous two screening techniques, products with little chance of surviving were rapidly screened out. The task of the third screening technique was to identify products with the highest potential (referred to as utility) of succeeding in the market place. The factors listed below were chosen to reflect this emphasis:-

* compatibility to ideal.

The MDS results had indicated preference for a savoury, non-bread, foreign product. Characteristics derived from the consumer survey - importance of taste and convenience - were considered as contributing to the features of an ideal product.

* cost of final product.

A wide variety of snack foods are readily available in Malaysia at very competitive prices. Although only 56% of the respondents from the survey indicated that price was important, the survey also showed that medium and heavy snackers were from the lower to medium income groups. The final product had to be competitive to survive on the market.

* competition from local manufacturers.

Local bakers in Malaysia are highly flexible and can change their product line rapidly to imitate new products or counteract the effect of competitive new products. To survive on the market, the product must have a unique selling point.

* nutritional value.

From the initial discussion groups, nutrition appeared to be a very important factor. If the product is perceived to have beneficial effects in terms of nutrition, parents would be more willing to buy the products for their children and family. A nutritional product was considered to be low in fat and sugar, "balanced" with the inclusion of fruits and vegetables where suitable.

The probability of a product idea reaching the levels of the weighted factors were estimated. The utilities for each factor were then summed to give the total utility for every product idea. The total utilities were compared for the twenty products (see Appendices 2.6 and 2.7 for the factors used, their weightings, and the calculation of the total utility for all the products).

The MDS results indicated that pies would be the preferred product and they scored the highest utility of all the 20 products. However, the final selection was left to the consumer to confirm these results. The top scoring products from each product category (bread-related products, cakes and pies) were selected for final screening by consumers. The eight products were: a carrot and raisin cake, a spice cake, a hot cross bun, a cheese roll, a macaroni and minced meat pie, a vegetable with mushroom gravy pie, a vegetarian pie, and a pizza.

A meat pie was finally selected by the consumers. At this stage, the product concept was a pie, which consisted of minced meat, macaroni, some vegetables and flavouring, presented in an aluminium foil tray and of a similar size to local pies.

2.4 THE METHOD OF FORMULATION

Systematic product design, as outlined by Earle and Anderson (1985), involves stepwise experimentation and quantitative techniques in product formulations. This approach requires firstly, the identification of the tasks in the formulation study and then the organisation of the experiments in a stepwise and systematic manner. Earle and Anderson (1985) suggested screening experiments (Stowe and

Mayer, 1966), factorial experiments (Box et al., 1978), EVOP (evolutionary operations, Fox, 1968) and mixture designs (Snee, 1971) as methods for experimental design. These techniques have been applied in the food industry, and more recently, sensory data have been used in experimental designs to guide formulation (Hare, 1974; Henika, 1982; Moskowitz and Rabino, 1983; Norback and Evans, 1983; Stone and Sidel, 1985).

The three major steps in the formulation of the pie consisted of the selection of raw materials, formulation development and process development.

2.4.1 Selection of raw materials

A pie consists of three separate components: pie top, filling and pie bottom. Throughout the formulation process, these components were investigated separately.

All New Zealand pastry shortenings contain some beef or mutton tallow and this meant that they were not suitable for consumption by Muslims as they could not be guaranteed as "halal". Alternative shortenings considered for the purpose were vegetable shortening and butter. Although ideally, butter would have been suitable for both the pie top and pie bottom from the flavour point of view, it is an expensive ingredient. Thus, vegetable shortening was selected for use in the pie bottom, as it was cheaper, and butter was used in the pie top where it would impart a pleasant flavour to the product. However, experiments were also made to see if vegetable shortening was suitable for the pie top as well.

The original product concept was of a pie with minced meat and macaroni. Discussions with consumers revealed that beef was the most favoured meat. Chicken pies were already available in Malaysia, pork cannot be eaten by Muslims and sheepmeat flavour is not popular amongst either the Malays or Chinese. The consumers wanted vegetables, particularly peas and carrots in the pie. Thus, mixed vegetables were incorporated in the filling. Some flavouring was also desirable and spices, herbs, tomato flavour and cheese flavour were mentioned as possible flavours for the pie. The students in Malaysia who evaluated

the pie also liked chili and curry flavours. A hydrolysed vegetable protein was used as a "meat" flavouring as no animal component or alcohol was allowed for Muslims, and therefore no commercial meat flavour could be used.

2.4.2 Formulation development

The target of the formulation process was the "ideal" profile of the product characteristics set up by the pseudo-consumer panelists in New Zealand. An attempt was made to set an "ideal" profile using students in Malaysia. However, the "ideal" profile obtained from Malaysia was not used as the product that was evaluated by the Malaysian students could not be duplicated in New Zealand and the panelists in New Zealand could not relate to the "ideals" set up by the Malaysian panelists and preferred to fix their own "ideals".

In the initial formulation experiments in New Zealand, the proportions suggested by the consumers were used for the filling. For the pie top and bottom, commercial recipes were used. Using the pies from the initial experiments, a general area of ingredient levels was obtained from the training session with the panelists. Further experimentation was done separately on the pie top, bottom and filling using experimental designs, as shown in Figure 2.3. The panelists tested the effects of the changes in the various components in a complete pie as it was felt that the sensory properties of the components would be affected if they were tasted separately. Empirical equations were derived which related acceptability to the proportion of the various ingredients in the formulations. This helped direct the formulation work.

When the basic pie was finally acceptable, an experiment was done with pies incorporating curry flavour, sweet and sour flavour, tomato flavour and mixed spice flavour. The panelists preferred the mixed spice flavour.

General Area of Experimentation

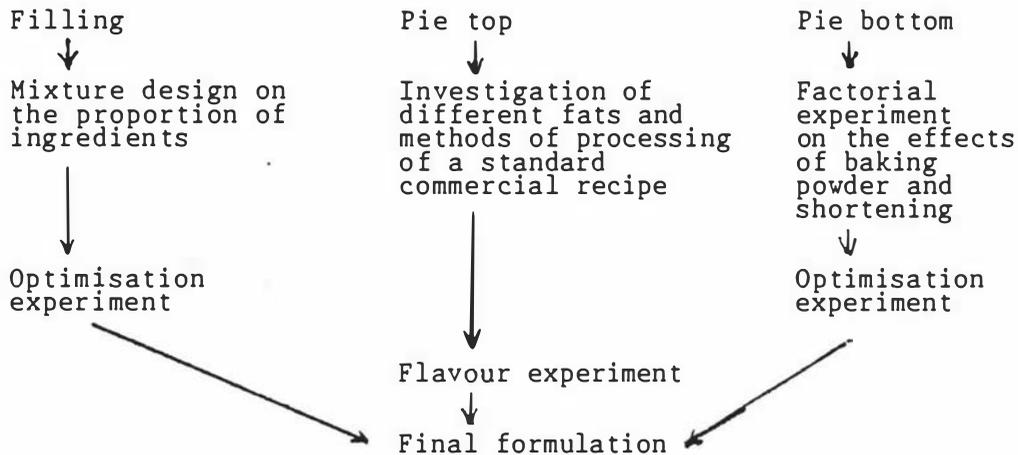


Figure 2.3: Scheme of formulation

The final formulation of the pie consisted of the following ingredients:

| | |
|-------------|---|
| Filling: | water 80% visual lean beef frozen mixed vegetables (peas, corn and diced carrots from J. Wattie Canneries Ltd) macaroni elbows (New Zealand Cereal Foods Ltd) thickening agent (Fieldthik, Fielders, Australia) flavouring (Luxor KB-300V hydrolysed vegetable protein) mixed spices (garlic powder, onion powder and white pepper) |
| Pie bottom: | salt vegetable shortening (Abels NZ Ltd) salt baking powder (Levinex, Edmonds Food Industries, Ltd) colour (Permicol, Yolk E, Bush Boake Allen NZ Ltd) |
| Pie top: | flour water butter flour water salt |

2.4.3 Process development

The manufacture of pies was easily duplicated on a bench scale for the experimental work. To make the pie bottom, all the ingredients were mixed together in a mixer, and then rolled out to the desired thickness in a pastry brake. In industry, either a two arm mixer or a spiral mixer is used for the purpose. For the experimental work in

formulation, a Kenwood Chef model 701A with a dough hook attachment and a hand pastry brake was used.

A different process, however, had to be designed for the pie top. Commercial manufacture involves mixing all the ingredients together, sheeting the pastry through a pastry brake and then "turning" the pastry. This results in the alternate layering of the shortening and pastry. With pastry shortening, it is possible to mix in all the ingredients at the same time, as there are discrete lumps of shortening left after mixing, and these lumps can be rolled out into thin layers during the turning process. Because butter has a lower melting point and is less plastic and tough than pastry shortening, a different process had to be used to ensure that the butter did not soften and become absorbed in the dough during the turning process, resulting in poor "layering". A modified method was used which involved mixing half the butter with the flour and water and rolling out the resultant pastry. During the first bookfold, a layer of chilled butter was incorporated. This ensured that there were discrete layers of butter remaining after the turning process.

The size of the pie and the packaging were also mentioned by consumers. Consumers wanted a pie of a similar size to pies in Malaysia. This was not possible as the pie bakeries in New Zealand have a standard range of pie tins. A size closest to Malaysian pies was used. An aluminium foil tray was requested by the consumers as they felt it presented a "clean" image. However, the facilities to package the pie in foil trays were not available in New Zealand. Additionally, the pie had to be frozen and transported to Malaysia. It required protective packaging to prevent damage and moisture loss during freezing and transportation. The bakeries had found cellophane to be a suitable packaging for the purpose, and thus clear cellophane was used to package the pies.

2.5 PRODUCTION TRIAL

A representative from the New Zealand Institute of Meat Management was present at the production trial because of the "halal" requirements of the product. A Ministry of Agriculture and Fisheries official was also present to ensure that export conditions were met during the manufacture of the pie. Prior to production, the entire factory was cleaned and sanitised. Microbiological tests were conducted on a random sample of contact surfaces in the factory using plate count agar (agar sausage was used on even surfaces and the swabbing technique was used for uneven surfaces).

The process used in the production trial is shown on a flowsheet in Figure 2.4.

The finished product was cooled and then packaged in cellophane wrappers. Labels were attached by hand, and the pies were packed into cartons before freezing in an air blast freezer. The label complied with the Malaysian food regulations (MDC Sdn Bhd, 1985) and included the product name, ingredients, weight, and name and address of the manufacturer and importer.

The pies were repacked into polystyrene chilly bins for transporting to Malaysia. All practical steps were taken to ensure that the product remained frozen from when it left the factory in New Zealand until it was required for consumer testing in Kuala Lumpur.

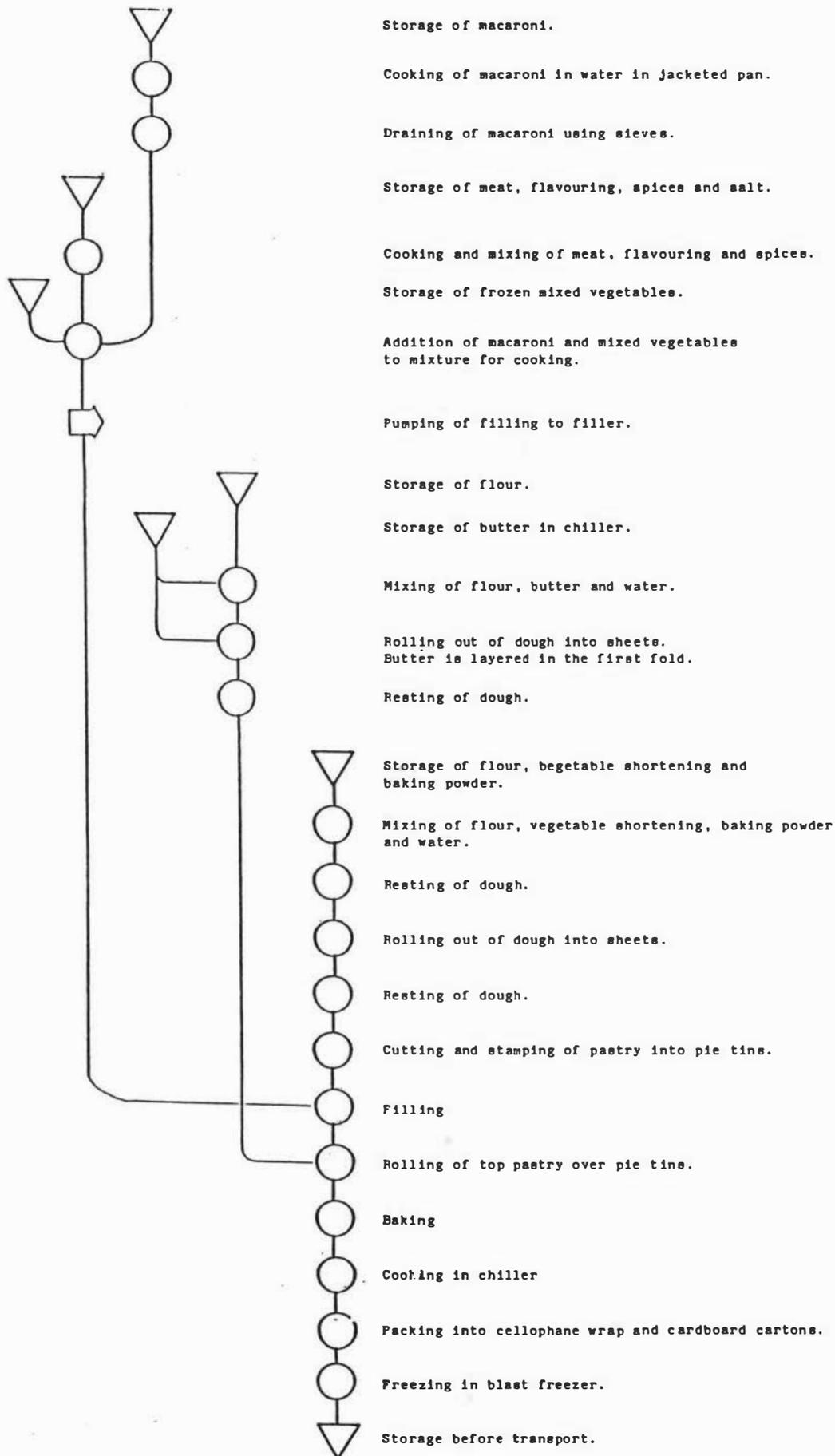


Figure 2.4: Process flowchart for production of pie

2.6 COSTING AND PRICING

2.6.1 Manufacturing costs

The cost of manufacturing the pie was estimated based on a recipe costing system set up by a local pie manufacturer. The system included costs on raw material, manufacturing, distribution, and overheads (see Table 2.2).

Table 2.2: Percentage contribution of costs to the manufacture of a pie

| | |
|------------------------------------|--------|
| <u>Raw material costs</u> | 46.5% |
| <u>Manufacturing costs</u> | |
| (including labour and electricity) | 23.5% |
| <u>Overheads</u> | 27.8% |
| <u>Dispatch costs</u> | 2.2% |
| Total manufacturing costs | 100.0% |

2.6.2 Distribution and selling costs

The major component of the distribution cost was the frozen transportation by sea from New Zealand to Malaysia. There were also transportation and storage costs in Malaysia. In the calculation of the retail price, the retail margin (30% of the selling price) was estimated from the normal margin for bakery products while the wholesale margin (15% of the landed price) and handling charges (5% of the landed price) were estimated from the normal margin for frozen foods. Without duty, a final retail price of MR\$1.30 with a profit margin of NZ\$0.04/pie was obtained. However, there was a possibility of a 50% duty on the product which would raise the price to MR\$1.80.

2.6.3 Comparison of price and costs

The retail price of the pie therefore could vary between MR\$1.30 and MR\$1.80 depending on the price of the duty paid. MR\$1.30 was the price that was acceptable to the consumer and there was some doubt that the pies would be bought at a higher price.

2.7 CONSUMER INPUT IN PROJECT

This chapter has outlined the major steps in the research, but as the emphasis was on the use of consumers in product development, techniques which involved the use of consumers have been described in greater detail in the rest of the thesis. Figure 2.5 shows a plan of the consumer research.

| <u>Places where study was carried out</u> | <u>Time of research</u> | <u>Project stage</u> | <u>Type of consumer input</u> |
|---|-------------------------|--|---|
| New Zealand | Sep, 1983 | Preliminary research | Focus group Chapter 3 |
| Malaysia (Penang) | Feb, 1984 | Survey of Malaysian habits | Consumer survey Chapter 3 |
| Malaysia (Penang) | Mar-May, 1984 | Comparison of perceptions of snacks between groups | Multidimensional scaling by consumer groups Chapter 4 |
| Malaysia (Penang) | June, 1984 | Idea generation | Idea generation by consumers using brainstorming and nominal group technique Chapter 5 |
| Malaysia (Penang) | Aug, 1984 | Consumer screening | Ranking by consumer groups Chapter 5 |
| New Zealand | Jun-Oct, 1985 | Formulation | Sensory evaluation by profiling using pseudo-consumer panels Chapter 6 |
| Malaysia (Kuala Lumpur) | Jan, 1986 | Product testing | Central location test Focus group Sensory Profiles Chapter 7 |

Figure 2.5: Flowchart showing the major stages of the project

CHAPTER 3

ATTITUDES AND BEHAVIOUR OF MALAYSIANS TOWARDS SNACK FOODS

3.1 USE OF CONSUMERS IN INITIAL MARKET RESEARCH

It was important to study the attitude and behaviour of Malaysians towards snacking as there was little published information, especially on the differences between the ethnic groups. General observations had been made by McArthur (1962) and Wilson (1975) on the eating habits in rural areas. Nutritional surveys have been carried out in rural areas but are irrelevant since the potential market for bakery snacks is in the urban areas.

The preliminary desk study in New Zealand resulted in several product areas for further investigation. In order to use consumers to focus and direct the research, three different techniques were used in the initial market research. Two of these techniques are reported in this chapter. A focus group was used to study consumers' reactions and preferences to the proposed product areas. The focus group was conducted in New Zealand. Similar focus groups were also planned in Malaysia, but due to recruitment problems, they could not be carried out.

To obtain the information on the snacking habits of Malaysians, a consumer survey was conducted. Penang was chosen for two reasons: it is a major urban area in Malaysia and academic supervision for the work was available through the Universiti Sains Malaysia.

The third technique used for the market research was a multivariate technique which mapped consumer perceptions of bakery snacks (discussed in Chapter 4).

3.2 PRELIMINARY FOCUS GROUP

3.2.1 The use of focus groups

The focus group evolved from depth interview used in the 1960's and is now a commonly accepted technique for market research in marketing texts (Kotler, 1980; Zikmund, 1982). It has been used for various purposes, including the preliminary evaluation of product concepts by consumers (Kraft, 1981; Churchill, 1983). The development of the focus group and its merits is discussed in detail in Chapter 5 (where it was reviewed as a non-analytical technique for idea generation).

The focus group technique involves recruiting six to twelve consumers who are drawn from the population of interest and conducting a semi-structured discussion using a moderator to guide the discussion. The discussion usually starts off with general questions which gradually become more specific and detailed as the session continues. One of the advantages of the focus group discussion is that it is flexible and the interviewer can modify the topics to suit the discussion, and explore the various topics in as much or as little detail as required.

Interactions amongst participants is encouraged to stimulate the discussion. It has been recommended that participants are selected so that they are relatively homogeneous to minimise conflict and put the participants at ease. Focus groups are usually taped and later transcribed for analysis. The sessions generally last from one to two hours.

The skill of the moderator is vital to the success of the focus group and some of the key qualifications that moderators of focus groups must have are discussed in detail by Churchill (1983). The key qualifications include kindness but firmness, permissiveness, involvement, incomplete understanding of the information presented, encouragement, and flexibility. Further descriptions of this technique can be obtained from Zemke (1978); Churchill (1983); Egbert (1983); Diamond and Gagnon (1985); Pramualratana et al. (1985).

3.2.2 Experimental method

A focus group was conducted at Massey University campus, New Zealand to evaluate consumer reaction to the alternative product areas. Four Malaysian Chinese students were selected for the purpose (there were few Malay students available). All the students had been in New Zealand for less than one year.

The focus group session was carried out in the consumer panel room of the Food Technology Department at Massey University. The session was conducted by the author and was recorded on a cassette tape. The participants were told that they were evaluating products which could be made in New Zealand for export to Malaysia. Several samples of unfamiliar products were available for the participants to taste as an aid to the discussion. A brief description of the product areas was also given to the participants.

Discussion on each product area was initiated by asking the participants to describe the taste and acceptability of each sample. Participants were then asked to discuss their general reaction to the product area. At the end of the discussion, suggestions for further products were requested, and the product areas were ranked in order of preference.

3.2.3 Discussion of product areas

3.2.3.1 Local traditional cakes (kuih)

The participants tasted two traditional Malaysian cakes "bingkang ubi" and "bingkang roti berjagung" (sticky sweet cakes made with tapioca starch and sweet corn respectively, see Appendix 3.1). None had heard of "bingkang roti berjagung" but the participants liked the sample. It was agreed that the sample of "bingkang ubi" only mildly resembled the "bingkang ubi" of Malaysia.

In general, the participants liked local, traditional cakes because they were local, made daily and sold fresh by traditional outlets (usually hawkers in the market place). They felt it was important to see a wide range of unpackaged cakes displayed, so that they could

smell the products. It was not felt to be of any significant advantage to sell the cakes anywhere else as they would not buy them from other outlets. It was also mentioned that the "bingkang ubi" was very easy to make and that many housewives make it at home. This, however, only applied to non-working housewives with time to spare, as the cake is inexpensive and readily available.

3.2.3.2 Pastry products

The participants tasted sardine rolls (sardine paste in a flaky pastry), vol-au-vent shells filled with a mixture of sardines, onions and chillies and also an apple pie. They were not enthusiastic about the sardine roll or the apple pie. But they liked the concept of the vol-au-vent shells and suggested filling with "sambal" (a Malaysian side dish, often made with chillies, fermented prawn paste and tamarind juice) and with seafood.

The participants were not familiar with fruit pies although many had a strong liking for meat pies. Pies were associated with a savoury filling and sweet pies were an unusual concept. On the other hand, they were enthusiastic about minced meat pies, chicken pies, and bacon and egg pies. A curry pie was also suggested. The concept of frozen pizzas was not accepted as it was considered to be too much trouble to heat or cook pizzas. It was claimed that pizzas sold in Malaysia did not contain the correct ingredients, such as salami and pepperoni. New Zealand pizzas, however, were acceptable.

3.2.3.3 Cake/biscuit mixes

The participants were initially not familiar with the product concept (dry mixes for baking at home). Participants were shown a packet of cake mix but not the baked cake. They thought that it was an interesting idea and would buy the product for convenience. It was thought to be particularly useful for housewives who had no time to bake their own cakes and biscuits. Flavours suggested as acceptable were chocolate, banana and orange.

3.2.3.4 Special variety breads

Participants observed that there was a trend towards health and diet foods in Malaysia, e.g. wholemeal breads and low calorie foods. It was felt that special variety breads would fit in well with the trend. They were especially interested in the idea of a honey and nut loaf and variety breads, e.g. garlic rolls, onion rolls, cheese rolls. Heavy wholemeal breads were not favoured.

3.2.3.5 European-style cakes

The importance of "freshness" was important in this product area. The idea of packaged cakes was not favoured as packaged cakes could be months old. The availability of fresh cakes made packaged cakes an unacceptable alternative. Locally made cakes (e.g. chiffon cakes with "pandan" flavour) were preferred as they were more acceptable. New Zealand cakes were too "heavy" and too sweet.

3.2.3.6 Pastry dough for both consumer and caterer

Products in this category included prepared pastry doughs (e.g. short pastry, sweet pastry, puff pastry) and prepared dough (e.g. bread or pizza dough, Indian bread) which could be sold to either consumers or caterers. Caterers could include restaurants, bread and cake shop operators. Participants were rather unsure how they would use pastry doughs although they liked the idea. They would not buy bread or pizza doughs. Prepared doughs for Indian breads, e.g. chapati and murtabak, did not appeal as they preferred to buy these products from hawkers and restaurants. From these outlets, gravy and curry could be bought to go with the bread.

3.2.3.7 General comments by participants

The concept of "freshness" came up repeatedly in the discussion. Participants mentioned that given the alternative of purchasing fresh as opposed to "unfresh" (packaged food), they would opt for the former. There was a strong preference for baked foods to be bought in bread and cake shops rather than sundry shops (Malaysian grocery stores). This, again, was linked to the concept of "freshness", and also

"cleanliness". A preference was also expressed for local flavours to be incorporated especially in the vol-au-vent fillings and in the cakes. Participants ranked the product areas according to preference, considering that products were to be made in New Zealand and exported to Malaysia.

1. meat pies
2. special variety breads
3. pastry products
4. cake/biscuit mixes and pastry/dough for both consumer and caterer
5. local kuihs

Participants suggested biscuits ("Farmbake" biscuits were mentioned, these are biscuits which are packed in bags), pavlova (a dessert made with egg white), chocolates, confectionery, and ice cream, when asked for more ideas on product categories. They felt that Malaysian biscuits were not very appealing and all of them purchase imported biscuits.

3.2.4 Conclusions from the focus group

From the focus group discussion, the following conclusions were drawn:

- * "freshness" and "convenience" (i.e. no preparation required) were both very important features in a snack product for Malaysians, and to a lesser extent, the smell or aroma of the product.
- * bread and cake shops, rather than sundry shops were the preferred outlets for bakery snacks.
- * Meat pies were specifically mentioned as their most preferred New Zealand product and local cakes (kuih) as least preferred.

3.3 SURVEY OF MALAYSIAN SNACKING HABITS

Two different types of techniques have commonly been used to assess snacking behaviour. They are the 24 hour recall method and the consumer survey (Gillespie, 1983; Richardson et al., 1981; Truswell et al., 1981; Sinthavalai, 1986). The 24 hour recall method is generally used where nutritional data are required, while consumer surveys are often used when less specific data are required. Siegel et al. (1976) and Sinthavalai (1986) also used surveys to evaluate the acceptability of specific snacks. It would appear that in the context of market research, consumer surveys are the more useful technique.

3.3.1 Consumer survey objectives

A consumer survey was carried out to determine the snacking habits of Malays and Chinese in Penang. The objectives of the survey were to:

- * determine how the two ethnic groups snack, in terms of occasions, frequency, types of foods eaten, and places of purchase.
- * explore attitudes towards bread and cake shops and the factors that affect snacking.
- * determine opinions on the potential distribution outlets for bakery snacks.
- * determine consumption pattern for homemade snacks, i.e. the frequency and types of foods eaten.
- * determine their purchasing habits and reasons for the purchase of imported snacks.
- * relate, if possible, the above findings to differences in ethnic groupings, sex, age and income.

3.3.2 Survey method

Quota sampling was used in order to obtain an even representation of both ethnic groups, and of socio-economic groups. Quota sampling is a form of non-probability sampling and no valid estimate of error could be obtained. Probability sampling was not used because ethnic and income group distribution were strongly affected by housing area and

information was required only of potential consumers of bakery products.

A person-to-person interview method was chosen, rather than a self-administered survey. Although there is a high literacy rate in Malaysia, it was felt that few people would have the confidence or be willing to fill in a questionnaire. In self-administered surveys, non-response is the biggest problem and in this study there was no estimate of the expected percentage of non-response. There were substantial advantages in using interviewers as they gained the confidence of respondents, obtained specific answers to sensitive questions and made the use of a longer, more complex questionnaire possible. A household survey was carried out and the interviewers were given an area in which they could select households for interview using the random walk method.

3.3.2.1 Design of survey questionnaire

The questionnaire started with a brief introduction by the interviewer, emphasising her attachment to the Universiti Sains Malaysia, and a non-technical summary of the purpose of the survey. The questionnaire consisted of 26 questions, most of which were directed response questions with multichoice answers. The questionnaire was divided into five sections - general snacking habits, bread and cake shops, homemade snacks, imported snacks, and demographics. Questions on demographics (income, age and occupation) were placed at the conclusion of the questionnaire. This was to ensure that if the respondent did not feel at ease answering those personal questions, then it would not affect the rest of the questionnaire which had been completed. Otherwise, the respondent might refuse to complete the questionnaire altogether. In addition, once the respondent had answered all the other questions, he or she would be somewhat conditioned to answering and would be far less likely to react adversely than if asked personal questions first (Stopher and Meyburg, 1979). The questionnaire was translated into both Malay and Mandarin for the benefit of respondents who did not understand English. A sample copy of the final questionnaire in English is included in Appendix 3.2.

3.3.2.2 Selection and training of interviewers

Students from the School of Social Sciences of Universiti Sains Malaysia were chosen to do the interviewing. These students had previous experience and were willing to conduct the interviews. The questionnaire was explained in detail to each of the ten interviewers and they were asked to familiarise themselves with the questionnaire and pre-test it on one another. There was constant contact between the author and the interviewers during the course of the survey so that as problems arose, they could be rectified immediately.

3.3.2.3 Pilot survey

A pilot survey was carried out by interviewers to pre-test the questionnaire. Ten surveys were carried out with sample households. Respondents found the questionnaire confusing especially the first section which consisted of questions asking the respondent the last time he/she snacked alone, with friends, and with their family, and what they ate on each of those occasions. To overcome this confusion, the question was rephrased to ask with whom the respondent last snacked. The modified questionnaire was found to be much more acceptable and the interviewers did not encounter any further problems with the questionnaire.

3.3.2.4 Organisation of the survey

Areas in Penang were selected which fitted the income and ethnic group distribution required. Each interviewer was assigned an area and given a quota (10-20 respondents) to interview. The aim was to survey 100 Malays and 100 Chinese, with equal numbers of both sexes.

Instruction sheets on how to perform an interview, and questionnaires in the appropriate languages were distributed to the interviewers. A sample of the work of each interviewer was checked to ensure reliability, completion of forms, legibility, and adherence to the selected quota as it was not practicable to check every questionnaire.

3.3.2.5 Coding of results

Since the results of the survey were to be analysed with the computer programme for statistical analysis, Statistical Analysis System (SAS, release 83.2), the results were coded onto a coding form. From there, the data were keyed into the computer and verified by an experienced operator from the computer unit in Universiti Sains.

3.3.3 Survey sample of respondents

3.3.3.1 Ethnic group and sex

For reasons explained earlier in the thesis, only Malays and Chinese were surveyed. The sample surveyed was very close to target quota with 107 Malay respondents and 109 Chinese respondents.

It was assumed that both sexes eat snacks, so an equal number of males and females was included in the quota.

3.3.3.2 Age group

Respondents were categorised into age groups of 0-12 years, 13-20 years, 21-30 years, 31-40 years, and over 40 years, so that the respondents fell broadly into children, young adults, adults, middle-aged people and older people. Initially, the age group distribution of the respondents was designed such that approximately half the respondents were between 31-40 years of age, a quarter of the respondents were between 21-30 years, and another quarter of the respondents were between 13-20 years. The choice of this ratio was influenced by the fact that parents (who largely fall into the 31-40 year bracket) often make the decisions concerning food in the family. It was important that their opinions be given due consideration. People over 40 years were not in the original quota because they are more traditional in their eating habits and would not be the target market for bakery products. Children less than 12 years old were considered unlikely to have much money to spend on snacks.

In the survey, the age group distribution of the Chinese respondents matched the specified distribution quite well (see Table 3.1). There

were, however, more Malays in the 21-30 years age group than specified. The interviewers found it difficult to fulfil the quota for the 31-40 years age group and thus made up with respondents from the 21-30 years age group and those over 40 years. It is possible that the 31-40 years age group were out at work at the time the interviews took place.

Table 3.1: Respondent distribution by ethnic group and age group

| | Malay | | Chinese | | Overall | |
|---------------|-------|-------|---------|-------|---------|-------|
| | No. | % | No. | % | No. | % |
| 0-12 years | 1 | 0.9 | 0 | 0.0 | 1 | 0.5 |
| 13-20 years | 24 | 22.4 | 29 | 27.1 | 53 | 24.8 |
| 21-30 years | 39 | 36.4 | 31 | 29.0 | 70 | 32.7 |
| 31-40 years | 32 | 30.0 | 46 | 43.0 | 78 | 36.4 |
| Over 40 years | 11 | 10.3 | 1 | 0.9 | 12 | 5.6 |
| Non-response | - | - | 2 | - | 2 | - |
| Total | 107 | 100.0 | 109 | 100.0 | 216 | 100.0 |

Note: Non-responses were not used in the calculation of percentages

3.3.3.3 Income group

There was an attempt to select respondents only from households with a total income exceeding \$500 per month. This was an arbitrary cutoff point to avoid respondents from very poor households. However, 14% of the respondents earned below the \$500 per month. The income group distribution of all the respondents is tabulated in Table 3.2. Unfortunately, there were no comparable figures from official sources to verify whether this distribution of incomes was typical of the population.

Table 3.2: Respondent distribution by ethnic group and income group

| | Malay | | Chinese | | Overall | |
|---------------------|-------|-------|---------|-------|---------|-------|
| | No. | % | No. | % | No. | % |
| < \$200/month | 3 | 2.8 | 0 | 0.0 | 3 | 1.4 |
| \$200-499/month | 22 | 20.6 | 8 | 7.3 | 30 | 13.9 |
| \$500-999/month | 26 | 24.3 | 37 | 34.9 | 63 | 29.1 |
| \$1,000-1,499/month | 30 | 28.0 | 24 | 22.0 | 54 | 25.0 |
| \$1,500-1,999/month | 16 | 15.0 | 12 | 11.0 | 28 | 13.0 |
| > \$2,000/month | 10 | 9.3 | 28 | 25.7 | 38 | 17.6 |
| Total | 107 | 100.0 | 109 | 100.0 | 216 | 100.0 |

3.3.4 General snacking habits

3.3.4.1 Number of respondents who snacked

Of the 216 respondents, 95.4% indicated that they snacked between meals while 4.6% claimed that they never snacked between meals. For the purpose of this survey, snacking included any food eaten between breakfast, lunch and dinner. Morning tea, afternoon tea and supper were considered as snacks. Drinks taken without food were not considered snacks. Ninety eight percent of the Chinese respondents ate snacks, while the figure was slightly lower for the Malay respondents (92.5%) as shown in Figure 3.1. The 206 respondents who snacked were used in the survey analysis. The 10 respondents who did not snack were dropped from further analysis.

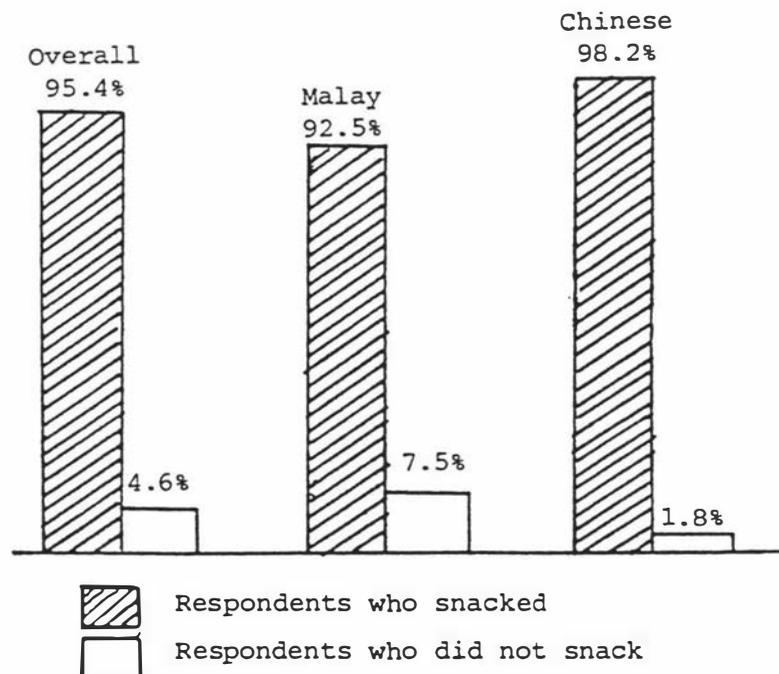


Figure 3.1: Distribution of respondents based on their snacking habits

3.3.4.2 Frequency of snacking

When asked about the last time they snacked (excluding the day of the interview) 80.5% of the respondents indicated that they had snacked "yesterday" (see Table 3.3). There was no significant difference between either ethnic group or sex in this respect. Most respondents snacked once or twice a day; less than 5% of the respondents snacked more than four times a day (see Table 3.3).

Table 3.3: Frequency of snacking

| | Malay | | Chinese | | Overall | |
|--------------|-------|-------|---------|-------|---------|-------|
| | No. | % | No. | % | No. | % |
| Yesterday | 89 | 89.9 | 76 | 71.7 | 165 | 80.5 |
| 2 days ago | 7 | 7.1 | 20 | 18.9 | 27 | 13.2 |
| > 2 days ago | 3 | 3.0 | 10 | 9.4 | 13 | 6.4 |
| Non-response | 0 | - | 1 | - | 1 | - |
| Total | 99 | 100.0 | 107 | 100.0 | 206 | 100.0 |

Note: Percentage is given out of the total number of respondents who snacked (missing responses were not included), i.e. 99 Malays, 106 Chinese and 205 total.

Number of times snacked on last day of snacking

| | Malay | | Chinese | | Overall | |
|---------------|-------|-------|---------|-------|---------|-------|
| | No. | % | No. | % | No. | % |
| Once | 29 | 29.3 | 43 | 40.2 | 72 | 35.0 |
| Twice | 40 | 40.4 | 37 | 34.6 | 77 | 37.4 |
| Three times | 19 | 19.2 | 19 | 17.8 | 38 | 18.4 |
| > Three times | 11 | 11.1 | 8 | 7.4 | 19 | 9.3 |
| Total | 99 | 100.0 | 107 | 100.0 | 206 | 100.0 |

Note: Percentage is given out of the total number of respondents who snacked, i.e. 99 Malays, 107 Chinese and 206 total.

3.3.4.3 Situations for snacking

The respondents were asked who they snacked with on the last day they ate snacks. There was an even distribution amongst those who snacked alone, with family members and with friends. Most respondents either snacked only by themselves, or only with their family. More Malays snacked in all three different situations than the Chinese and more Chinese snacked alone than Malays. It can be seen that snacking was frequently a social event, more so with the Malays who eat afternoon tea with their family (see Table 3.4).

Snacks were eaten most frequently in the afternoon. Other occasions of importance were supper, in the morning (between breakfast and lunch), and while watching television (see Table 3.4).

Table 3.4: Situations for snacking

| Snacked | Malay | | Chinese | | Overall | |
|----------------------------|-------|-------|---------|-------|---------|-------|
| | No. | % | No. | % | No. | % |
| Alone only | 18 | 18.1 | 29 | 27.1 | 47 | 22.8 |
| With family only | 23 | 23.2 | 21 | 19.6 | 44 | 21.4 |
| With friends only | 15 | 15.2 | 23 | 21.5 | 38 | 18.4 |
| Alone & with friends | 13 | 13.1 | 12 | 11.2 | 25 | 12.1 |
| Alone & with family | 8 | 8.1 | 6 | 5.6 | 14 | 6.8 |
| With family & with friends | 5 | 5.1 | 12 | 11.2 | 17 | 8.3 |
| All three | 17 | 17.2 | 4 | 3.8 | 21 | 10.2 |
| Total | 99 | 100.0 | 107 | 100.0 | 206 | 100.0 |

Occasions snacks were eaten

| | Malay | | Chinese | | Overall | |
|-----------------------------|-------|------|---------|------|---------|------|
| | No. | % | No. | % | No. | % |
| In the afternoon | 68 | 68.7 | 67 | 62.6 | 135 | 65.5 |
| Supper | 32 | 32.3 | 49 | 45.8 | 81 | 39.3 |
| In the morning | 43 | 43.4 | 31 | 29.0 | 74 | 35.9 |
| Watching television | 37 | 37.4 | 28 | 26.2 | 65 | 31.6 |
| At the movies | 16 | 16.2 | 18 | 16.8 | 34 | 16.5 |
| Recess time in school | 12 | 12.1 | 13 | 12.1 | 25 | 12.1 |
| Shopping | 10 | 10.1 | 8 | 7.5 | 18 | 8.7 |
| Other | 18 | 18.2 | 9 | 8.4 | 27 | 13.1 |
| Total number of respondents | 99 | - | 107 | - | 206 | - |

Note: Percentage is given out of the total number of respondents who snacked, i.e. 99 Malays, 107 Chinese, and 206 total.

3.3.4.4 Types of snacks eaten

The respondents snacked on a wide variety of foods. This can be seen by the proportion of respondents who indicated they snacked on "other" foods, which consisted of foods that were mentioned by a few respondents only. The most popular types of snacks were hawker food, and bakery snacks (see Table 3.5). Biscuits and kuih were the next most popular snacks.

The type of snacks eaten were also related to the occasions they were eaten. For example, hawker food, kuih, biscuits and other baked snacks were mostly eaten in the morning, afternoon and supper. Puffed and extruded snacks were eaten while watching television and at the movies. Nuts were usually eaten while watching television and bakery snacks were the most popular snacks during shopping.

Table 3.5: Types of snacks eaten for different occasions

| | Afternoon | | Morning | | Supper | | Watching Television | |
|------------------------|-----------|-------|---------|-------|--------|-------|---------------------|-------|
| | No. | % | No. | % | No. | % | No. | % |
| Hawker food | 20 | 14.8 | 18 | 25.0 | 27 | 33.8 | - | - |
| Bakery snacks | 37 | 27.4 | 17 | 23.6 | 12 | 15.0 | 7 | 10.8 |
| Kuih | 31 | 23.0 | 12 | 16.7 | 6 | 7.5 | 7 | 10.8 |
| Biscuits | 24 | 17.8 | 10 | 13.9 | 10 | 12.5 | 9 | 13.8 |
| Puffed/extruded snacks | 2 | 1.5 | 2 | 2.8 | 1 | 1.2 | 8 | 12.3 |
| Nuts | 4 | 3.0 | - | - | 5 | 6.2 | 14 | 21.5 |
| Fresh fruits | 3 | 2.2 | 2 | 2.8 | 3 | 3.8 | 3 | 4.6 |
| Other | 14 | 10.3 | 11 | 15.2 | 16 | 20.0 | 17 | 26.2 |
| Non-response | - | - | 2 | - | 1 | - | - | - |
| Total | 135 | 100.0 | 74 | 100.0 | 81 | 100.0 | 65 | 100.0 |

Note: Percentage is given out of the total number of respondents who snacked on different occasions, i.e. 135 in the afternoon, 72 in the morning, etc.

3.3.4.5 Places where snacks were bought

Snacks were bought mainly from hawkers, sundry shops and supermarkets (see Table 3.6). It is noteworthy that 16.5% of all snacks eaten were homemade. Only 4.8% of all snacks were purchased from bread and cake shops, although a much higher percentage of respondents (89%) actually shopped at bread and cake shops (see Appendix 3.3). Twenty eight percent of all bakery snacks were bought at bread and cake shops, 17% in restaurants and coffee shops, 13% in supermarkets, 13% in canteens and 9% in sundry shops (see Appendix 3.4). Thus, bakery snacks were bought at a large number of outlets.

Table 3.6: Places where snacks were bought

| | Number | % of total no. of purchases |
|------------------------|--------|--------------------------------|
| Hawker | 90 | 21.8 |
| Sundry shop | 88 | 21.3 |
| Homemade | 68 | 16.5 |
| Supermarket | 42 | 10.2 |
| Restaurant/coffee shop | 36 | 8.7 |
| School canteen | 32 | 7.8 |
| Bread and cake shop | 20 | 4.8 |
| Canteen at work | 17 | 4.1 |
| Other | 20 | 4.8 |
| Non-response | 46 | - |
| Total | 459 | 100.0 |

Both the Chinese (88.8%) and Malays (89.9%) shopped at bread and cake shops; only 10.7% of all respondents never bought from bread and cake shops. Bread, cake, filled baked buns and curry puffs were the most popular items bought at bread and cake shops. Bread and cake were more popular among the Malays, while the Chinese bought other items, such as filled baked buns and curry puffs (see Table 3.7).

Table 3.7: Type of food last bought at a bread and cake shop

| | Malay | | Chinese | | Overall | |
|-----------------------------|-------|------|---------|------|---------|------|
| | No. | % | No. | % | No. | % |
| Bread | 48 | 53.9 | 40 | 42.1 | 88 | 47.8 |
| Cake | 46 | 51.7 | 34 | 35.8 | 80 | 43.5 |
| Filled baked bun | 26 | 29.2 | 44 | 46.3 | 70 | 38.0 |
| Curry puff | 23 | 25.8 | 36 | 37.9 | 59 | 32.1 |
| Pie | 10 | 11.2 | 14 | 14.7 | 24 | 13.0 |
| Other | 3 | 3.4 | 5 | 5.3 | 8 | 4.3 |
| Total number of respondents | 89 | - | 95 | - | 184 | - |

Note: Percentage is given out of the total number of respondents who shopped at bread and cake shops, i.e. 89 Malays, 95 Chinese and 184 total.

3.3.4.6 Homemade snacks

Although a significant proportion (91.6%) of the respondents ate homemade snacks, homemade snacks only made up 16.5% of all snacks eaten. Only 8.4% did not eat homemade snacks, although 16.3% ate them infrequently. The Malays and Chinese ate different types of homemade snacks (see Table 3.8). A higher percentage of the Malays ate kuih. 25% of the Chinese ate kuih and 26% ate cakes.

Table 3.8: Types of homemade snacks eaten

| | Malay | | Chinese | | Overall | |
|-----------------------------|-------|------|---------|------|---------|------|
| | No. | % | No. | % | No. | % |
| Kuih | 61 | 67.0 | 24 | 24.7 | 85 | 45.2 |
| Cake | 13 | 14.3 | 25 | 25.8 | 38 | 20.2 |
| Biscuit | 9 | 9.9 | 12 | 12.4 | 21 | 11.2 |
| Leftover food | 6 | 6.6 | 9 | 9.3 | 15 | 8.0 |
| Soup | 8 | 8.8 | 16 | 16.5 | 14 | 7.4 |
| Other | 20 | 22.0 | 39 | 40.2 | 59 | 31.4 |
| Total number of respondents | 91 | - | 97 | - | 188 | - |

Note: Percentage is given out of the total number of respondents who ate homemade snacks, i.e. 91 Malays, 97 Chinese and 188 total.

3.3.4.7 Imported snacks

A large proportion of the respondents (79.8% Malays and 92.5% Chinese) bought different types of imported snacks, shown in Table 3.9. Biscuits were popular imported snacks, especially with the Malays. Cakes were only bought by 3.4% of the respondents. The major reason given for buying imported snacks was taste (60.6% of those buying imported snacks). All other reasons given were held by less than 10% of respondents.

Table 3.9: Type of imported snacks bought

| | Malay | | Chinese | | Overall | |
|-----------------------------|-------|------|---------|------|---------|------|
| | No. | % | No. | % | No. | % |
| Fresh fruit | 19 | 24.1 | 47 | 48.0 | 66 | 37.3 |
| Biscuits | 30 | 38.0 | 15 | 15.3 | 45 | 25.4 |
| Chocolates | 20 | 25.3 | 20 | 20.4 | 40 | 22.6 |
| Cereal products | 4 | 5.1 | 4 | 4.1 | 8 | 4.5 |
| Cakes | 3 | 3.8 | 3 | 3.1 | 6 | 3.4 |
| Other | 3 | 3.8 | 9 | 9.2 | 12 | 6.8 |
| Total number of respondents | 79 | - | 98 | - | 177 | - |

Note: Percentage is given out of the total number of respondents who both imported snacks, i.e. 79 Malays, 98 Chinese and 177 total.

3.3.5 Attitudes

3.3.5.1 Attitudes towards eating of snacks

When asked to rate their opinion on some factors related to eating of snacks, respondents indicated that it was important that the snacks tasted good, were good for them, and were easy to obtain. The price and calorie value of the snack were of less importance (see Figures 3.2-3.7). There was not a great deal of difference between the two ethnic groups.

3.3.5.2 Attitude to bread and cake shops

A large majority of the Malay respondents (79%) thought that foods sold in the bread and cake shops were "halal". Out of the 18 respondents who said they did not know if the foods were "halal", 75% of them indicated that they would buy more frequently from the shops if they knew the food was "halal". Respondents were asked to indicate their opinion on some statements regarding bread and cake shops. Most respondents (75.5%) thought that foods sold at bread and cake shops were good for them. Smell was also an attractive feature of bread and cake shops with 79.3% of the respondents indicating they liked the smell of the shops. Opinions on most other statements were divided, resulting in a bimodal distribution (see Figures 3.8-3.13). However, more than 50% of the respondents agreed that "there were a variety of food in the shops, the foods sold in bread and cake shops were expensive, those shops had something different to offer, and everything in the shops was delicious to eat".

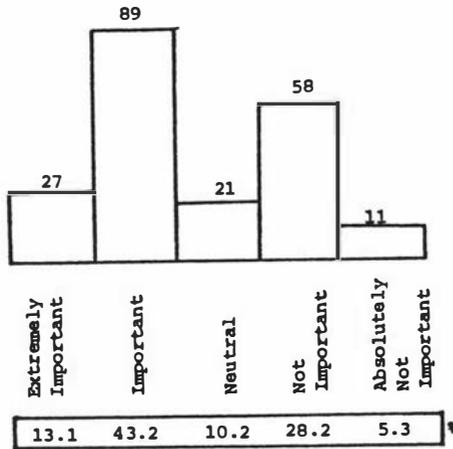


Figure 3.2: Respondent distribution by their opinion on the question "How important is the price of the snack?" (Total no. of responses - 206)

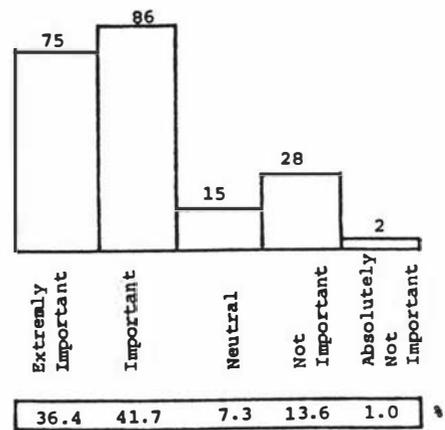


Figure 3.3: Respondent distribution by their opinion on the question "How important is it that the snack is good for you?" (Total no. of responses - 206)

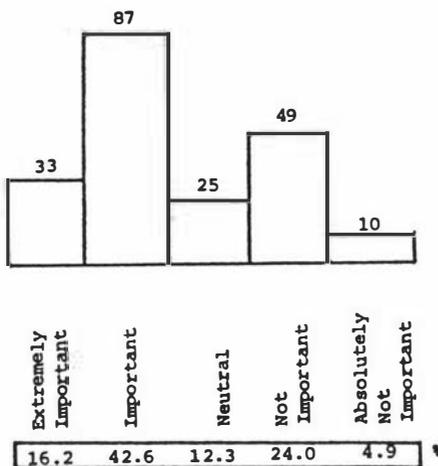


Figure 3.4: Respondent distribution by their opinion on the question "How important is it that the snack does not need any preparation?" (Total no. of responses - 204, non-response - 2)

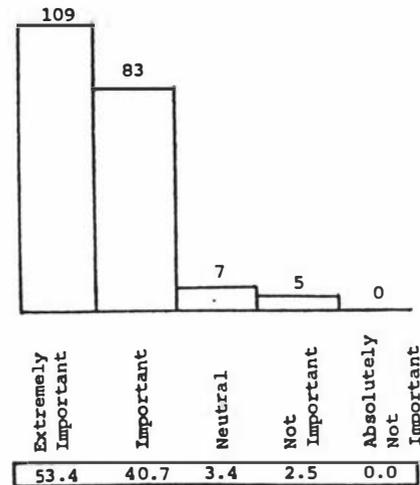


Figure 3.5: Respondent distribution by their opinion on the question "How important is it that the snack tastes good?" (Total no. of responses - 204, non-response - 2)

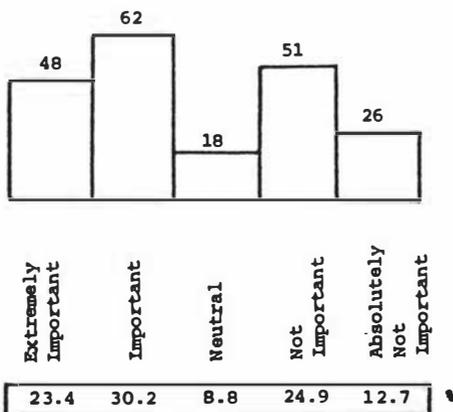


Figure 3.6: Respondent distribution by their opinion on the question "How important is it that the snack is not fattening?" (Total no. of responses - 205, non-response - 1)

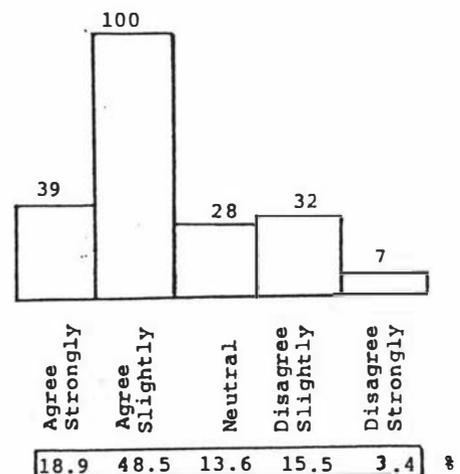


Figure 3.7: Respondent distribution by their opinion on the question "How important is it that the snack is easy to obtain?" (Total no. of responses - 206)

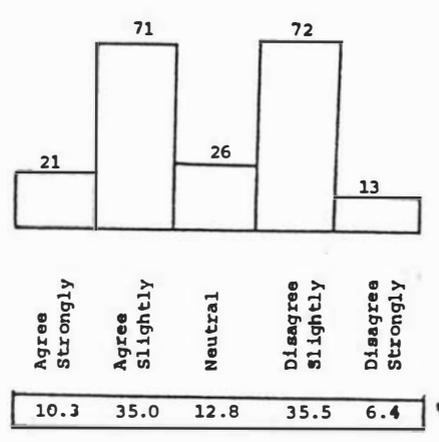


Figure 3.8: Respondent distribution by their response to the statement "Everything is delicious to eat" (Total no. of responses - 203, non-response - 3)

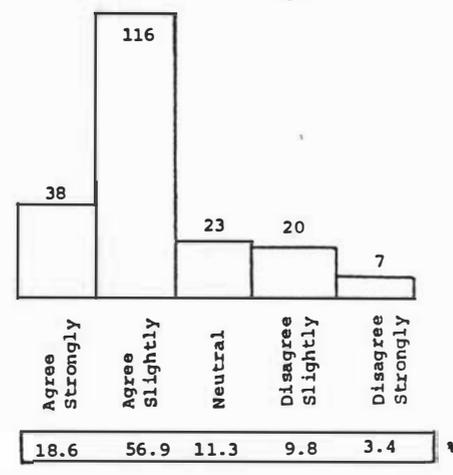


Figure 3.9: Respondent distribution by their response to the statement "The food is good for you" (Total no. of responses - 204, non-response - 2)

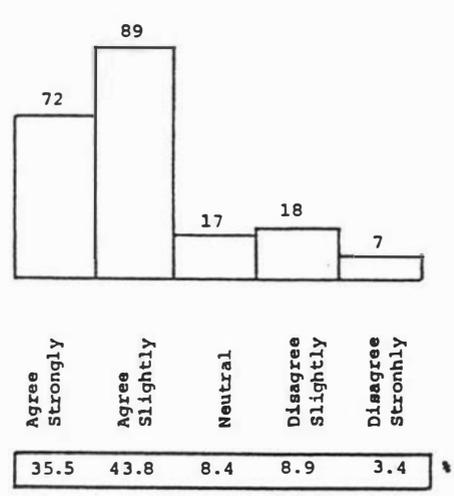


Figure 3.10: Respondent distribution by their response to the statement "I like the smell of bread and cake shops" (Total no. of responses - 203, non-response - 3)

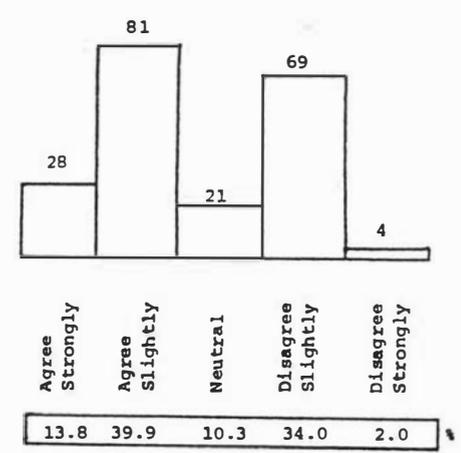


Figure 3.11: Respondent distribution by their response to the statement "There is a variety of food in the shop" (Total no. of responses - 203, non-response - 3)

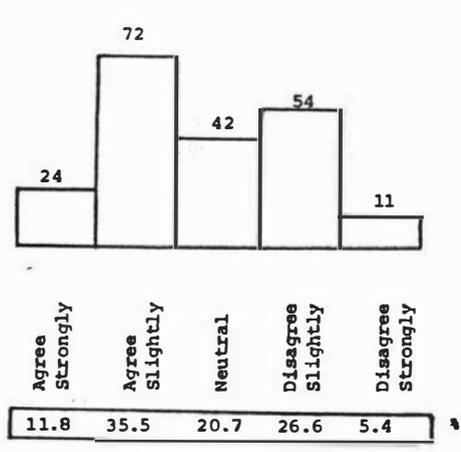


Figure 3.12: Respondent distribution by their response to the statement "The foods sold in bread and cake shops are expensive" (Total no. of responses - 204, non-response - 2)

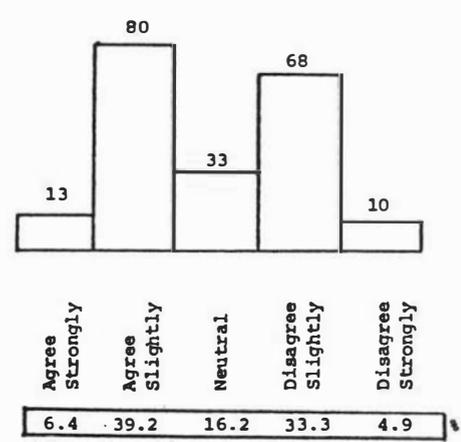


Figure 3.13: Respondent distribution by their response to the statement "Bread and cake shops have something different to offer" (Total no. of responses - 204, non-response - 2)

3.3.5.3 Attitudes to outlets for bakery snacks

Nearly 70% of the respondents thought that bakery products should be sold through canteens. Of those people, 21% said the reason for the purchase was nutritional (i.e. the snack was good for them), 20% convenience and 19% variety. There were a number of other reasons stated by fewer numbers of respondents. Most of the people who did not want to buy baked products in canteens said it was because of price.

Respondents wanted bakery snacks in sundry shops because of convenience but the 59% who did not want to buy in sundry shops attributed their reluctance to the lack of hygiene, lack of freshness in the products and also because they thought that sundry shops were "inappropriate". A similar pattern was found with most of the respondents who wanted to buy from hawkers. The respondents who wanted to buy from hawkers said that it should be convenient while those who did not want to buy were worried about the lack of hygiene.

Table 3.10: Opinion of respondents on whether or not bakery products should be sold through canteens, sundry shops and hawkers

| | Canteens | | Sundry shops | | Hawkers | |
|--------------|----------|-------|--------------|-------|---------|-------|
| | No. | % | No. | % | No. | % |
| Yes | 141 | 68.8 | 69 | 33.8 | 69 | 33.6 |
| No | 32 | 15.6 | 120 | 58.8 | 125 | 61.0 |
| Don't know | 32 | 15.6 | 15 | 7.4 | 11 | 5.4 |
| Non-response | 1 | - | 2 | - | 1 | - |
| Total | 206 | 100.0 | 206 | 100.0 | 206 | 100.0 |

3.3.6 Conclusions from survey

The survey indicated that eating of snacks was both widespread and frequent amongst Malays and Chinese. Ninety eight percent of the Chinese and 93% of the Malays snacked, 81% of respondents snacked on the day before the interview. The eating of snacks occurred most frequently in the afternoon. Sixty six percent of respondents snacked in the afternoon, 39% snacked at supper and 40% in the morning. Bakery snacks and hawker food were the most popular snacks, each comprising 19% of all snacks eaten. Bakery snacks were mainly bought as morning

and afternoon snacks. The single most important factor related to the eating of snacks was taste. Other factors of importance were that the snack should be good for them and that it should be easy to obtain.

Bakery snacks were purchased at a wide variety of outlets. Twenty eight percent bought from bread and cake shops, 13% from restaurants and coffee shops, 10% from supermarkets and 10% from canteens. Twenty five percent of the bakery snacks were homemade. A high proportion of respondents (89%) bought from bread and cake shops. Malays and Chinese bought slightly different items. Both Malays and Chinese bought bread but Malays tended to buy cakes and Chinese tended to buy filled baked buns. Most respondents wanted bakery products to be sold in canteens. Such a desire was not expressed for sundry shops or hawkers. The principal reason given by respondents who wanted bakery products to be sold in these outlets was "convenience". Those who objected were concerned about the lack of hygiene in sundry shops and in hawker stalls.

3.3.7 Discussion of results from focus group and survey

To a certain extent, the two techniques were complementary, as one was a quantitative technique and the other was qualitative. The focus group could gauge consumer reaction towards product areas and specific products, as well as the features desirable in a bakery snack. The survey could present a background of the snacking behaviour of the potential consumers and showed how frequently snacks were eaten, the type of products eaten, where purchased, etc. Both focus group and consumer survey were used to find out some of the attitudes that consumers had towards bakery snacks and bread and cake shops in general and more specifically the potential product areas for development.

The focus group results indicated that there were three major features in bakery snacks: freshness, convenience of preparation, and the smell of the product. Participants from the focus group preferred to buy bakery products from bread and cake shops, and traditional cakes from hawkers. This was because they associated bakery products with the clean image of bread and cake shops and they wanted to see and smell a variety of kuihs as normally displayed by hawkers. The survey also showed this strong link between "freshness" and bakery products from

bakery shops. There was strong opposition to outlets such as sundry shops and hawkers for bakery products. Similarly, the smell was a very important feature in bread and cake shops.

Participants in the focus group mentioned that Malaysian consumers are becoming more health conscious and products which are seen to be healthy are more desirable. Seventy six percent of respondents in the survey thought that bakery snacks in bread and cake shops were "good for them", but only 54% of the respondents thought that it was important that snacks were not fattening. Thus, the health concept was associated with a general perception of what is "good for them" but not greatly affected by the caloric value of the product.

The survey showed that consumers wanted convenience in their purchases, while focus group participants placed a high priority on convenience of preparation. This indicated that consumers wanted to spend as little effort as possible for snacking. In a bakery snack, the consumers wanted convenience in shopping and preparation, an attractive smell, a good taste, nutrition (good for them) and, in the case of Malay consumers, "halal" food.

Participants in the focus group mentioned that the incorporation of local flavours into otherwise foreign products would make them more suitable for Malaysian tastes. Meat pies were especially mentioned as a possible product for export because they liked the pies in New Zealand. Although the results from the focus group suggested that bread and cake shops were the only outlets for bakery products, the survey indicated that bakery snacks are purchased at a variety of outlets.

3.3.8 Conclusions

Using a focus group and consumer survey, it was found that Malaysians snacked extensively, on a large variety of foods. Bakery products formed a significant part of the snacks eaten. Features that were important in bakery snacks included the taste, freshness, smell and convenience of the product. Although imported foreign snacks (in particular, biscuits) were consumed, consumers would prefer them to have local flavours. The type of bakery snacks bought were bread, cake, filled baked buns, curry puffs, pies and the traditional Malay cakes, kuih. Meat pies were thought to be a possible product for export from New Zealand.

CHAPTER 4

PERCEPTIONS OF BAKERY SNACKS BY MALAYS AND CHINESE IN MALAYSIA

The focus group and consumer survey identified several features desirable in a bakery snack, including taste, freshness, convenience, and an image of cleanliness. The survey also revealed slight differences between the two ethnic groups in their buying patterns from bread and cake shops and of imported snacks. Although the focus group result also indicated a preference for pastry products, particularly meat pies, this had not yet been confirmed with consumers in Malaysia, especially the Malays (as the focus group participants were Chinese).

Several issues had to be resolved before a product could be developed for the two ethnic groups. A product area acceptable to both ethnic groups had to be found and differences in the perceptions of the ethnic groups towards bakery snacks had to be investigated.

Since the 1960's, techniques for translating perceptions into meaningful spaces which can be interpreted as product attributes have become increasingly available. It has also become possible to incorporate preferences into those spaces to identify potential market gaps. A review of the literature was made to aid in the selection of a suitable technique to compare the Chinese and Malay perceptions of bakery snacks. Multidimensional scaling (MDS) was chosen and similarity judgements were made by groups of consumers.

4.1 SELECTION OF PERCEPTUAL MAPPING TECHNIQUE

Shocker and Srinivasan, in 1979, reviewed approaches used in concept evaluation and generation. Products are usually represented abstractly in terms of attributes. These attributes were thought to be relevant to consumer choice of products. The products could be represented in a "perceptual product space" consisting of axes which could be related to the attributes. Products were represented in the space by means of the perceived location (coordinates on the axes). They reviewed approaches used for the identification of the attributes and for the creation of a

perceptual product space. Direct scaling, factor analysis and multidimensional scaling (MDS) were the most popularly used methods. Discriminant analysis was also used.

Direct scaling and factor analysis both involve consumers in scaling products on pre-selected attributes. Factor analysis further involves reducing the large number of attributes to a few interpretable dimensions. MDS, on the other hand, requires similarity judgements to be made by the consumers between products. The similarity scores are then reduced to a perceptual space.

A major disadvantage with direct scaling is that the technique involves representing each attribute in a dimension of the space. This leads to a large number of dimensions. In food products, there is a mindboggling array of attributes which affect consumer attitudes and preferences for a product. With MDS and factor analysis, these numerous factors are reduced to a few manageable factors on which the product developer can concentrate.

While MDS only requires similarity judgements, direct scaling and factor analysis involve scaling of the attributes. There are both advantages and disadvantages to the two approaches. Since the attributes are pre-specified in direct scaling and factor analysis for rating by the consumer, there is no doubt as to the meaning of these attributes. However, the attributes selected can be a result of the researcher's bias. With factor analysis and direct scaling, there is also a possibility that not all the relevant attributes are included for rating. This is not the case with MDS, but it is debatable as to what the dimensions derived from the overall similarity between products reveal. It is possible that the dimensions may consist of attributes which distinguish between the products, attributes which are most commonly used by the consumer, or attributes which determine preference. Interpretation of the dimensions poses a problem. Additionally, the dimensions derived from MDS may not be interpretable in actionable terms (Shocker and Srinivasan, 1979). From observation, many of the dimensions obtained from multidimensional scaling are either market positioning or product design variables. Thus, there is no guarantee that the dimensions obtained will be useful for product design.

Hauser and Koppelman (1979) compared discriminant analysis, factor analysis, and MDS as alternative methods for determining perceptual spaces and developing models of preference. They compared the techniques on criteria such as ability to provide managerial interpretation, ability to predict consumer preferences accurately, ease of use, and cost of implementation. Factor analysis was found to be superior to discriminant analysis on interpretability and predictability but equal on the other two criteria. However, in comparing costs, they only took into account the cost of computing, without taking into account the time the respondent takes to complete the rating tasks.

Wilkinson (1985) used both MDS and factor analysis to aid meat product development, and found that factor analysis gave more meaningful results. This worker attributed the lack of a useful perceptual space in MDS to the scenario he used, which was general similarity ratings in buying and using meats. It was suggested that more specific tasks, such as the comparison of the similarity of flavour, colour, and appearance, should be used instead.

Despite the arguments in favour of factor analysis, there is one important factor in MDS which outweighs the other techniques. MDS can be used where non-verbal aspects of perception are present or where different cultural groups are involved and translation affects the meaning and perception of the attribute descriptions. This problem may be corrected by better translation, using methods proposed by Brislin (1970, 1976, 1980) such as back translation, bilingual and committee approach, decentering, and pre-tests. Basically, all these methods are aimed at putting the same test into different languages while preserving the same ideas across linguistic boundaries. Thus, it appeared that MDS was a simpler technique to use where expertise in translation was not readily available. For this reason, MDS was selected as the method to study Malay and Chinese perceptions of bakery snacks.

4.2 MULTIDIMENSIONAL SCALING

Multidimensional scaling encompasses a set of mathematical techniques capable of representing similarities data in a geometrical configuration. The spatial arrangement of the data points reflects their underlying relationship which may not be known to the researcher. Indeed, the major application of MDS has been in the area of discovering stimuli of relevance to the subjects under investigation.

4.2.1 Application of MDS to food products

One of the earliest applications of MDS to a food related area was by Yoshida (1963) who scaled eleven taste chemicals and recovered a three dimensional space that resembled Henning's taste model (Schiffman and Erikson, 1971). This was followed by Erikson, Doetsch and Marshall (1965), Gregson (1965), and Gregson and Russell (1966) who worked on taste, and taste mixtures. Later, Schiffman and Erikson (1971) used MDS to develop a three-dimensional psychophysical model of gustatory quality. The three dimensions represented the hedonic response to the stimuli, the molecular weight and the deviation from neutral pH 7.

Parallel to the work on taste models using MDS was the application of MDS techniques to odours. Yoshida (1964) and Woskow (1968) were the early pioneers, followed by the work of Moskowitz (1974), and Moskowitz and Gerber (1974). However, it was not until 1975 that Moskowitz and von Sydow used MDS on actual food flavours (as opposed to chemical compounds). In a review of psychophysical and psychometric approaches to sensory evaluation, Moskowitz (1977) included MDS as a technique for representing stimuli in a geometrical space. He noted that proximities analysis found wide use in studies with model systems of both tastes and odourants. With the advent of INDSCAL (Individual Differences Scaling, Carroll and Chang, 1970), MDS analysis was found to be a useful tool for the comparison of the performances of panelists (Moskowitz, 1974; Moskowitz and von Sydow, 1975). Since then, MDS has become accepted as a tool in sensory analysis (Moskowitz, 1977; Williams et al., 1983; 1984).

The advent of MDS aroused considerable interest in the market research area as it enabled the identification of the relevant attributes of

products. Early market research applications had been done with the purpose of gaining an insight into the perceptions of various consumer products (Green and Carmone, 1969; Green and Rao, 1971). Applications of the product spaces to idea generation soon followed, with the identification of spaces or 'gaps' in the perceptual configuration (Morgan and Purnell, 1969; Douglas, 1978).

With the development of nonmetric "unfolding" analysis by Coombs (1964), the MDS space could be used to represent both stimuli and subjects as points. Each subject is located as an "ideal" point where the subject's preference is at a maximum. Carroll and Chang (1972) expanded this to include the vector model in PREFMAP (Preference Mapping) where preferences are represented as vectors, pointing towards the region of increasing preference. The development of ideal points and models eliminated, to a certain extent, the guesswork in identifying preferred products.

In the early seventies, research in MDS was mostly concerned with the technical aspects of MDS (e.g. comparison of algorithms, data collection and reduction techniques, Monte Carlo investigation of stress values) rather than the application and usage of MDS. Some of these investigations used food products as the stimuli (Percy, 1975; Narayana, 1976; Holbrook et al., 1982). Cooper (1983) reviewed the use of MDS in market research. He dealt with problems and proposed solutions as they developed in the journal literature. It is known that MDS was indeed applied in the commercial sector to consumer food products, particularly in the identification of new products and new product areas. Unfortunately, most of the commercial applications of MDS to food products were not published and are not readily accessible.

More recently, Wierenga (1980) recommended the use of MDS models for the analysis of consumer perceptions and preferences for food products. In a separate paper, Wierenga (1983) developed a model for consumer behaviour which affects the choice of a particular food item. This model incorporated the various attributes (e.g. hedonic, instrumental and symbolic attributes) which contribute to the choice of a food. This worker proposed the use of MDS and factor analysis to analyse how consumers perceive products and how the products influence preference.

MDS has also been applied to several new areas of food research. Anderson (1975) used the technique to select raw materials which could be incorporated into the design of nutritional foods acceptable to Thais. Schiffman et al. (1979) used MDS to uncover the qualitative differences among sweeteners in order to relate physicochemical parameters to sweetness. In another paper, Schiffman (1983) proposed the use of MDS to aid the design of flavour molecules. This worker was able to recapture 84% of the interstimulus distances in a two dimensional space portraying 39 odours. In an interesting application of MDS, Cardello et al. (1983) used the technique to assess sensory data of seventeen fin fish species and proposed the resultant two dimensional "fish map" be used to educate consumers on the sensory properties of non-traditional fish species. Worsley et al. (1984) used MDS to investigate the rules by which 10 year old Australian children combined foods.

In conclusion, it can be said that MDS has only been systematically used for sensory evaluation of foods but not for product development. Many researchers have pointed out the potential of MDS in the design of new products but to date, definitive research methodology for this purpose has not been found.

4.2.2 Application of MDS to cross-cultural research

Cross-cultural research is more prevalent in the disciplines of social science, anthropology and psychology. It is only within these fields that MDS has been used to compare different cultural groups. In the few instances that it has been used, the application of MDS in cross-cultural research was an extension of the existing use of MDS to a specific area of research. However, although MDS has proved a success methodology for the comparison of cultural differences, it has not been widely used.

In 1979, the Journal of Cross-Cultural Psychology conducted a ten year analysis (1970-1979) on all the articles that were published in the journal during that period. Amongst the criteria selected for analysis was the type of statistics used. It is significant that none of the articles used MDS as a method of statistical analysis. However, in their review of measurement in cross-cultural psychology, Hui et al.

(1985) listed MDS as one of the techniques, and in particular singled out INDSCAL as especially useful for the purpose of cross-cultural research.

Although the use of MDS to compare different cultural groups parallels the use of MDS in specific areas of research, most research in this domain is relatively recent. Notable exceptions are the works of Taylor et al. (1973) who explored the role of cultural background, language and geographic region in the perception of ethnic identity; Davidson (1975) who investigated the cultural differences in the perception of black culture and Whiting et al. (1975) who compared the effect of culture on the social behaviour of children. Since 1975, the majority of studies used INDSCAL as a method of analysis. The methodology of analysing cross-cultural differences, however, were quite varied (see Table 4.1).

 Table 4.1 Methodology used in the analysis of cross-cultural differences

| AUTHOR | YEAR | METHODOLOGY |
|-----------------------|------|---|
| Taylor et al. | 1973 | Subjective comparison of dimensions |
| Davidson | 1975 | Correlation of stimulus value for all dimensions between cultural groups |
| Whiting et al. | 1975 | Comparison of median scores of dimensions |
| Forgas et al. | 1977 | Correlation of joint INDSCAL space with bipolar scale |
| Shikiar et al. | 1978 | Comparison of mean weight of each dimension as obtained from INDSCAL |
| Schweizer | 1980 | Comparison of mean weight of each dimension as obtained from INDSCAL |
| Hermann and Raybeck | 1981 | Correlation of similarity matrices |
| Foster and White | 1982 | Correlation of similarity ratings for each stimulus |
| Hui and Triandis | 1983 | Comparison of mean weight of each dimension as obtained from INDSCAL |
| Forgas and O'Driscoll | 1984 | Discriminant analysis of dimension weights as obtained from INDSCAL in joint space and univariate analysis of variance of the weights |

The most popular method was the comparison of mean weight of each dimension obtained from INDSCAL. This method was used by Shikiar et al. (1978); Schweizer (1980); Hui and Triandis (1983); Forgas and O'Driscoll (1984). Shikiar (1978) compared the mean weight of two ethnic groups for each dimension and found that they were different for Anglos and Blacks. Schweizer (1980), on the other hand, plotted the dimension weights of every individual Batak and Javanese on the same diagram and claimed that the ethnic groups did not mix in the space. The worker then concluded that inter-ethnic difference was demonstrated. Hui and Triandis (1983) used mean weights obtained from INDSCAL as a guideline for comparing U. S. Hispanics and mainstream navy recruits and concluded that INDSCAL was a promising addition to the methods used by cross-cultural psychologists. Forgas and O'Driscoll (1984) used multiple discriminant analysis instead of subjective assesement to compare INDSCAL dimension weights. They found that Australian and Papua New Guinean subjects were significantly different and the two cultures could reliably be identified on the basis of their pattern of INDSCAL weights alone.

Another method used was the correlation of similarity matrices demonstrated by Hermann and Raybeck (1981) and Foster and White (1982). Forgas et al. (1977) used a simple and useful method that is not often mentioned - that of looking at the joint space of the ethnic groups to see if they represented a meaningful merger. These workers also correlated bipolar scales with the dimensions of the joint configurations. The results indicated that, except for the second dimension, the other two were not comparable across the British and German subjects. Hui et al. (1983) also compared mean dimension weights and found that some dimensions were more salient to one cultural group than to the other.

It was apparent that INDSCAL was the most popular method of analysis for cross-cultural research and the use of INDSCAL dimension weights was a successful method of distinguishing between ethnic groups.

4.3 LITERATURE REVIEW ON THE METHODOLOGY FOR MDS

4.3.1 Data collection for MDS

Shepard (1972) classified the various types of data used for MDS into proximity data, dominance data, profile data and concept measurement data. Generally, proximity or similarity data are the most popular form of data used to recover an underlying structure. The similarity judgement is considered to be related to the "psychological distance" of the objects under study.

There are three fundamental issues involving the methods of data collection; the ease of usage, the number of similarity judgements, and the quality of the data obtained. The ease of usage is evaluated in terms of time taken to complete the task, whether or not subjects found the task boring and/or difficult, the number of comparisons involved, and the amount of preparation required of the data. There has been no systematic comparison of the methods of data collection in these terms and one can only assume from the usage patterns what has proved the simplest method. According to McIntyre and Ryans (1977), the paired comparison or rating scale is used more frequently in market research than the rank order method. The rating scale has gained general acceptance and Schiffman et al. (1981) used it for their numerous examples.

A significant disadvantage of MDS is the large number of comparisons that have to be made for the input data. As Coxon (1982) pointed out, balanced incomplete designs only exist for some types of data collection and only for a certain number of objects. There are three approaches resolving this problem. One, taken by Spence and Domoney (1974), is the design of incomplete data for single subjects using paired similarity data (paired comparison). Results indicated that random and balanced designs such as cyclic designs perform quite well. In a second approach, Rao and Katz (1971) used different data collection methods such as subjective grouping methods (sorting), pick $k/n-1$ method and order $k/n-1$ method, which were suitable for large stimulus sets. He concluded that no method recovered the original configuration perfectly, although the pick and order methods produced better recoveries than the subjective grouping methods. A third and

seldom used approach, is to collect an incomplete data set from individuals and then combine their responses. Individual differences, however, cannot be investigated using this method.

The third issue involves the quality of the data collected, whether or not the data can recover the MDS configuration and if the configuration obtained reflects the true perceptions of subjects. Unfortunately, there have been few studies on the effect which different data collection methods have on MDS configurations. Summer and Mackay (1976) suggested that direct similarity judgements may not be very good measures of individual perceptions. However, in their study, they only used one method of direct similarity judgement and expected the subjects to select their individual (as opposed to aggregate) configurations as most representative of their perceptions. Using two direct similarity measures, Whipple (1976) found the configurations produced were not similar to the configurations obtained from preference data. Similarly, Green and Carmone (1969) concluded that configurations obtained from direct similarity measures do not agree with configurations obtained from preference data alone.

In summary, the literature revealed that rating scales were the most popular method of collecting MDS data; that designs exist to reduce the number of comparisons and that several data collection methods, such as preference and similarity data are desirable.

4.3.2 Dimensionality of an MDS configuration

Determining the appropriate dimensionality of an MDS space has concerned researchers for a long time. Since MDS is often used to represent spatially a set of data, it is desirable to be able to estimate the "correct" or "true" dimensionality of a solution to aid the location of the various points in space. Many criteria, both subjective and statistical have been put forward to assist the analysis of dimensionality of an MDS solution. These include goodness-of-fit, interpretability, ease of use, and stability.

Kruskal's stress is the most common statistical measure of goodness-of-fit. This is calculated as the square root of a normalised "residual sum of squares" between the data and the configuration. Hence, larger values indicate worse fit. Kruskal and Wish (1978) recommended the use of computer programmes such as M-D-SCAL, TORSCA or KYST which systematically minimise stress; or a programme such as ALSCAL which minimises a very similar quantity, called SSTRESS. There are usually two formulas for calculating STRESS called formula 1 and formula 2.

The value of stress increases with an increasing number of objects scaled. It is also affected by different methods of analysis, for example:

- * the numerical values for stress formula 2 are larger than those for stress formula 1.
- * the secondary approach to ties, treating tied values as equivalences, produces higher stress values than the primary approach.
- * increasing dimensionality tends to decrease stress.
- * the presence of a diagonal in the half matrix increases stress.

Kruskal (1964) put forward two criteria by which to judge the dimensionality of a solution. The first rule of thumb was that stress was to be interpreted as follows: 0.025 - excellent, 0.05 - good, 0.10 - fair, and 0.20 - poor. The other criteria was the "elbow" test, where dimensionality is distinguished as a sudden drop in the marginal improvement in the plot of stress versus dimensionality. Klahr (1969) pointed out that for a given number of stimuli, stress decreases with increasing number of dimensions; and for a certain number of dimensions, stress increases with an increasing numbers of stimuli. Kruskal's rule of thumb obviously did not allow for differing number of stimuli or dimensions and thus cannot be applied in a wide variety of situations. As Shepard (1974) pointed out, no one likes to submit publications with a result that is only "fair" or "poor".

Both Klahr (1969) and Stenson and Knoll (1969) used nonmetric scaling to analyse random input data to provide a guideline against which to evaluate the significance of the results obtained from empirical nonmetric MDS solutions. However, since the distribution of stress is unknown, it is not possible to say how close the empirical stress can approach the stress from the random data before one concludes that the solution is meaningless. Spence (1983), using the studies of Spence and Graef (1974), and Wagenaar and Padmos (1971), pointed out that if data is not random, the stress for any recovered dimensionality will be smaller than the random data value for that number of dimensions. This includes the case of an over-estimated number of dimensions.

A second major concern with finding the appropriate dimensions for the data is interpretability. In many applications of MDS, an understanding of the cognitive perception of the subjects is desired. Although inability to interpret a dimension does not mean that it does not exist, most researchers are reluctant to include an unknown quantity as it does not aid in the understanding of the model.

At present, two of the most frequently quoted methods for deciding on dimensionality are stress, and interpretability. However, there is also a tendency to select configurations in two or three dimensions for ease of visualisation.

4.3.3 Interpretation of axes

The configurations produced by MDS do not come with an explanation of what the dimensions represent - this process of interpretation falls on the investigator. Unfortunately, there are no methods which can automatically determine the structure of the data. However, the task is crucial as the interpretation of axes is the end result sought in many studies.

The procedures presently available for detecting the underlying structure of the configuration are subjective and tend to rely heavily on the experience of the investigator and the investigator's familiarity with the subject or the products concerned.

The task of interpreting a configuration presupposes the existence of dimensions which have to be decided upon before the process of interpretation. A usual method of obtaining the reference axes is to allow the MDS programme to rotate the configuration to the principal components or principal axes. The first principal axis is the axis in which the stimuli have the maximum variation. The second principal axis is orthogonal to the first, which means that it is statistically independent of the first axis and so it explains the maximum amount of the remaining variation. However, the dimensions obtained in this manner may not be the easiest or most meaningful for interpretation and a rotation of the axes may be necessary.

Coxon (1982) differentiated between internal and external methods of interpretation. While only original data is used for internal analysis, additional information obtained independently of the scaling is used for external analysis.

4.3.3.1 Internal methods of interpretation

The intuitive method of interpreting axes is termed spanning dimensions by Coxon (1982). The stimuli from the extreme ends of each axis are compared to see the property or attribute in which they contrast. These stimuli can then be compared with the stimuli towards the middle of the axis to check if there is a gradation in the property hypothesised. This method has serious drawbacks in that it is limited by the researchers' verbal and conceptual ability and depends on his/her familiarity or experience with the stimuli concerned. More often than not, an MDS configuration will contain regions in which stimuli tend to cluster together. A close examination of those regions may reveal the characteristics in which the stimuli are represented. In addition, Coxon (1982) pointed out that "a configuration may be interpretable in differing ways in different regions and there is no guarantee whatever that one particular type of structure will best describe the entire configuration".

Guttman's "facet theory" has been used in identifying structures in MDS configurations. This procedure utilises an original data measurement framework which relates various facets or aspects of the population or stimuli to the response obtained. The advantage in this approach is

that it compels the researcher "to be more specific in data collection procedures, to inspect the "a priori" or theoretical similarity and the relationship of questions before obtaining the data, to be more alert to characteristics to be looked for in the configuration and to be aware of the type of structures/clusters to be expected" (Coxon, 1982).

4.3.3.2 External methods of interpretation

Multiple regression is a frequently used method for correlating external data with stimulus points in the space. Schiffman et al. (1981) refers to this as a property model, and it includes both the vectors and the ideal points. In effect, the property analysis uses external data to give a statistical basis to the amount of correlation between the stimulus points in the configuration and the property data collected. However, the property model does not automatically produce attributes or properties which are related to the stimulus configuration. This task remains the responsibility of the researcher: the model can only identify the properties which are related to those used by the subjects for similarity judgements.

4.4 EXPERIMENTAL METHOD

4.4.1 Selection of techniques for MDS

Direct similarity judgements were selected for use by the consumer as this was a popular method in market research and was thought to be a simple task for them. A line scale of 10 cm was used, ranging from 1 being very dissimilar to 10 being very similar. Schiffman et al. (1981) had found it a useful and easy scale for MDS.

In this study, balanced incomplete designs and incomplete data for single subjects were not used. Because of the small number of consumers involved, an incomplete design might result in an unstable space. In addition, complete individual spaces would form a better basis for comparisons between the two ethnic groups. The literature suggests that different methods of data input (i.e. similarity and preference) is desirable to obtain two different configurations. However, it was not feasible to collect preference data in addition to

similarity data due to the large number of products involved. Eighteen products were selected for the MDS, which meant that there was a total of 153 comparisons for consumers. A brief description of the products is given in Appendix 4.1. The products selected fell into two categories: products which were familiar to Malaysians, and products which were either non-existent or unfamiliar.

The task of similarity judgements was divided into two sessions. In the first session, 12 products were introduced for scaling; the other 6 products were scaled in a subsequent session. In the second session, the six products were also compared with the 12 products from the first session. The reasons for dividing the sessions were twofold. Firstly, since the subjects were mostly housewives, it was expected that they would not be familiar with the use of rating scales and hence would require some introduction. To facilitate this, the first 12 products selected were local products with which the subjects would be familiar. Secondly, the six new products which were unfamiliar had to be described in detail. This was done in the second session to avoid confusing consumers.

Preference data was also collected by asking the consumers to rank the products. This was to enable areas of preference or ideals of the two ethnic groups to be identified.

4.4.2 Selection of the consumers and the place for MDS

The study was carried out in February-May 1984. Subjects chosen to perform the similarity judgements were housewives or working women between the ages 25-40 years. They were chosen for several reasons. Firstly, since the study involved several sessions, it was reasoned that women (in particular, housewives) were more able to spare the time than working males. Secondly, women were more likely to be familiar with food as well as to have an interest in it. Interest was an essential quality as the women had to attend several meetings spread over a period of several months. At these meetings, they performed similarity judgements, generated and screened new product ideas. Additionally, women tended to take the family into consideration, and were thus in a better position to discuss the food habits of their family. Subjects were recruited through contact with women's

organisations such as the Women's Association in Universiti Sains Malaysia and the Young Women's Christian Association (YWCA). For each ethnic group, three groups of 4-6 people were selected.

The location and times of each meeting were selected for the convenience of the subjects. However, it was ensured that each meeting place had a table around which subjects were seated, and had sufficient privacy so that the subjects were not interrupted during the session. Each meeting lasted for one to one and a half hours.

4.4.3 Data collection for 12 products

The 12 products were chosen from the types of bakery snacks identified in the consumer survey as those eaten by Malays and Chinese. The products were chosen to give a range of attributes such as taste (sweet, bland, savoury), method of cooking (baked, steamed, deep fried), type of bakery snack (pastry, bread, cake, bun), textural characteristics (firm, soft, with and without filling), origin of snack (Malay or Chinese) and traditional versus modern snacks. The products were white bread, wholemeal bread, chocolate cake, fruit loaf, bun with "tausa" filling, bun with "sambal" filling, doughnut, steamed pao with "kaya" filling, egg tart, curry puff, "cucur badak", and "kuih talam".

In the questionnaire, the respondent was asked to compare pairs of products for similarity. The order of the products in the pairs was randomised. The overall order of the pairs of products was also randomised and therefore there was unlikely to be any order bias. It was also unlikely that the subjects were affected by fatigue and disinterest due to the small number of judgements in each session (66).

Due to the fact that housewives are not frequently subjected to the use of scales, considerable care was taken in explaining the task to the subjects. Each subject was given individual attention to ensure that they understood the use of the scales, before starting the similarity judgements. Besides comparing the pairs of products, the subjects also ranked the 12 products in order of preference.

4.4.4 Data collection for 18 products

Six new products were introduced in the second session. They were honey and nut loaf, jalapeno bread, orange cake, apple pie, chicken pie and pizza. Some of the products chosen were non-existent in Malaysia, and others, were not easily available. Several of these products were made and presented during the meeting for the subjects to look at and taste. A brief description of the products was also supplied to the subjects.

The questionnaire asked the subjects to compare the similarities of the six new products and of the six products with the 12 products from the previous session. They also had to rank all 18 products in order of preference.

4.4.5 Preference testing with panelists in New Zealand and consumers in Malaysia

During the formulation of the pie, Malaysian students in New Zealand were used as pseudo-consumer panelists to guide the formulation by sensory evaluation. These panelists were asked to rank in order of preference, the 18 products used for multidimensional scaling and also the final product selected, a macaroni and minced meat pie, after tasting the pie.

After the formulation, a final product was made in a factory trial. This was sent to Malaysia for consumer testing. Four groups of consumers; eight Malay women, nine Chinese women, 10 Malay students and 10 Chinese students tasted the product and discussed it. These consumers were also asked to rank the 18 products and the meat pie in order of preference.

4.5 ANALYSIS OF DATA

4.5.1 MDS analysis

Three different types of analysis were performed on the data. Both KYST-2 (Kruskal et al., 1973) and INDSCAL (Carroll and Chang, 1970) were used to analyse the data, to investigate the differences, if any, between the two algorithms. For the analysis of preference data, both PREFMAP (Carroll and Chang, 1967; 1972) and LINMAP (Srinivasan and Shocker, 1973) were used. Internal methods of interpretation were used with the help of cluster analysis. As well, an external analysis was made using the subjective interpretation by the consumers themselves to see if the axes were meaningful to them.

The similarity judgements were averaged (using means) across all the subjects for each ethnic group, as well as over all the subjects. MDS of the averaged data was performed using KYST-2 and INDSCAL. The KYST-2 analyses were done using Euclidean distances, stress formula 1, a Torsca start, and the primary approach to ties, while INDSCAL analyses were done by computing all dimensions simultaneously with a criterion of 0.001 for ending the iterations. A separate configuration was obtained for each ethnic group, and for 12 and 18 products. The similarity judgements were also clustered using an hierarchical clustering scheme available in the MDS(X) series of programmes, HICLUS (Hierarchical Clustering, Johnson, 1977). Only the minimum method was used, in preference to the maximum method, as both methods produced virtually identical solutions.

The configurations obtained from KYST and INDSCAL, for 12 and 18 products and for both ethnic groups were compared with one another using Procrustes analysis available in Genstat (A General Statistical Program, Rothamsted Experimental Station, 1977).

The ranked preference data was mapped onto the multidimensional space of the products using PREFMAP and both the constrained and unconstrained version of LINMAP (LINMAP and MIXED MODE respectively). The LINMAP option of the programme estimates the ideal points using a squared Euclidean distance model as well as the attribute weights. Unlike PREFMAP, the ideal point coordinates are constrained to be finite attribute weights and are constrained to be non-negative. The MIXED MODE option, however, permits both finite (ideal point model) and infinite (vector model) ideal points whichever best fits the data, but again attribute weights are constrained non-negative. Since the LINMAP option resulted in a large proportion of the ideal points at the boundaries, the results of the MIXED MODE option was used for further analysis.

Ideal points were obtained for each subject; as well as for all the subjects together, each being weighted equally. For the LINMAP and MIXED MODE options, upper and lower bounds were supplied to the programme so as to ensure that the ideal points were restricted within the product space.

4.5.2 Dimensionality of MDS configurations

To determine the dimensionality of the MDS solutions, the stress values of the 12 and 18 product KYST spaces were plotted against the number of dimensions (see Figures 4.1 and 4.2). A distinct elbow occurred in the third dimension for both the Malays and Chinese in the 18 product space at an acceptably low level of stress (0.11 and 0.12 respectively). The graphs for the 12 product space, however, was less clearcut, but again stress was acceptable at the third dimension.

From the INDSCAL solution, 44-54% of the variance was explained in three dimensions. Adding on a fourth dimension only improved the fit marginally, accounting for another 5% of the variance. In addition to that, there was good agreement between the KYST and INDSCAL solutions up to the third but not in the fourth dimension. Thus, the three dimensional solution was used for further analysis.

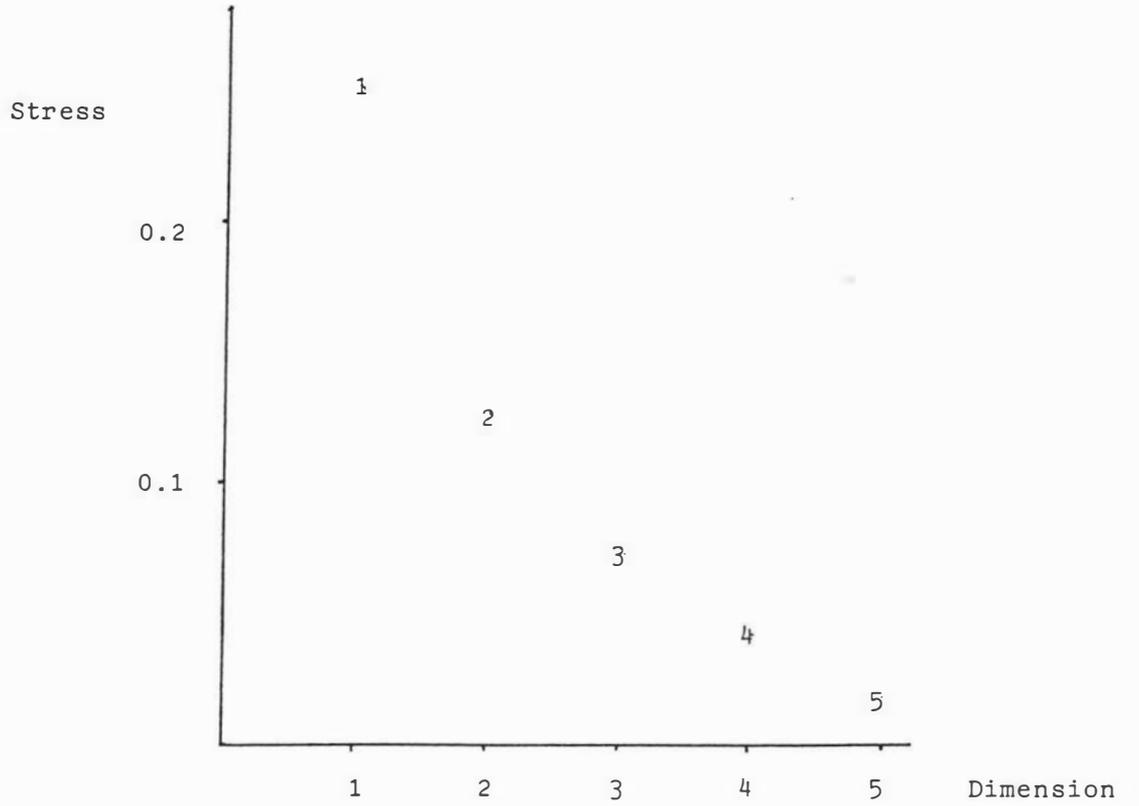


Figure 4.1: Stress vs dimension plot for 12 products (KYST for all subjects)

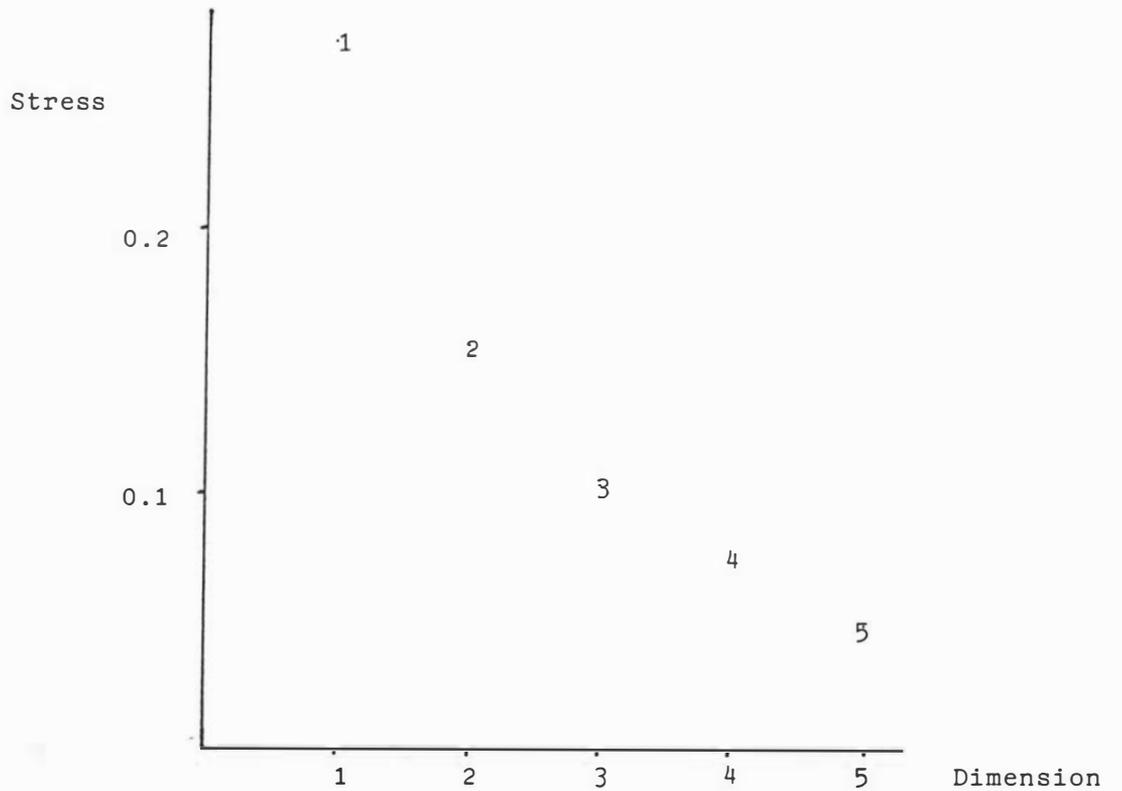


Figure 4.2: Stress vs dimension plot for 18 products (KYST for all subjects)

4.5.3 Interpretation of axes

4.5.3.1 External interpretation of axes by subjects

After the first session when the subjects had compared the pairs of products, they were asked to name all the criteria which they used to compare the products. The Malays mentioned taste, texture, nutrition, generic type of product (e.g. cakes, bread, buns), whether or not the product contained yeast, suitability for children, whether or not the food was filling. The Chinese mentioned taste, method of cooking, nutrition, whether or not the product was filling, and occasions product was eaten.

Part of the third meeting session for the subjects included the task of evaluating the principal axes obtained from KYST-2 solution of the similarity scaling of the 18 products. The subjects were shown the ordered distance of the products along each dimension and asked to identify the property or attribute which was varying in that dimension. A sample copy of the diagram shown to the subjects can be found in the Appendix 4.2.

The first dimension was easily recognised by the subjects, both Malays and Chinese. They identified the dimension as varying from sweet through to bland to savoury products. Opinion on the second dimension was more varied. However, two characteristics were most frequently mentioned - texture and type of product (e.g. bread, buns, pies, cakes, and others). Many subjects failed to identify the third dimension, although some put forward suggestions such as nutritional content, texture (simple to complicated), and local versus western snack.

4.5.3.2 Hierarchical clustering

Hierarchical clustering was used to aid in the interpretation of the configurations. The way in which the products were clustered could give an indication of the way in which the products were compared. The results were presented as contour diagrams plotted onto the KYST configurations (see Figures 4.3-4.6).

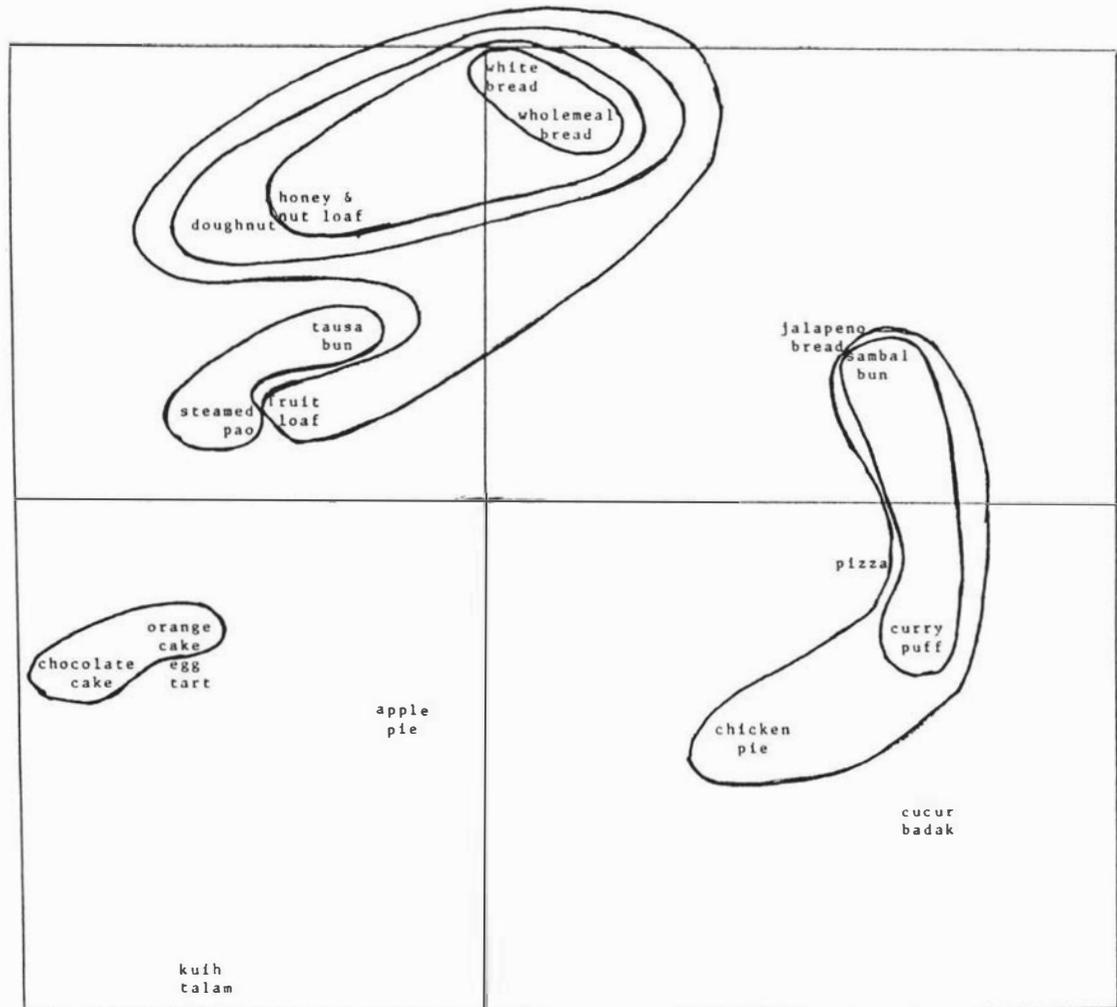


Figure 4.3: Contour diagram of hierarchical clustering plotted in multidimensional space for Malays - KYST (dimension 2 vs dimension 1)

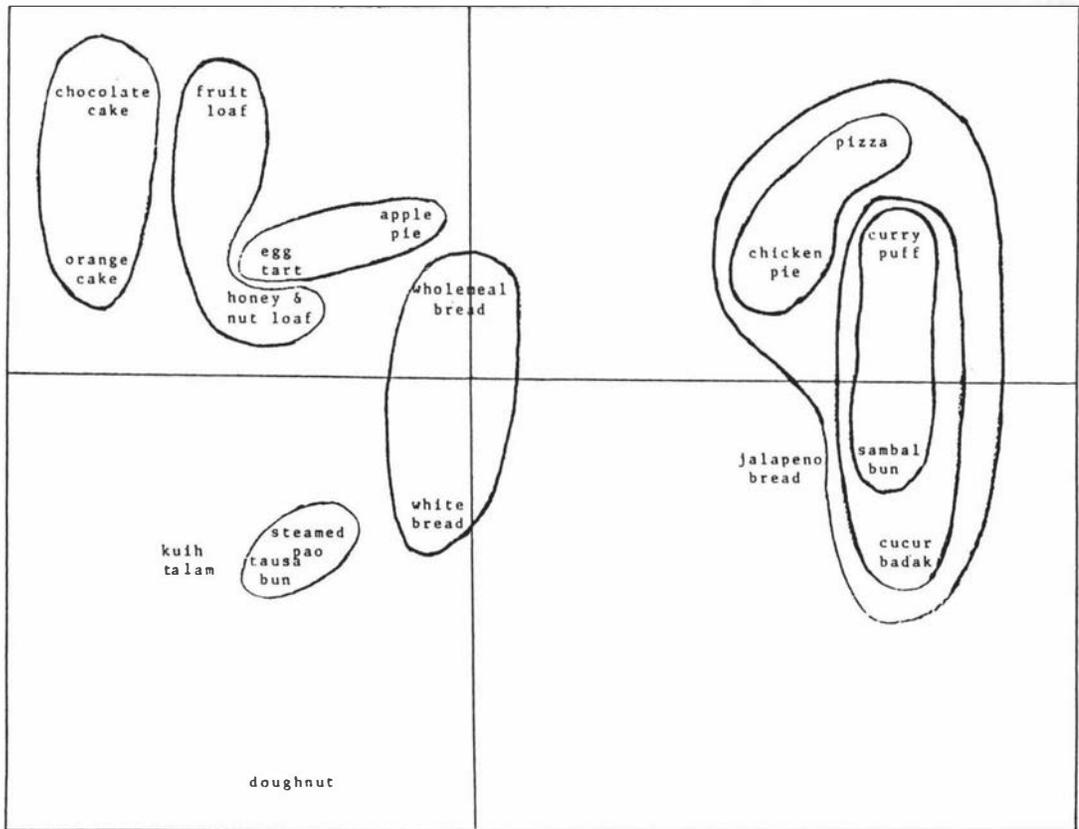


Figure 4.4: Contour diagram of hierarchical clustering plotted in multidimensional space for Malays - KYST (dimension 3 vs dimension 1)

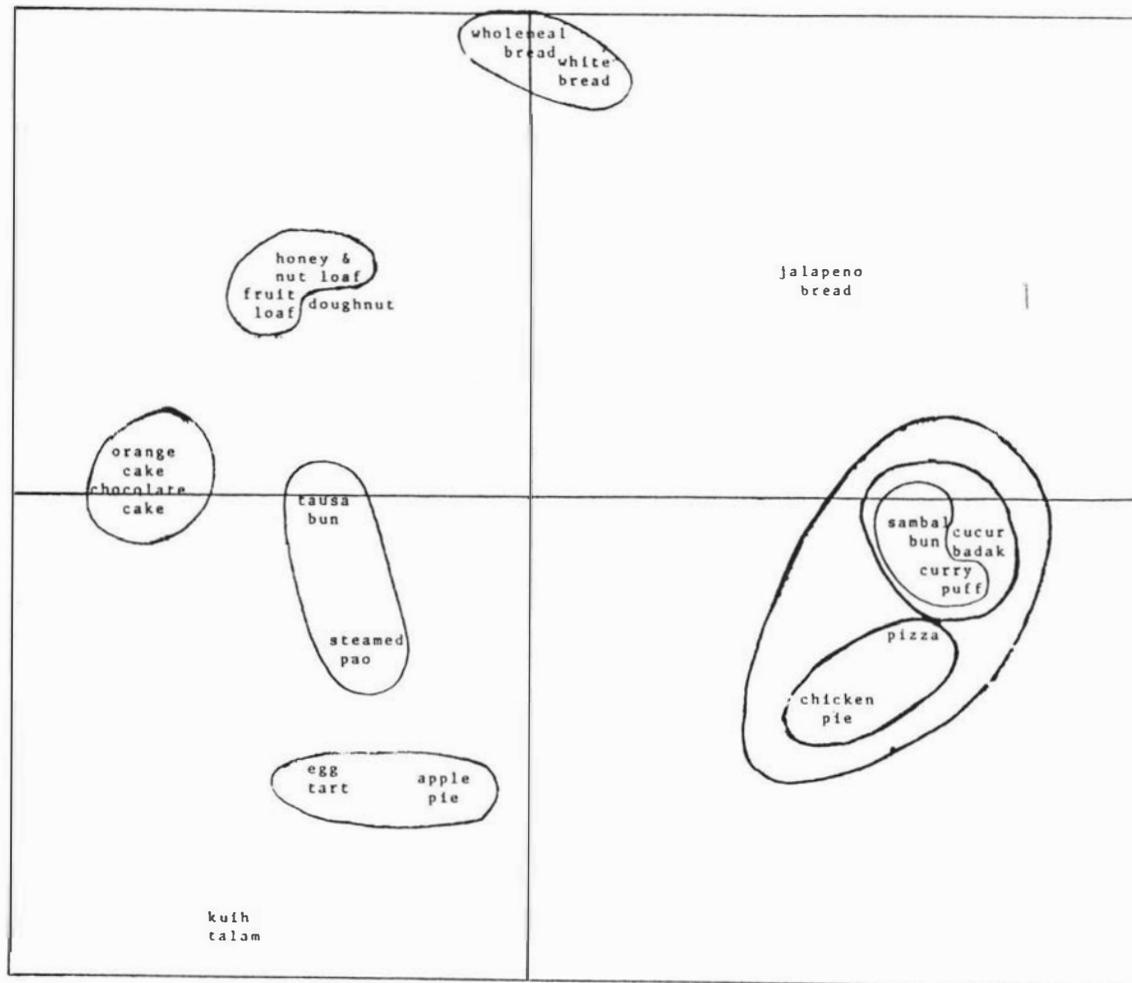


Figure 4.5: Contour diagram of hierarchical clustering plotted in multidimensional space for Chinese - KYST (dimension 2 vs dimension 1)

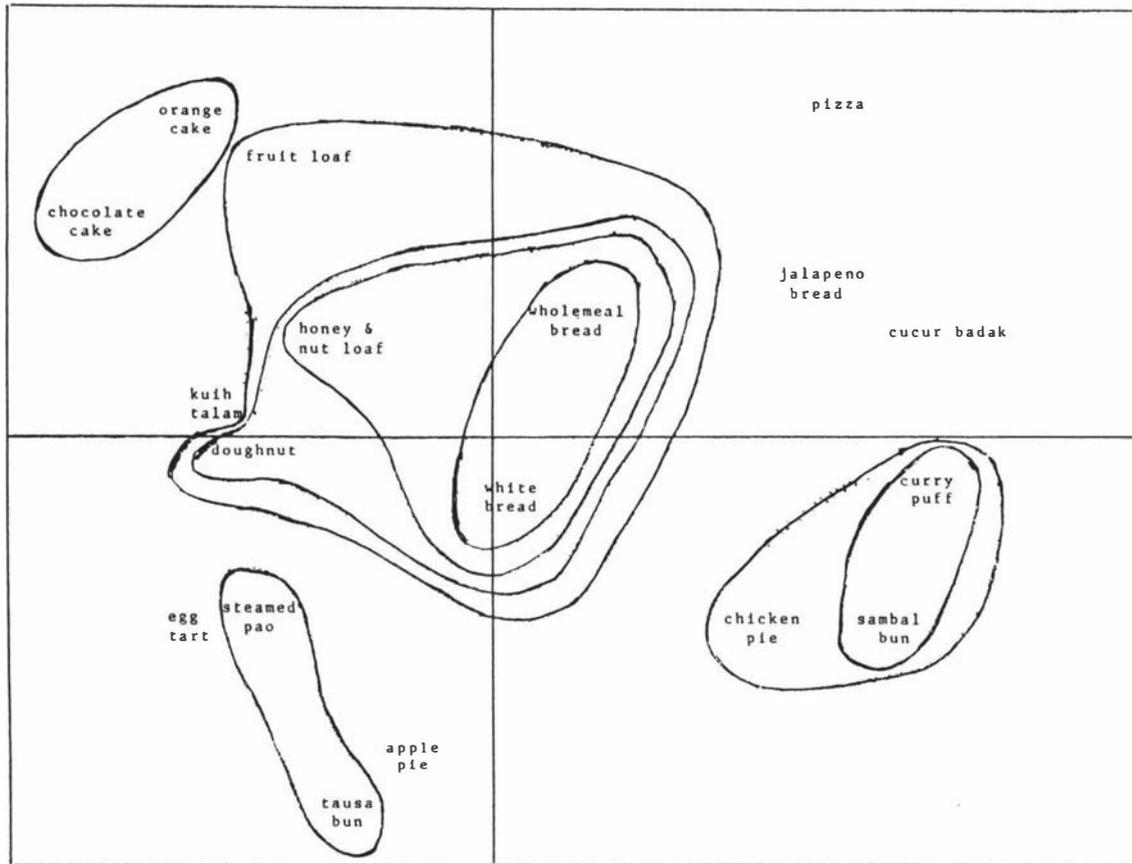


Figure 4.6: Contour diagram of hierarchical clustering plotted in multidimensional space for Chinese - KYST (dimension 3 vs dimension 1)

There were basically four groups of products which were identical for both the Malays and Chinese. These were the breads (white and wholemeal), cakes (chocolate cake, orange cake and fruit loaf), buns (steamed kaya pao and tausa bun), and savoury products (sambal bun and curry puff). The products were obviously grouped according to the generic type of products with perhaps the exception of the buns, where the steamed bun was associated with a baked bun and the sambal bun with the curry puff. This may be attributed to two factors. Firstly, both kaya (coconut jam) and tausa (red bean paste) are commonly used as filling for Chinese steamed buns as well as baked buns, and secondly, both the kaya and tausa are sweet fillings rather than savoury as in the sambal bun.

There were slight differences in the manner in which certain products were grouped. While the Malays placed doughnut with the breads, the Chinese grouped it with the buns. The Malays also placed honey and nut loaf, and fruit loaf in the bread category while the Chinese did not. It is possible that the Malays had identified fruit loaf as a bread with fruit instead of a fruit cake. An important difference in perception was revealed in the way chicken pie was clustered. While the Malays associated chicken pie with the local savoury products, sambal bun and curry puff, the Chinese clustered it with pizza.

4.5.3.3 Internal subjective interpretation

In the first dimension, the products were obviously scaled according to taste, from sweet to bland to savoury products.

The second dimension was not as straightforward. On one half of the dimension were bread-related products, starting with white and wholemeal bread, then honey and nut loaf, and then the buns. The other half of the scale consisted of products which were "non-bread". Texture (varying from products with a homogenous texture, to products with filling) was ruled out as a characteristic of the second dimension as cakes were located away from bread and together with products such as pies.

The third dimension proved difficult to interpret, and showed some variance between programmes and ethnic groups. Generally, however, the products were grouped into local and foreign products, with the buns, curry puff, and kuih talam on one half of the scale, and cakes, pizza, honey and nut loaf, and jalapeno bread at the other end. Surprisingly, in the Malay configuration, chicken pie and apple pie appeared at the local product end of the scale.

The dimensions that were finally decided on were:

- dimension 1 - taste (varying from sweet to savoury),
- dimension 2 - bread vs non-bread products and
- dimension 3 - foreign vs local products.

4.5.4 Comparison of configurations using Procrustes analysis

The Procrustes programme available in Genstat was used to compare the three dimensional configurations of the different ethnic groups, the number of stimuli and the different programmes. Procrustes analysis is a technique used for assessing the goodness-of-fit between two configurations. Two configurations are matched using the processes of translation, rotation/reflection and scale change. The resulting difference between the two configurations known as the Procrustes statistic is the residual sum of squares. Thus, a large residual sum denotes lack of fit (Sibson, 1978). The results of the analyses are presented diagrammatically in Figure 4.7.

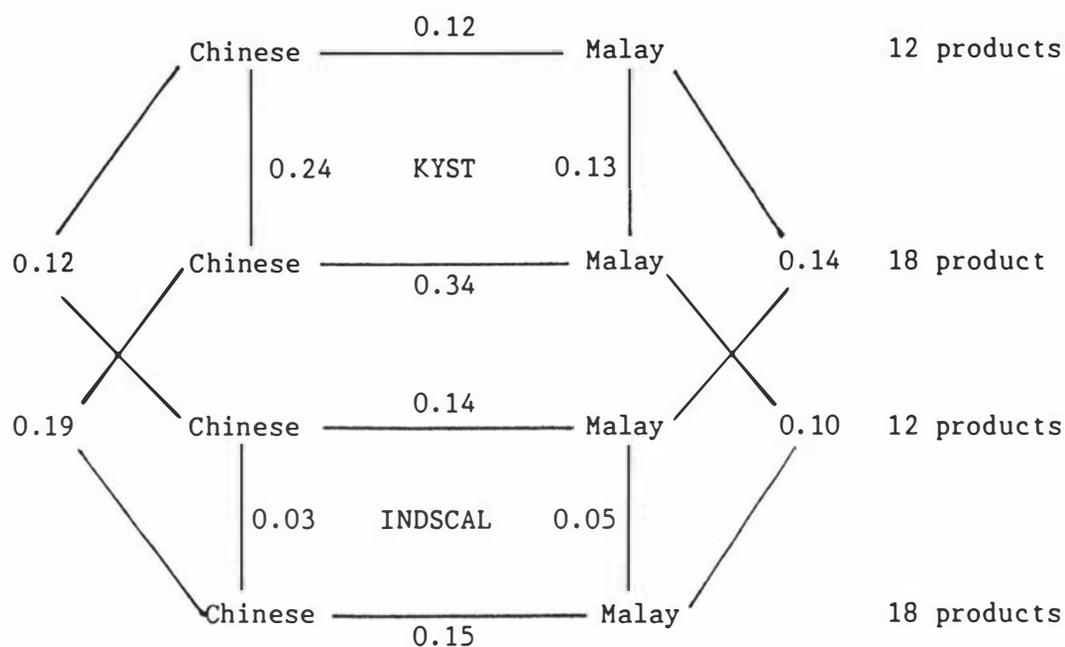


Figure 4.7: Procrustes statistics

From the results, several important points were noted:

- * differences between ethnic groups were greater than differences between programmes, which were in turn greater than differences between the different number of stimuli.
- * in all instances except one, the addition of the six products decreased the similarity between configurations, across ethnic groups and programmes. For the Malays, differences between the KYST and INDSCAL configurations decreased instead of increased, with an increased number of stimuli.
- * INDSCAL was less affected than KYST by the addition of six products. Using INDSCAL decreased the differences between the 12 and 18 product space, when compared to the KYST solutions. INDSCAL also decreased the differences between ethnic groups, both for the 12 and 18 product space. Thus, INDSCAL was able to reduce the difference due to the differing number of stimuli (12 and 18 product space) and the different ethnic groups.

4.6 RESULTS

4.6.1 Comparison between ethnic groups

It was obvious that the three dimensional configurations obtained from the Malays and Chinese were very similar. The combined space of both Malays and Chinese was meaningful as it resembled the original Malay and Chinese spaces (see Figures 4.8-4.13). The INDSCAL solutions are given in Appendices 4.3-4.8.

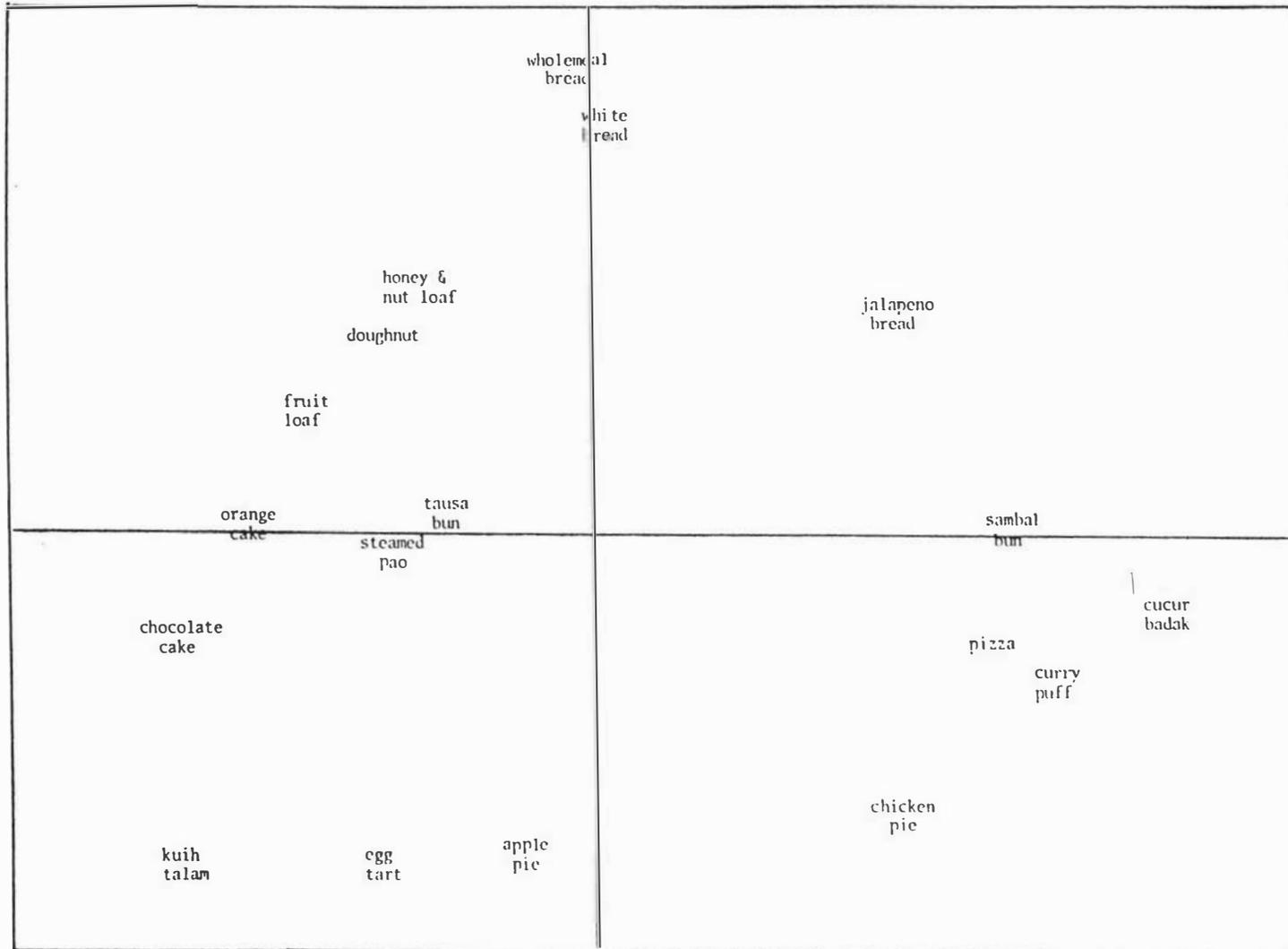


Figure 4.8: Plot of multidimensional space for all subjects - KYST (dimension 5 vs dimension 1)

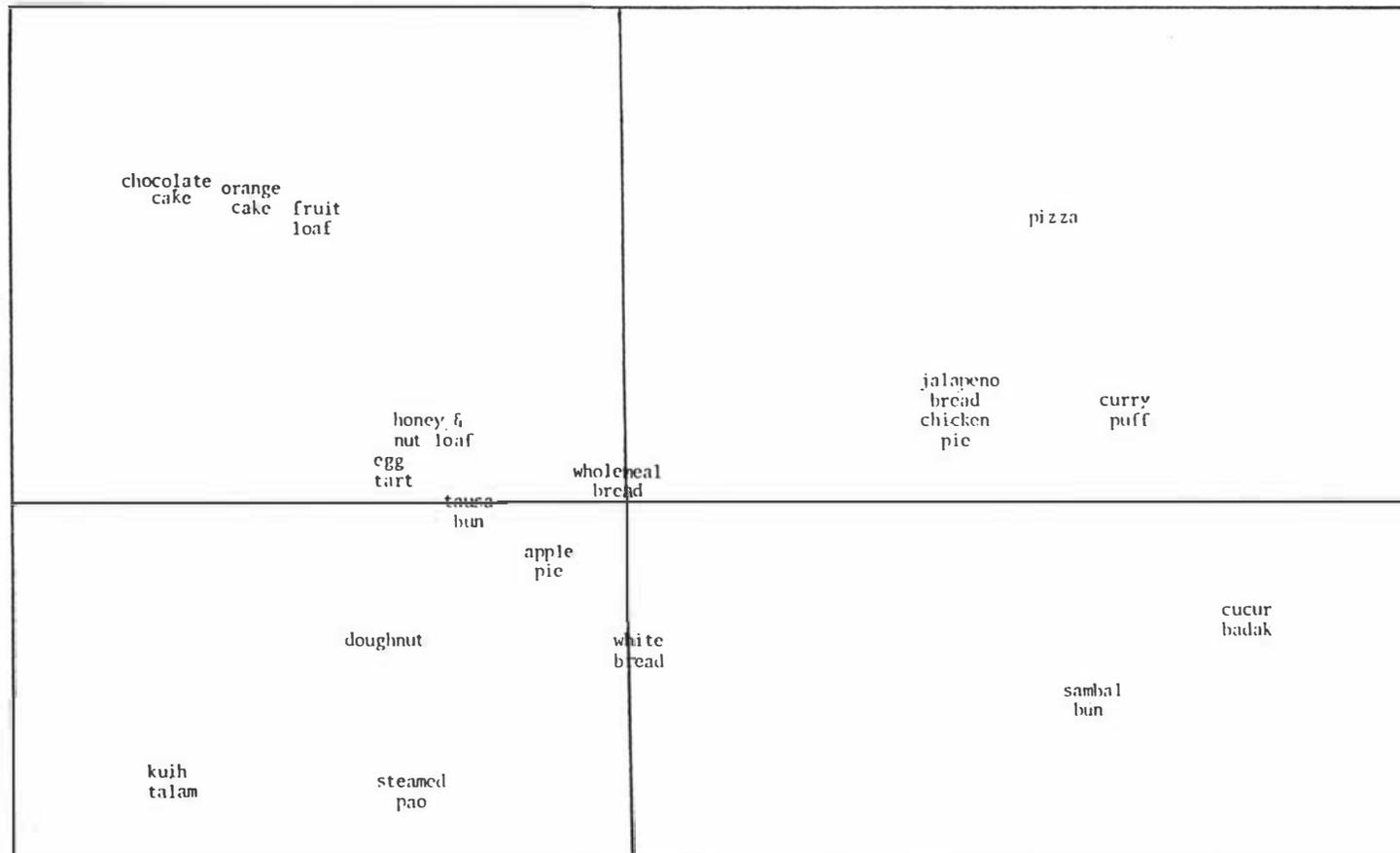


Figure 4.9 Plot of multidimensional space for all subjects - KYST (dimension 3 vs dimension 1)

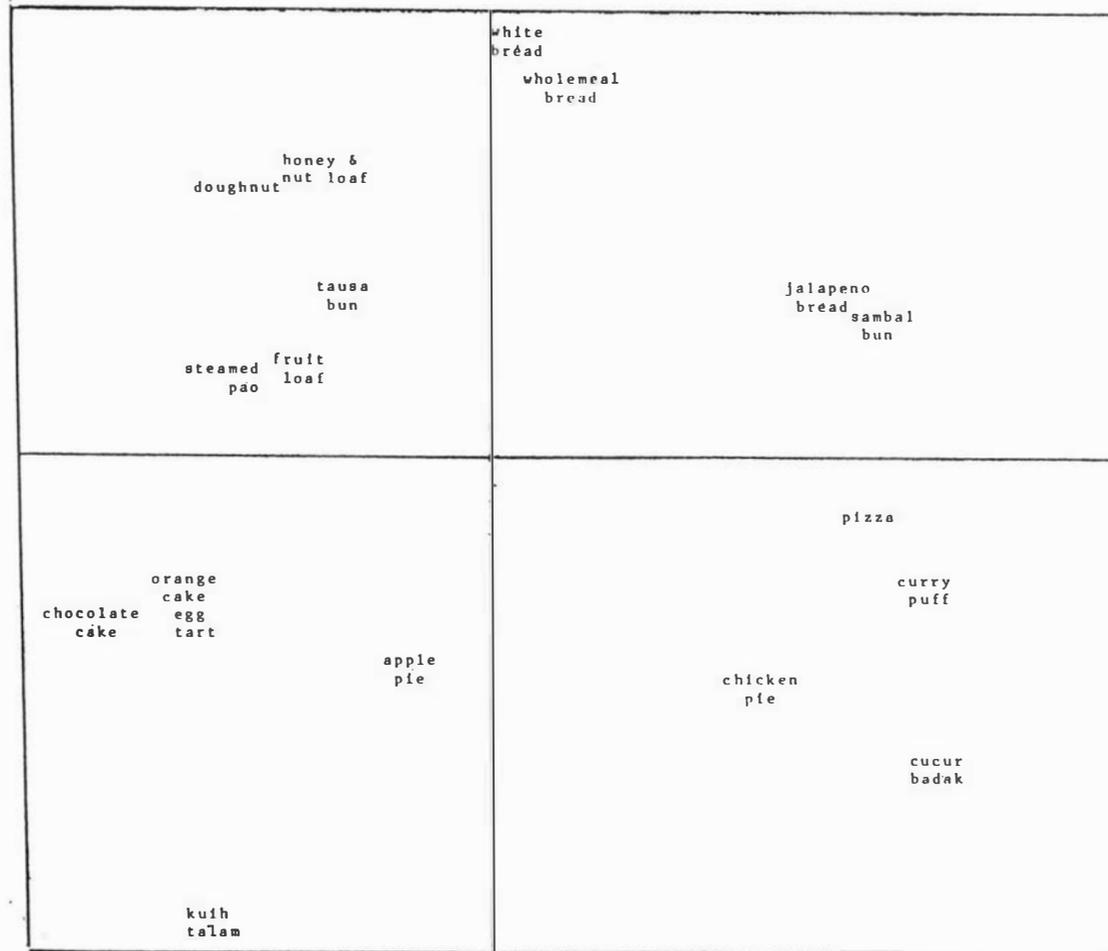


Figure 4.10: Plot of multidimensional space for Malays - KYST
(dimension 2 vs dimension 1)

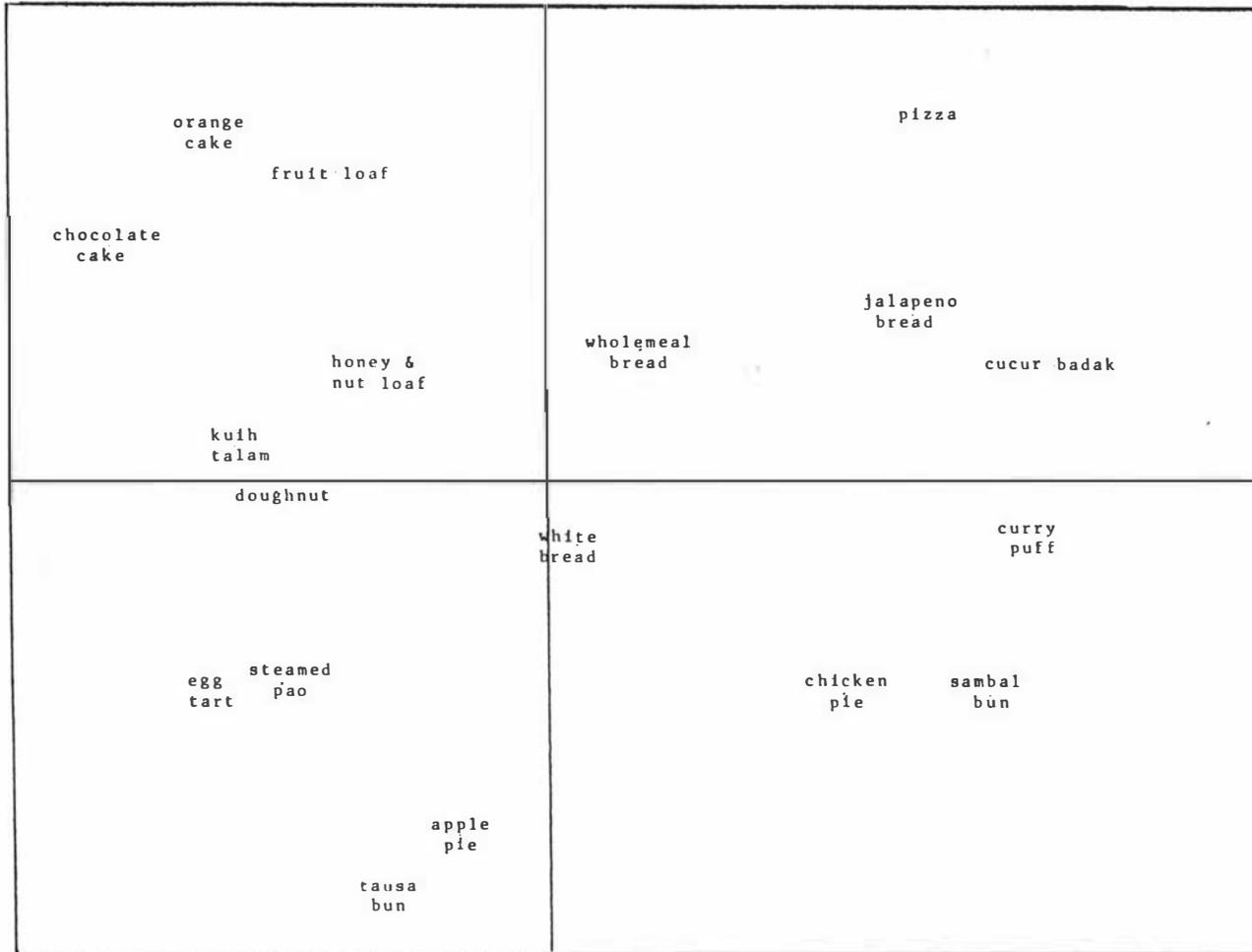


Figure 4.11: Plot of multidimensional space for Malays - KYST
(dimension 3 vs dimension 1)

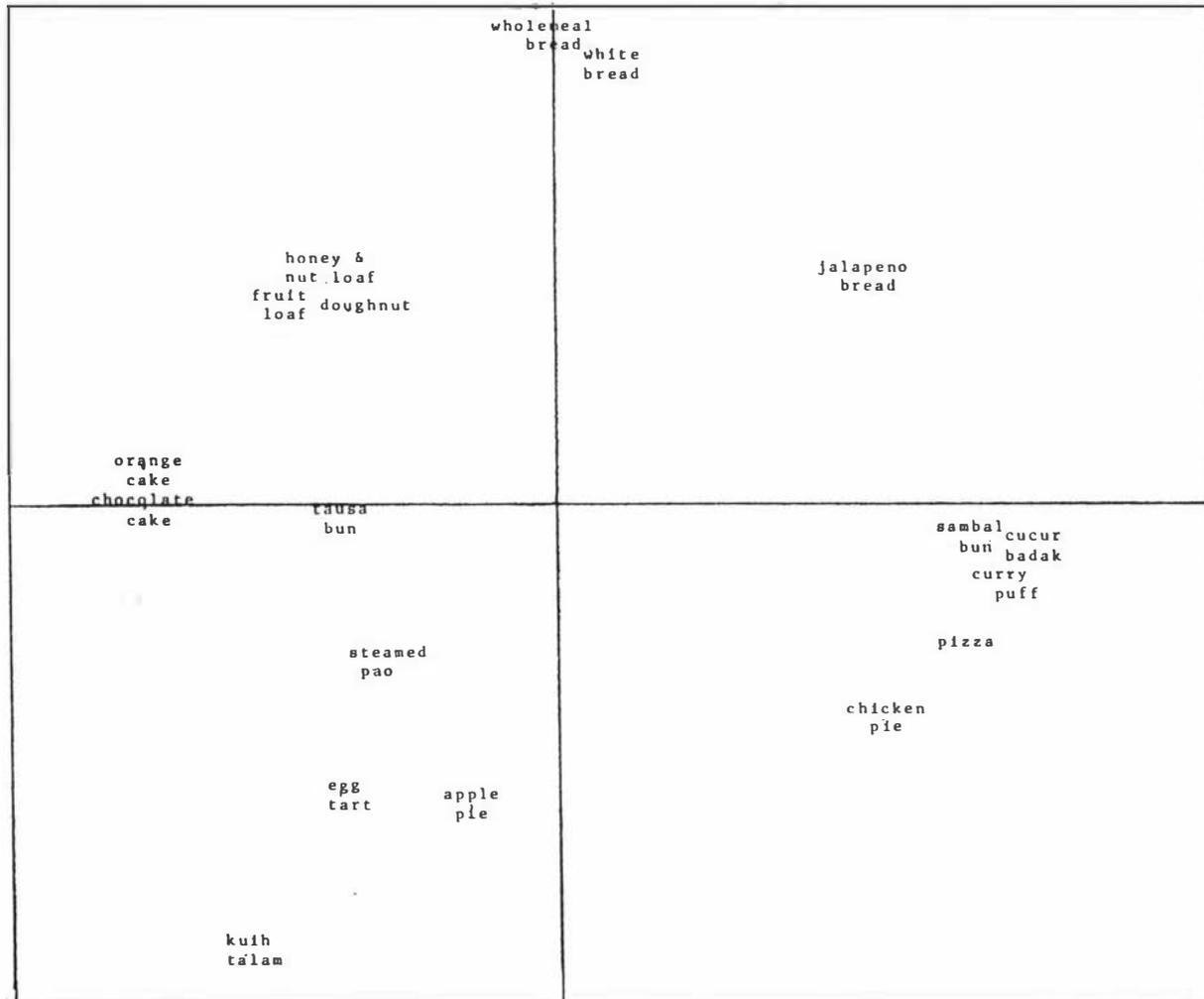


Figure 4.12: Plot of multidimensional space for Chinese - KYST
(dimension 2 vs dimension 1)

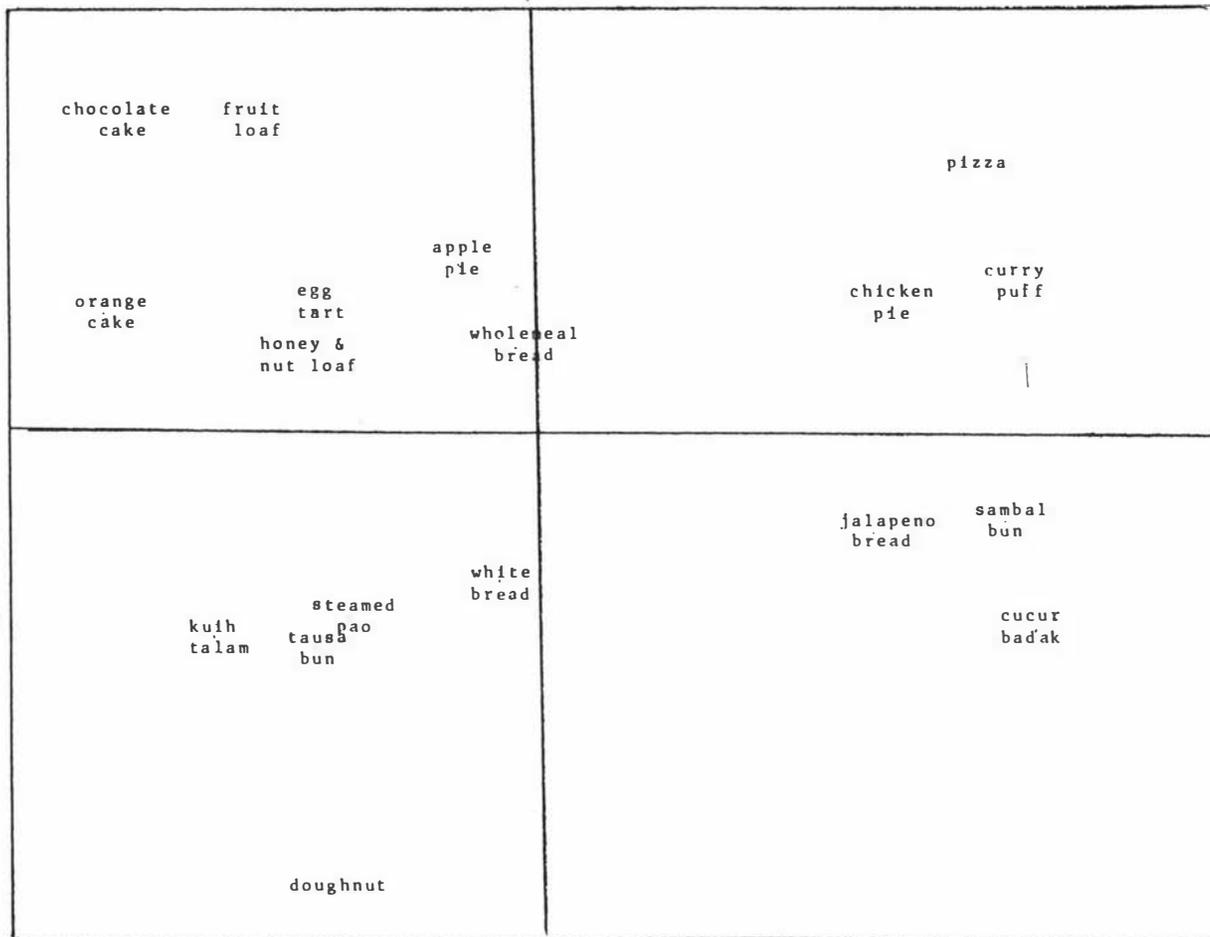


Figure 4.13: Plot of multidimensional space for Chinese - KYST (dimension 3 vs dimension 1)

The dimension weights obtained from INDSCAL were also used as an indicator as to whether the ethnic groups were different in their perception of the products. The mean dimensions weights were computed for both 12 and 18 products, for the Malays, Chinese, and the combined 18 product Malay and Chinese space (see Table 4.2).

Table 4.2: Mean dimension weights from INDSCAL

| | 12 product space | | | 18 product space | | |
|---------------------------------|------------------|------|------|------------------|------|------|
| | Dimension | | | | | |
| | 1 | 2 | 3 | 1 | 2 | 3 |
| Malay | 0.48 | 0.34 | 0.38 | 0.46 | 0.34 | 0.26 |
| Chinese | 0.47 | 0.38 | 0.36 | 0.50 | 0.30 | 0.26 |
| Combined space for all subjects | 0.5 | 0.34 | 0.33 | 0.48 | 0.30 | 0.27 |

As can be seen, the mean weights were very similar, indicating that there were no inter-ethnic differences. This was demonstrated by plotting the INDSCAL dimension weights obtained from the combined space (see Figure 4.14-4.15). It was not possible to differentiate the two ethnic groups on the basis of the way in which they perceived the products. Although the overall mode of perception was not different, there were slight differences in the way in which some products were perceived. In order to compare the specific differences in the product space attributable to ethnic groups, the three dimensional configurations for Malays and Chinese were superimposed on to one another separately for INDSCAL, KYST, and the 12 and 18 product space. To ensure that the differences were indeed due to ethnic groups and not to the programmes or the differing number of stimuli, they were checked with the different configurations to see if they occurred consistently (see Appendix 4.9-4.12). Generally, the configurations in dimensions one and two were very similar between Malays and Chinese, and products were grouped in more or less the same areas. In dimension three, however, significant differences were found between the way Malays and Chinese perceived some products.

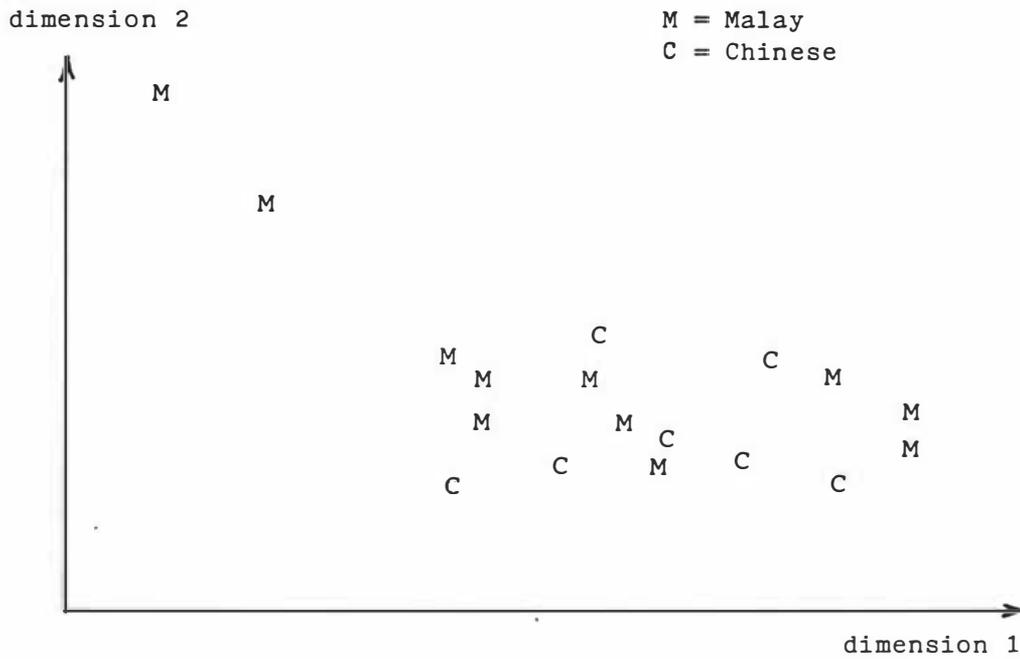


Figure 4.14: Plot of INDSCAL dimension weights for 18 products (dimension 2 vs dimension 1)

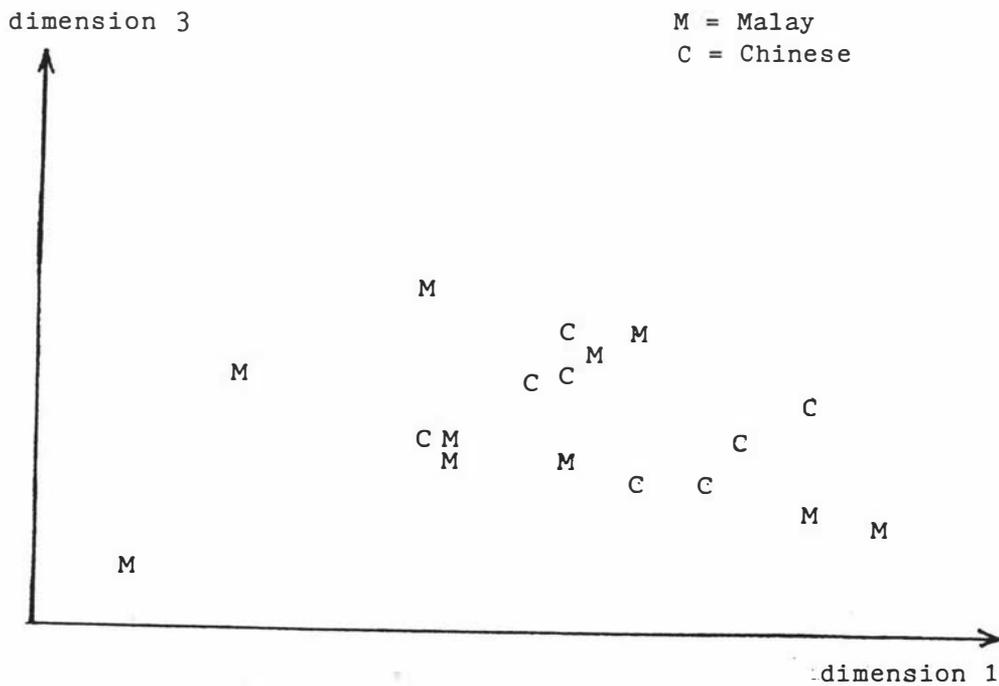


Figure 4.15: Plot of INDSCAL dimension weights for 18 products (dimension 3 vs dimension 1)

With the exception of one product, dimension one was very stable with both ethnic groups. The Chinese scaled "kuih talam" as sweeter than the Malays. In dimension two, several products appeared to be perceived differently by the ethnic groups. These were the "tausa" bun, "sambal" bun, doughnut and fruit loaf. The Malays scaled "tausa" bun, "sambal" bun and doughnut closer to the breads than the Chinese. The latter group perceived "tausa" bun as being similar to steamed bun, and grouped "sambal" bun together with other savoury products. The Chinese did not associate doughnut with anything in particular, indicating that the Malays placed a stronger emphasis on its bread-like attributes than the Chinese. This is consistent with the fact that Malays mentioned they used it as a factor in comparing the products. In the third dimension, wholemeal bread was perceived as more foreign than white bread, particularly by the Malays. The Malays also thought that doughnut was more foreign than the Chinese did. The reverse, however, was true of chocolate cake. Interestingly, the Malays perceived the two pies as local rather than foreign products.

4.6.2 Comparison between KYST and INDSCAL configurations

In the comparison of configurations from the two MDS programmes, KYST and INDSCAL, consideration had to be given to the fact that the configurations could be rotated, translated and rescaled. The orientation of the INDSCAL configurations are unique (in the sense that any change in their orientation destroys the optimality of the INDSCAL solutions). Therefore, the INDSCAL configuration was taken as a reference with which to compare the KYST configurations.

Since the KYST configurations were virtually identical to the INDSCAL configurations in terms of axes orientation and location of the origin, only rescaling was necessary. Rescaling was done so that the extreme points of both configurations more or less matched one another. Four sets of configurations were compared, Malays and Chinese with 18 Products. The configurations were superimposed on one another (see Appendix 4.13-4.16). Procrustes analysis had indicated that the differences between programmes were consistent across the four comparisons and the differences were not major, although no statistical conclusions could be drawn.

Generally, the INDSCAL configurations were quite similar to the KYST configurations, particularly in the first two dimensions. More differences were found in the third dimension. However, there were some products which differed in their relative positions across the two programmes. Although the type of products which were positioned differently across the programmes were not identical in each case, a pattern was evident. In the first dimension, fruit loaf was found to have a fairly large difference in position between programmes. In the second dimension, it was the savoury products, and in the third dimension, it was white bread. It is possible that the subjects' scaling of these products were not consistent and thus produced the variances between programmes. It is possible that the subjects had difficulty in deciding whether white bread was a local or foreign product as it has been in Malaysia for a long time.

4.6.3 Comparison between 12 and 18 product space

The results from Procrustes analysis indicated that differences due to the addition of the six products had minimal effect on the configurations and this was true for Malays and Chinese, KYST and INDSCAL configurations. See Appendix 4.17-4.24. •

Since the rating of the 12 and subsequent six products were done in two separate sessions, it was important to see if the addition of the six products had altered the initial configuration. If not, then it was possible to conclude that the task of similarity judgements could be divided into several sessions. This would enable a larger number of comparisons to be made under similar circumstances.

Dimensions one and two were generally stable and not affected very much by the additional products. In the third dimension, doughnut, wholemeal bread, curry puff, and "cucur badak" were positioned slightly differently. In the 12 product space, doughnut, wholemeal bread, and "cucur badak" appeared closer to the foreign end of the scale than in the 18 product space.

4.6.4 Preference result

The LINMAP and MIXED MODE solutions were almost identical. In the LINMAP solution, some attributes were considered irrelevant as they were estimated to have zero attribute weights. In their study of a university administrator's preference function, Hopkins et al. (1977) encountered a similar situation. They concluded that zero attribute weights could be due to the subject being inconsistent in his judgements involving those variables. This showed up as zero weights or the results were artificially derived by fitting the algorithm. In the present study, it could also be due to the fact that the subjects genuinely liked products from opposing ends of the attribute axis.

According to the Index of Fit, C^* , (the ratio of the pairs of stimuli whose preference order is violated to the pairs of stimuli whose preference order is preserved), 0 represents a good fit and 1 represents a poor fit. MIXED MODE had a better solution than LINMAP. 88.9% of the Malays and 76.7% of the Chinese had an Index of fit below 0.30 for MIXED MODE as opposed to 81.5% and 62.1% respectively for LINMAP.

The attribute weights, which can be interpreted as the relative importance of the attributes, did not show a consistent emphasis on any one dimension. No conclusions can be made on the relative importance of each dimension.

4.6.4.1 Preference of consumers in Penang

For dimension 1, most Chinese and Malays preferred a savoury product. The Malays strongly preferred a non-bread product in the second dimension, while nearly 50% of the Chinese showed a preference for bread-type products. There was a strong preference for foreign products, particularly by the Chinese in the third dimension. There was a large proportion of Malays who preferred a product which was slightly foreign, as compared to the Chinese who wanted a very foreign product. The overall preference result from LINMAP, which was the collective preference of all subjects was very similar between the Malays and Chinese. It was a savoury, foreign, non-bread product.

The Index of Fit was very good for both Malays and Chinese. The mean Index of Fit was 0.16 and 0.22 respectively.

4.6.4.2 Preference of pseudo-consumer panelists and consumers in Kuala Lumpur

All four groups of consumers preferred a savoury, non-bread product. There was less consensus in the third dimension; the Chinese women preferred a local product; the Chinese students preferred a foreign product, half the Malay students and Malay women wanted a foreign product, the other half wanted a local product.

The Index of Fit was only marginally worse than that of the consumers in Penang; varying between 0.21-0.31. The panelists in New Zealand generally followed the same trend as all the other consumers with respect to the first and third dimensions, with a preference for a savoury, foreign product. However, there was no agreement in the second dimension where there was an almost equal number of panelists preferring a bread compared to a non-bread product. The Index of Fit was 0.34, higher than all the consumers. This could indicate that the multidimensional space was slightly less relevant to them than to the consumers who generated the data.

4.7 CONCLUSIONS

The results of this study indicated that Malaysian consumers could scale products in terms of similarity, although the concept of scaling was initially foreign to them. Careful explanation of the task, with the use of examples and individual attention, was required. Consumers could scale novel products and product concepts. Again, careful presentation of the concepts with samples was helpful. However, some of the variation between the ethnic groups could have been due to the unfamiliarity or newness of the products. If consumers' perceptions of the product were not well developed, this could result in instability in the multidimensional space. Thus, in positioning "new" products, use of more than one multidimensional programme may be helpful in detecting differences in consumer perception of products. Where the task of similarity judgements was too large for one session, it was possible to divide the task into two sessions. It is probable that more sessions could be used if required. This overcame the need to collect incomplete data sets from individuals and the use of balanced incomplete designs. However, to confirm this, similarity data should be compared across sessions.

Between the KYST and INDSCAL programmes, the latter was found to be more useful for several reasons. Firstly, INDSCAL was less affected by the addition of more products. Secondly, the orientation of the INDSCAL configuration is unique and thus further processing of the configuration is not necessary before interpretation. Thirdly, INDSCAL had the added advantage of dimension weights which could be used to compare the ethnic groups. In this study, PREFMAP was not a useful method of analysing preference data as it produced negative attribute weights. LINMAP was found to be less useful than the MIXED MODE version of LINMAP as the preference results from LINMAP were at the boundaries of the space. Preference was found to be reasonably consistent across the various groups of consumers and also across ethnic groups.

Generally, the MDS results were useful in comparing the perceptions and preferences of the two ethnic groups. INDSCAL was more useful for the cross-cultural comparison than KYST. Although, in this case, there was only slight differences between the Malays and Chinese in the

multidimensional space, the similarity of the INDSCAL dimension weights confirmed the findings.

Where general perceptual data is required, MDS is a useful and rapid technique as it does not require prior background knowledge. Data collection does not pose a big problem. It was found that with 12 products, a stable three dimensional solution could be obtained, particularly with INDSCAL. Collecting the data can be organised by recruiting consumers from the population of interest; and depending on the number of products for scaling, a 2-4 hour session is sufficient. The scaling can either be done in one sitting (where the task could be divided up with breaks in-between) or conducted in several separate sessions. The analysis can also be carried out fairly rapidly depending on the form of the data collected. It was found useful to ask the consumers the criteria they used to judge the similarities. The criteria named assisted in the interpretation of the axes and also provide an indication of the factors the consumers thought were useful in comparing the products concerned.

Interpretation of the dimensions in this study was subjective, with the help of hierarchical clustering and the consumers who scaled the products. It was quite apparent how the products varied along the dimensions; labelling the dimensions, however, was rather more difficult, particularly for the second dimension. It is suggested that consumers be used to help identify the dimensions, although that may not always be fruitful.

A general area of preference which was reasonably consistent across consumer groups was obtained. However, it was more difficult to obtain specific information on the types of products/concepts suitable for development and the relative merits of product ideas. The MIXED MODE version of LINMAP was found to be the most useful programme for preference data, as it could provide either ideal points or vectors, depending on the data.

MDS is a useful tool in the early stages of product development where little is known of the consumers. It is also particularly useful for comparing different groups of people, whether it is ethnic groups, age groups, or income group. Once completed, the multidimensional scaling space is useful for all subsequent studies in the relevant area as it provides a background on which further work can be based. MDS is especially relevant for product developers designing export products for a market where they have little experience. Firstly, little prior marketing information is required and secondly, cultural differences, especially in language, are unlikely to affect the technique (compared to focus groups and consumer surveys).

In conclusion, the MDS was successful in identifying perceptions of Malays and Chinese towards bakery products and in locating a general region of preference for savoury, foreign and non-bread products.

CHAPTER 5

USE OF CONSUMERS IN IDEA GENERATION AND SCREENING

5.1 INTRODUCTION

The previous chapter outlined some of the criteria by which consumers judge bakery snacks. The next stage in the product development process was to generate and screen product ideas to select one product concept for further development.

Good product ideas are essential for product development because without innovative product ideas, there can be no successful products. Booz et al. (1984) noted that one of the three most important process steps in developing successful new products was idea or concept generation. In market research, there are established techniques for obtaining information from consumers. This is not true for idea generation or screening. As yet, there is no systematic way of gathering product ideas from consumers, except through customer complaints. Consumers have an idea of the products currently on the market, and may also recognise needs which are not yet fulfilled. They may be able to suggest new product concepts which could fill those needs. This part of the research investigated whether the consumer could produce new product ideas, and the techniques suitable for this purpose. Attempts were made to adapt techniques so that consumer input could be made possible in both idea generation and screening of concepts.

5.2 IDEA GENERATION

5.2.1 Literature review - use of consumers in idea generation

Traditionally, the emphasis has been on sources of new ideas as opposed to the structured or systematic generation of product ideas. Both Buzzell and Nourse (1967) and White (1973) distinguished between internal and external sources of information (see Table 5.1 for a distinction between the two types of sources).

 Table 5.1: Internal and external sources of product ideas

| <u>Internal sources</u> | <u>External sources</u> |
|-----------------------------|--------------------------------------|
| R & D activities | Consumers |
| Company personnel including | Retail trade |
| sales personnel, production | Trade magazines and other literature |
| personnel. | Competitors |
| | Other industries |
| | Consultants |
| | Suppliers |
| | Government agencies |
| | Overseas trends |
| | Patents |

Using these sources resulted in a more or less random idea generation process. As product development became more systematic and organised, the necessity for an active search for new product ideas led to the development of techniques to aid this. Twiss (1980) classified techniques for creative problem solving into analytical and non-analytical techniques. Analytical techniques were those that applied logical thought processes exercised within a formal structuring of information. Non-analytical techniques were those that stimulated imaginative thinking along unorthodox paths, deliberately aiming to free the mind from the constraints imposed by logical analytical thought processes (see Table 5.2).

 Table 5.2: Techniques for product idea generation

| <u>Technique</u> | <u>Brief description of technique</u> |
|--|--|
| ANALYTICAL TECHNIQUES | |
| Morphological analysis (Zwicky, 1948; Bridgewater, 1969; Twiss, 1980) | This is a systematic method of combining all possible product characteristics. The advantages are that the technique is simple to use and generates a wide range of possibilities. |
| Attribute listing (Carson, 1979; Twiss, 1980) | An existing product is analysed in detail relating each part to the purpose it serves. The individual part can then be examined to determine whether it can be improved or used in different combinations to create a new product.# |
| HIT: Heuristic Ideation Technique (Tauber, 1972) | This technique is a variation of morphological analysis, but recognises that a solution can contain zero or more than one value from each product characteristic. |
| Technological forecasting | Technological forecasting is used to forecast users' needs at some future period. |
| * Technology monitoring | Technology monitoring provides a systematic basis for the collection and recording of information which is in effect a wide ranging surveillance system of relevant sources. Its primary purpose is to direct attention to areas where a new development combined with existing knowledge makes possible an innovation.# |
| * Delphi method | The Delphi method involves using a panel of experts in various fields to predict what may happen to specific technologies and economic and sociological factors. The answers are put together to provide a pattern of possible future for the area of inquiry. |
| Gap analysis | Formal procedures can be used for finding market gaps. |
| * Spectrum analysis | Spectrum analysis examines all the important factors in the market and ranges the existing products according to these factors. When all the relevant factors are examined, the gaps can be put together almost as if on an overlay and gap combinations can lead to interesting concepts.# |
| * Multidimensional scaling | Multidimensional scaling gives a spatial representation of existing products, enabling gaps in the market to be visualised. |
| NON-ANALYTICAL TECHNIQUES | |
| Brainstorming (Osborn, 1953) | Brainstorming is a completely unstructured approach where a group of people gather together to generate ideas spontaneously. No evaluation is permitted during the brainstorming session.# |

| | |
|--|---|
| Synectics (Gordon, 1976) | Synectics is a word coined by Gordon to describe the structured group technique he devised for achieving a creative problem-solving climate. It aims to achieve freedom from constraints imposed by the problem as stated, elimination of negative responses, deferred judgement, and escape from the boundaries imposed by orthodox thought patterns.# |
| Lateral thinking (de Bono, 1981) | Both lateral thinking and synectics recognise the same underlying principles of creativity. de Bono has developed a range of techniques to promote lateral thinking in practical problem solving.# |
| Extended creativity group (Reilly, 1971) | Basically, this method uses synectics-trained leaders and consumers as participants. Described as combination of synectics and focus group. |
| Deliberate dreaming (Barrett, 1978) | Deliberate dreaming proponents claim that we can go to sleep with the intention to dream up a solution to a particular problem and actually have the dream happen. |
| Focus groups (Zikmund, 1982) | A focus group discussion is an unstructured, free flowing interview with a small group of people. It is not a rigidly constructed question and answer session, but a flexible format discussion. |
| Nominal group technique (Van de Ven and Delbecq, 1974) | This is a "pseudo-group" technique where the participants start off by listing their ideas on a piece of paper, for about 5-10 minutes. The moderator then collects the ideas in a round robin session after which each idea is discussed in turn. |

These are the descriptions used by Twiss, 1980.

Most of those techniques were not designed for use by consumers. The use of consumers to aid in the design and promotion of products was employed back in the 1950's when marketing specialists sought to discover why people buy a given product using motivation research (Luck et al., 1961). One technique that was commonly used was the depth interview (Luck et al., 1961; Kassarian and Robertson, 1973), also known as the group depth interview (Goldman, 1962) when applied to an interacting group. It was subsequently called the focused interview (Buzzell et al., 1969; Churchill, 1976; Cox et al., 1976) and more recently, the focus group discussion (Aaker and Day, 1980) or focus group (Calder, 1977; Reynolds and Johnson, 1978; McDaniel, 1979; Szybillo and Berger, 1979; Hisrich and Michael, 1982; Seymour, 1983).

Hess (1968) distinguished the focus group interview as a variation of the depth interview, and noted that in the former, a small number of individuals were brought together for an interview rather than being interviewed one at a time (as in a depth interview). This worker listed the respondent interaction advantages of the focus group over the individual depth interview as synergism, snowballing, security, and spontaneity. Wells (1974) suggested that group interviewing has proved so durable because it has some important assets that allow it, to compete effectively with other ways of getting information. He listed the advantages as:

- * group interviews are fast and cheap, a three or four interview study can be conducted, analysed and reported in less than a week. The cost is also much lower than that of most other attitudinal research techniques.
- * the group interview is a superb mechanism for generating hypotheses when little is known.
- * group interviews drastically reduce the distance between the respondent and the client who can participate in most or all the interviews.
- * group interviews are flexible as opposed to survey interviews which work from a rigid question schedule.
- * group interviews are capable of handling contingencies, such as consumer trade offs e.g. "if...and...otherwise".
- * the sixth advantage is identical to the one proposed by Hess (1968), synergism, i.e. respondents tend to stimulate one another.
- * finally, group interviews have an important advantage over the standard questionnaire study in that the findings emerge in a form that most clients fully understand.

Traditionally, new product ideas were obtained through motivational research techniques with interviews conducted by highly trained interviewers and psychologists. This approach was based on the premise that understanding consumer attitudes and behaviour would assist in the design of new product concepts and improvement of existing ones. However, the emphasis has now shifted to a more direct approach of obtaining new product ideas through the focus groups. Many criticisms have been levelled against focus groups, including:

- * results cannot be generalised because samples are invariably small and never selected by probability methods;— questions are not asked the same way each time; responses are not independent; results are difficult to quantify (Wells, 1974).

- * personalities of the researchers and consumers are variables that have an important and unmeasured influence on the opinion expressed by the group member (Rosenberg, 1977).

- * there are often discrepancies between what the group members say and how they actually behave in the market place, i.e. a lack of validity (Rosenberg, 1977).

These criticisms were addressed by Calder (1977) and Reynolds and Johnson (1978). Calder categorised the nature of qualitative research into exploratory, phenomenological, and clinical research depending on the type of knowledge desired. Focus groups used for the purpose of idea generation fell within the exploratory research category (Aaker and Day, 1980), that is the knowledge sought was everyday knowledge. In this instance, the inability to generalise results was not critical. Although the personalities of the researchers and consumers may affect the ideas generated from focus groups, this should not affect the usefulness of the ideas obtained. Similarly, a lack of validity would not affect the quality of ideas obtained from focus groups. Indeed, Reynolds and Johnson (1978) found that except in one instance, qualitative and quantitative findings were in accord.

Apart from the use of focus groups in idea generation, a widespread interest in creativity techniques in the late 1960's and early 1970's led to the application of these creativity principles to group research. Both brainstorming and synectics have been applied to groups (particularly groups of consumers). One earlier attempt to apply synectics to consumers was by the Gene Reilly group (Reilly, 1971), who used synectics trained leaders and research specialists to guide consumer discussion. Hussey (1973) developed a method which he believed overcame the deficiencies of brainstorming and focus group by selecting people who had creative and verbal skills. Participants were trained and interfaced with the actual users of the information via a moderator. It was around this time that Sampson (1970) questioned whether consumers could create new products. He conducted both brainstorming and modified synectics groups, and observed that consumers could express new but not completely novel ideas, and were likely to have more success with simple, non-technical problems.

Holmes and Keegan (1983) stressed the usefulness of creative techniques and proposed the application of creative principles to idea generation by consumers. These principles included problem redefinition, "freewheeling", freedom from criticism, incubation, and encouraging quantity. In particular, Holmes and Keegan (1983) recommended the selection of consumers who had above average creativity.

During the 1970's, there was considerable research into non-interacting groups because of the criticisms of interacting groups such as the negative effects due to the dominance of any group member(s), and the fear of criticism by other group members (Taylor et al., 1968; Gustafson et al., 1973; Van de Ven and Delbecq, 1974; Green, 1975). Those criticisms gave increased attention to the nominal group technique first developed by Delbecq and Van de Ven (1968) from social psychological studies of decision conferences and studies of industrial problems of programme design in the NASA aerospace field. Nominal group technique has found wide acceptance as another creative technique (Summers and White, 1976; Burton et al., 1980; Burton, 1981) and has been applied to consumer research (Claxton et al., 1980).

Idea generation by consumers has not been confined to non-analytical techniques. MDS, which utilises input from relatively small groups of consumers, has also been used as a method of generating product ideas. With MDS, however, the consumers do not interact with one another. Their task is an indirect method of generating ideas as opposed to brainstorming, synectics, and focus groups.

As far as commercial application is concerned, according to surveys carried out by Verhage et al. (1981) on Dutch companies and Geschka (1978) on European companies, only brainstorming was found to be applied as an idea generation technique, with a very low reported usage of any other techniques and there was no mention of the use of consumers in idea generation.

Although techniques are available for idea generation, there is very little research on the comparative suitability and effectiveness of these for idea generation using consumers. Fern (1982) was an exception who investigated the use of focus groups for idea generation. This worker studied the effect of group size, acquaintanceship, and moderator on response quantity and quality. Individual interviews were found to generate more ideas than focus groups. Eight member groups generated significantly more ideas than four member groups and there were no differences between focus groups and unmoderated discussions groups. The effect of acquaintanceship was not clearly determined.

5.2.2 Experimental method

Two techniques were selected for the purpose of this study: brainstorming and nominal group technique. Consideration was given to the fact that the consumers were unskilled and therefore unsuitable for techniques such as synectics. It was not possible to select consumers on the basis of creativity (as suggested by Holmes and Keegan, 1983) because consumers had been recruited earlier for MDS. Selecting brainstorming and the nominal group technique meant that two types of group dynamics, (interacting versus non-interacting), could be investigated. Brainstorming was selected instead of focus groups as it is based on creative principles of which the idea generation process is part and it is the most common method of idea generation in industry.

5.2.2.1 Organisation of the idea generation groups

The participants who did the similarity comparison for MDS also participated in the idea generation sessions. There were three groups of Malays and Chinese, making six groups in total. The six sessions were divided into three brainstorming sessions and three nominal group technique sessions, as shown in Table 5.3. There were four to six participants in each session. The Malays and Chinese were in separate sessions. All the sessions were conducted by the author.

Table 5.3: Number of brainstorming and nominal group technique sessions for each ethnic group

| | Malays | Chinese |
|-------------------------|--------|---------|
| Brainstorming | 2 | 1 |
| Nominal group technique | 1 | 2 |

5.2.2.2 Brainstorming

A brief introduction to brainstorming was given at the start of the session and the rules explained to them. The subjects were given the problem to work on, i.e. "what new bakery snacks can you think of?". The session was allowed to develop as spontaneously as possible with minimal interruption from the moderator. Each participant was encouraged to contribute their ideas through eye contact and direct questioning where necessary. To avoid domination of the session by some participants, eye contact was avoided whenever necessary and interruptions made by presenting a new question to the group. When the participants ran out of ideas, suggestions of products, product categories and product modifications were made to further stimulate them and prevent the session from ending before they were exhausted of ideas. Each session lasted from 30-45 minutes.

5.2.2.3 Nominal group technique

At the session each participant was supplied with pen and a paper with the question "what new bakery snacks can you think of?" written on it. Participants were given 5-10 minutes to write down their ideas. Individual effort was encouraged although questions pertaining to the problem were allowed. When everyone had exhausted their ideas, there was a round-robin collection of ideas. The moderator asked each participant in turn for one idea and continued round the group until all the ideas were exhausted.

When all the ideas had been collected, each idea was discussed in turn, to clarify and expand it and to stimulate further ideas.

5.2.3 Discussion of results

The total number of different product ideas obtained from each idea generation session was recorded in Table 5.4. To compare the two techniques, an Index of Quality was devised since the total number of ideas may not reflect the usefulness of the ideas obtained. As the purpose of the session was to produce new ideas, this formed the basis of the Index of Quality. Each idea which was unique to the Malaysian situation was given one point, and ideas which were completely new were given two points. The sum of these points formed the Index of Quality. The results of the calculation are shown in Table 5.4.

 Table 5.4: Results of idea generation sessions

| Technique | Number | Index | Index/Number |
|-------------------------|------------|------------|------------------|
| Brainstorming | 45, 13, 28 | 61, 6, 32 | 1.36, 0.46, 1.14 |
| Nominal group technique | 26, 26, 24 | 21, 27, 23 | 0.81, 1.00, 0.96 |

With the exception of one brainstorming session, many novel ideas were obtained from the consumers. From Table 5.4, it is clear that nominal group technique produced highly consistent results, both in terms of quality and quantity. On the other hand, the brainstorming results were erratic, in both number and the Index of Quality. The major

reason for the low idea output in one of the brainstorming sessions was that participants had lost interest and had difficulty in agreeing to a time for meetings. This was especially difficult as the session fell on the Muslim month of Ramadan when the Malays were fasting.

The results in the above table reflect succinctly the advantages and disadvantages of both methods of idea generation. The nominal group technique is a reliable and consistent method for obtaining product ideas. It is less dependent on the enthusiasm and predisposition of the participants and on the atmosphere of the session than brainstorming. With brainstorming, the outcome is highly dependent on these above mentioned factors. Brainstorming requires more selective screening of participants to ensure that they are keen, and more skill on the part of the moderator to create and maintain a relaxed atmosphere.

Ideas were not generated at an even rate during brainstorming, resulting in too many ideas at some stages and "lapses" in others when the respondents had temporarily run out of ideas. These lapses could result in a premature end to the session and success is dependent on the moderator's experience to encourage participants to come up with more ideas either through contributing product ideas or product categories relevant to the study. The moderator must be prepared to participate when the session reaches a "low". The times in which the lapses occurred depended on the dynamics of the group.

Under the experimental conditions, brainstorming was considered a more productive technique for generating ideas than the nominal group technique. Brainstorming was also capable of producing more creative ideas, but nominal group technique was more consistent. The nominal group technique was a useful technique for participants who did not verbalise well as they were only required to read from the lists they had prepared. There was less pressure to perform as each person was given a turn and this reduced competition between participants. One drawback of this method was the limited time which each participant had to think by herself. This could be easily rectified by lengthening the time at the start of the session for the participant to think of ideas alone. Some participants felt that the task of idea generation was over once they had written down a list of ideas and did not attempt to

think any more. This defeated the purpose of the round-robin recording which is meant to stimulate "hitchhiking" and further ideas.

Most of the groups were fairly homogeneous, in that they interacted socially or through a common activity. However, in one group where one of the participants was an odd member, this affected her performance in the brainstorming session. Although research has found heterogeneous groups to be more effective than homogeneous groups, the heterogeneous group under investigation consisted of individuals who were different from one another and did not include just one odd individual. Another aspect of brainstorming, combination and improvement worked particularly well in the sessions. Participants were encouraged to improve or combine existing ideas or products to form new ideas and many new ideas were formed using that method.

5.3 SCREENING

5.3.1 Use of consumers in the screening process

Apart from Cooper (1985) who listed market research as one of the approaches to initial screening, there is very little reference to the use of consumers in the screening process. Cooper (1985) recommended a variety of market research techniques, ranging from consumer panels and focus groups to perceptual and preference mapping for screening of product ideas.

In their review of multivariate approaches for product concept evaluation and generation, Shocker and Srinivasan (1979) proposed that each concept could be evaluated in terms of the share of preference it would receive from consumers. Szybillo et al. (1979) reported that advertising agencies used focus groups for preliminary evaluation of product concepts, advertising copy, and rough advertising.

5.3.2 Experimental method

From the quantitative screening, seven product ideas remained which roughly fell into 3 categories - cakes, buns, pies - and one pizza. Since the types of bakery products purchased from bread and cake shops by the two ethnic groups were found to be different, it was decided to find out which product categories they preferred, and within each product category, the product which was preferred. The product categories were ranked and products selected from each category. There was a need to find out the product category which was most favoured by the ethnic groups and to compare it with earlier findings. Seven Malay women and 13 Chinese women participated in the screening session.

The women were asked to rank the product categories from 1, the most preferred, to 4, the least preferred. They were also required to tick the product ideas they preferred in each product category. The individual ranks were averaged (using means) for the product category. The results are tabulated in Table 5.5.

 Table 5.5: Results of consumer screening of product ideas

Mean Preference Rank For Each Product Category
 (low rank for preferred products)

| | Rank Mean Score | |
|-------|-----------------|---------|
| | Malay | Chinese |
| Cake | 2.1 | 3.0 |
| Buns | 2.6 | 3.2 |
| Pies | 2.9 | 1.3 |
| Pizza | 2.4 | 2.5 |

Number Of Participants Preferring The Product In Each
 Product Category

| Product category | Product idea | Number preferring product | | Total |
|------------------|-------------------------------|---------------------------|---------|-------|
| | | Malay | Chinese | |
| Cake | Carrot cake | 2 | 4 | 6 |
| | Spice cake | 5 | 9 | 14 |
| Buns | Hot cross bun | 2 | 3 | 5 |
| | Cheese bun | 5 | 10 | 15 |
| Pies | Macaroni and meat | 4 | 6 | 10 |
| | Vegetable with mushroom gravy | 3 | 5 | 8 |
| | Vegetarian | - | 2 | 2 |

 Note: The total number of participants were 20, 7 Malays and 13 Chinese.

The Chinese had a strong preference for pies (mean rank of 1.3 which meant that most participants gave it a rank of 1). It was their most preferred product category. The preference of the Malays was less clear cut. All the product categories had very similar mean ranks, indicating no strong preference for any particular product category. However, their preferences within the product categories were similar to those of the Chinese. It appeared that the product category most appropriate for both ethnic groups was a pie product. There was a slight preference for a macaroni and minced meat pie. This preference, together with the high utility of that product (602) from quantitative screening were the reasons why this product was chosen for further development.

5.4 CONCLUSIONS

The success of idea generation with consumers was shown to be dependent on the type of technique used. Although brainstorming and the nominal group technique were useful in generating ideas, both techniques had their advantages and disadvantages. Brainstorming was very dependant on the attitude of the participants, while nominal group technique showed consistent results, even under different conditions. For both techniques, there was a good cross fertilization of ideas but completely novel product ideas were not suggested. The consumers were very good at combining and improving ideas, particularly at combining local products with western products to form new concepts. They were not really capable of providing completely new product ideas outside their own experience. Thus far, completely new products generally come from technological innovations and not from consumers. Since an effective product development programme needs a spectrum of "new" products from very innovative ideas to product modifications, idea generation using consumers could appear to have its place in product development. Idea generation with consumers could be used successfully for the less novel new product ideas, particularly product improvements, line extensions, adaptation of "foods and dishes prepared at home" and continuous innovation in a direction recognised by the consumer.

The screening technique used was successful in highlighting differences between the two ethnic groups. It confirmed the earlier findings from the consumer survey which indicated that Malays and Chinese preferred different types of bakery snacks. However, the results from the survey and the screening process were not directly comparable.

The Malays were not unanimous in their preference for product categories, unlike the Chinese who showed a distinct preference for pies. However, preference of the two groups for the different products within the categories similar. Consensus amongst the Chinese in selecting the product categories was high, the Malays were less unanimous. This can partly be attributed to the small group of consumers (7 Malays) used in the screening, so differences in opinion was exaggerated. A larger group of consumers would probably have provided a better indication of preference. The product categories chosen by the Chinese were consistent with the MDS preference results where the savoury, foreign, non-bread region was preferred. Pies fitted into this region of preference, followed by pizza. The product category least preferred was a filled bun which could be sweet or savoury, but definitely a local bread product. The product categories chosen by the Malays did not fit into the preference data they had earlier generated for MDS. Again, this could be due to the small number of Malays (7) as compared to the Chinese (13). It is thus recommended that screening be carried out with groups of at least 15 consumers.

CHAPTER 6

FORMULATION AND PRODUCT DESIGN

6.1 INTRODUCTION

From the original seven product concepts, a macaroni and minced meat pie was selected for further development. Both the survey and MDS results indicated that the sensory properties were a very important aspect of a bakery snack. Thus, sensory evaluation was an important part of the formulation work as the sensory properties were crucial to product acceptance. As the product was targeted towards two ethnic groups (Malays and Chinese) cultural differences had to be considered. The pie had to be "halal". This meant that the meat had to be slaughtered according to Muslim rites and no tallow could be used in the pastry. Optimisation of the product formulation for both ethnic groups was not possible during the formulation stage. Even representation of the two groups was not available for the work carried out in New Zealand. A pseudo-consumer panel of one Malay and nine Chinese students was used to evaluate the pie. The panel used a profile method of sensory evaluation scoring each attribute on a straight line intensity scale. During the optimisation stage, empirical equations were developed relating acceptability and the profile attributes of the products with the raw material composition.

6.2 USE OF SENSORY EVALUATION IN PRODUCT DEVELOPMENT

Consumer evaluation of the quality of any food product is based mainly on its sensory properties (Cooper, 1981). Thus, the sensory properties of a food are important, if not crucial, to its acceptance.

The vital role which sensory evaluation plays in product development has long been recognised (Dixon, 1970; Ellis, 1970; Blair, 1978; Civille, 1978; Erhardt, 1978; Institute of Food Technologists, 1981; Radtke and Rodriguez, 1981). In fact, Blair (1978) suggested that sensory evaluation represents the first opportunity the product developer has for feedback on his or her product. Sensory evaluation

has several functions in the product development process. These include:

- * identification of product attributes which are important and their influence on overall acceptability and/or purchase intent (Blair, 1978; Moskowitz, 1984).
- * optimising a product formulation in combination with systematic experimental design (Blair, 1978; Moskowitz and Rabino, 1983).
- * matching the product concept to a standard/differentiating the product prototype from a competitive product/ comparing a laboratory product prototype with a factory trial (Blair, 1978; Pangborn, 1980; Institute of Food Technologists, 1981).
- * developing a database of sensory evaluation data. Blair (1978) identified two uses for such a database - better evaluation of current product data by comparison with normative data, and better predictive capability in consumer testing with the passage of time and experience. Pearce (1980) emphasised the importance of developing and maintaining a database of competitive products as well, since this may indicate trends in the market place. He also noted that product acceptance could change with time, and the historical data from the database would aid in the evaluation of product performance.
- * evaluation of storage trial data. The estimation of product shelf life is the responsibility of a product development scientist and is an important part of product development (Labuza, 1979; Labuza and Schmidl, 1985).

The sensory evaluation methods for each of the above functions vary according to the task. In 1981, the Institute of Food Technologists classified the types of sensory evaluation methods for different applications, including new product development (see Table 6.1).

 Table 6.1: Recommended sensory test methods for specific types of applications

| Type of application | Appropriate test methods (refer to key below) |
|---|--|
| New product development | 1,2,3,4,5,8,9,10,11,12,13 |
| Product matching | 1,2,3,5,8,9,10,11,12,13 |
| Product improvement | 1,2,3,5,8,9,10,11,12,13 |
| Process change | 1,2,3,5,8,9,10,11,12,13 |
| Cost reduction and/or selection of a new source of supply | 1,2,3,5,8,9,10,11,12,13 |
| Quality control | 1,2,3,5,8,9,10,11 |
| Storage stability | 1,2,3,4,5,8,9,10,11,12,13 |
| Product grading or rating | 8 |
| Consumer acceptance and/or opinions | 12,13 |
| Consumer preference | 1,4,12 |
| Panelist selection and training | 1,2,3,4,5,6,7,8 |
| Correlation of sensory with chemical and physical measurements | 5,8,9,10,11 |

KEY

- 1 = Paired comparison (or paired preference)
- 2 = Duo-trio
- 3 = Triangle
- 4 = Ranking
- 5 = Rating difference/scalar difference from control
- 6 = Threshold
- 7 = Dilution
- 8 = Attribute rating (category scaling; and ratio scaling or
magnitude estimation)
- 9 = Flavour profile analysis
- 10 = Texture profile analysis
- 11 = Quantitative descriptive analysis
- 12 = Hedonic (verbal or facial) scale rating
- 13 = Food action scale rating

Source: Institute of Food Technologists, 1981

The sensory tests were divided into two major classifications - analytical and affective tests. Analytical tests are used for laboratory evaluation of products in terms of differences or similarities and for identification and quantification of sensory characteristics. There are two major types of analytical tests - discriminative and descriptive. Both employ experienced and/or trained panelists. Affective tests are used to evaluate preference and/or acceptance of products. Generally, a large number of untrained panelists selected to represent target populations are used.

In product development, it is the consumer panelists who are important in determining acceptability, and where trained panelists are used, their data should be linked to consumer data.

6.2.1 Use of panels in sensory evaluation

Traditionally, there have been two approaches to sensory evaluation. One approach is based on experts who tend to work with descriptive analysis. The other approach is based on market research practitioners who work with consumers. The latter relies on broadly based panels of inexpert consumers for evaluating the acceptance of foods and for diagnosing possible product improvement (Moskowitz, 1985).

Expert or laboratory panels are carefully selected, highly trained and hypercritical when compared to the average consumer (Amerine et al., 1965). These panels normally consist of 5-10 people while consumer panels are chosen to represent the potential market for the product (Anderson, 1981). A consumer panel will normally consist of 100-200 people with no special training or knowledge of the product being tested. Sensory evaluation with expert/laboratory panels is carried out in a controlled environment (Moskowitz and Chandler, 1979). Consumer tests can be carried out as central location tests, market place tests, and the home use tests (Gatchalian, 1981). Only central location tests are conducted under controlled conditions. Market place and home use tests are conducted under uncontrolled conditions. Expert or laboratory panelists generally use an analytical approach for sensory evaluation whereas affective tests are used by consumer panels to evaluate preferences and/or acceptance of products (Institute of Food Technologists, 1981).

Although the difference in hedonics between expert and consumer panels have been subjected to some investigation, the link between expert and consumer evaluation of sensory attributes is less well understood (Cardello et al., 1982). Traditionally, analytical techniques have been used by experts although it is not known how representative they are of consumer perceptions.

6.2.2 Bridging the gap between "expert" and consumer panels

The important task in product development is to bridge the findings of analytical laboratory panels and consumer panels. There have been many approaches to this problem but three main methods have developed. One is the use of laboratory panels representing consumers and the second is the use of analytical techniques with consumers (particularly profiling). In the third method, the consumer preference ratings are correlated with expert panel ratings.

In the first method, a compromise between an expert panel and a consumer panel have been used. This was known as a laboratory type panel (Miller et al., 1955), experienced laboratory judges (Dethmers, 1968), employee panel (Hirsh, 1975), and more recently in-house preference panels (Radtke and Rodriguez, 1981). The panels usually consisted of company employees, who have experience in tasting products, but not necessarily the product being tested. The purpose of these panels was to link the preference of the laboratory-type panels with consumer panels to enable prediction of consumer response. In general, consumers agreed with laboratory type panel findings in direction but not in the magnitude of difference. The in-house panels tended to be more critical (Miller et al., 1955; Dethmers, 1968; Radtke and Rodriguez, 1981). Radtke and Rodriguez (1981) recommended that laboratory type panel findings should be confirmed by market research to provide the degree of consumer acceptance.

In the second method to bridge the gap between expert and consumer panels, consumers have used analytical techniques such as descriptive sensory analysis (Tan and Piggott, 1983), flavour profiling (Dobbs, 1983), MDS (Schiffman, 1981; Cardello et al., 1982; Chauhan et al., 1983;), and the texture profile technique (Szczeniak et al., 1975). Dobbs (1983), in his work with non-alcoholic beverages, pointed out that "experts" are sensitive to small changes in product but do not have a clear, unambiguous terminology to communicate those perceptions effectively. Consumers know what they like but often do not have the words to say why. He felt that consumer-oriented flavour profiling could bridge the gap between development chemist and full scale consumer research. The external assessors were independent, and therefore were unbiased.

The use of consumers in quantitative techniques does not differ very much from the use of expert panelists. The consumer becomes "trained" and "experienced", with repeated evaluations (as do the experts). This is not a problem if these panels are created and used for a specific task only. Moskowitz (undated) recognised this problem and proposed the use of "expertised" consumers to guide product development. These panelists represented consumers who used the product, but were trained in the use of terms and scales. Participation was for a relatively extended period of time (1-2 months) and for 8-12 sessions. Apart from profiling existing and competitive products, these panelists could also scale new prototypes.

The use of hedonics and "ideals" was a significant step in the effort to link consumer and expert panelists as those ratings could be directly related to the attribute ratings (Moskowitz, 1981; Moskowitz and Rabino, 1983; Moskowitz, 1984; Moskowitz et al., 1985). Consumers were trained in the task of scaling and using these scales to rate both product attributes, hedonics and "ideals" (Moskowitz et al., 1977; Moskowitz and Rabino, 1983). "Ideals" consist of where the panelist think the product should be in terms of each attribute being rated. Szczesniak et al., 1975, used an "ideal product" in the consumer texture profile and noted that it provided a useful target for product formulation and improvement work. The formulation of a product could be optimised according to "ideal" ratings (Szczesniak et al., 1975; Moskowitz et al., 1977; Williams, 1983; Beausire and Earle, 1986).

Where there are difficulties in getting consumers to define attributes, MDS can be used. With MDS, it is the consumers' rather than the experts' assessment of similarities that is useful in generating a stimulus space relevant to them. Chauhan et al. (1983) found that untrained panelists could provide meaningful MDS results and Cardello et al. (1982) found no differences between trained texture profile panelists and naive consumers in a similarities scaling task.

The last method of bridging the gap between expert panelists and consumers consists of correlating consumer preferences with expert panel ratings. In this method, both types of panels maintain their traditional functions, the only difference is in the methodology

linking the results of the two panels. Kramer (1973) found a multiple correlation coefficient of 0.804 between consumer preference and five expert panel parameters. Sather et al. (1963) indicated that total scores for dry whole milk from trained panels could be used as a basis for a scoring system which would predict consumer preference scores. On the other hand, Sather et al. (1965) concluded that none of the trained panel scores was highly correlated with preference scores for sterile milk concentrates. However, they only used single correlations of attributes with preference scores and multiple regression techniques could have improved the correlation coefficients. Moskowitz (1985) investigated the correlation of expert attribute ratings with consumer acceptance for chocolate and concluded that using one attribute alone does not generate the best predictive system. He obtained an r-square of 0.95 by using both linear and quadratic terms to predict consumer acceptance. Moskowitz (1985) noted that once the link between the experts and the consumers is established, the experts can point the way towards profiles that correlate most highly with consumer acceptance.

For the purpose of product development, consumer panels using attribute profiles with "ideals" showed the greatest promise. With the use of "ideal product profiles", the product developer has a fixed target to achieve. The consumers have input on the sensory properties of the product through the use of ideals and also the rating of attributes. As Moskowitz (1983) pointed out, optimisation of the formulation for two target groups is possible with this method. There are, however, some drawbacks. Recruitment of consumers for such tasks is often difficult and if the development work is carried out over a period of time, arranging sessions for the panelists is also a tedious task. This is less of a problem with in-house "expert" or "laboratory" panelists. In this project, a consumer panel used analytical techniques during the formulation stage.

6.3 USE OF SCALES IN SENSORY EVALUATION

Cooper (1981) reviewed the three major types of scales used in sensory evaluation: category, semi-structured linear and ratio scales.

Category scaling methods have long been used as one of the major methods in the sensory evaluation of food acceptability in the form of the 9-point hedonic scale (Peryam and Pilgrim, 1957; Parizek et al., 1981; Pearce et al., 1986; Umoh and Fields, 1981; Vickers, 1983). Category scales have found widespread usage because of their diversity and ease of use, and because they are conceptually simple for both the experimenter and the panelist (Cooper, 1981).

The semi-structured line scale consists of a line scale of a specific length, with markers half an inch from each end, and a verbal anchor at each end. These scales have become popular in the sensory evaluation of non-food products (Lawless and Malone, 1986). From observation, it appears that line scales are very widely used in the food industry.

Magnitude estimation, originated by Stevens (1960), has been widely used by psychologists and grew in popularity in food research and product development (McDaniel and Sawyer, 1981). However, in the United States of America, its use appears to have decreased. The major advantage of magnitude estimation is that the scale is believed to have ratio properties.

The relative merits of each of the above three scaling techniques for sensory evaluation are presented in Table 6.2. Each of the techniques have advantages and disadvantages but there have been few systematic studies comparing these scaling techniques.

 Table 6.2: Advantages and disadvantages of category, line and
 ratio scales

CATEGORY SCALES

Advantages

- * panelists find the scale simple and easy to use.
- * panelists can use them with a minimum of training.
- * category scale values can be easily used in a host of statistical analyses.

Disadvantages

- * category scales presuppose equal interval properties, but they may not be linear.
- * panelists shy away from using the ends of the scale, and thus bias the ratings.
- * there is a tendency for panelists to assign the stimuli to categories such that all categories are used equally.
- * some panelists prefer to cluster their ratings in the middle of the range, whereas others prefer to use the upper part of the scale, and still others use the lower part.

LINE SCALING

Advantages

- * panelists have greater freedom as they are not restricted in their ratings to specific categories only.
- * panelists find the method conceptually easy to grasp.
- * there is less susceptibility to number preferences which is a problem with magnitude estimation.
- * regarded as an interval scale, thus parametric statistics can be used.

Disadvantages

- * the boundaries of the scale cause "end effects".
- * different panelists may use different portions of the scale.

MAGNITUDE ESTIMATION

Advantages

- * the data produced from magnitude estimation fits well into known statistical models, and statistical analysis can be carried out with much greater confidence than on category scaling data.

Disadvantages

- * it is a difficult task for panelists, requiring memory of the sensory intensity of an attribute in the previous sample.
 - * panelists have a tendency to use a preferred set of numbers.
-

Cooper (1981) noted that few workers had studied the comparative effectiveness of sensory scaling methods. Since then, there have been several studies comparing sensitivity, reliability and ease of use of category scales, line scales and magnitude estimation.

Giovanni and Pangborn (1983) compared graphic scales (line scales) and magnitude estimation for the measurement of taste intensity and degree of liking of beverages. They concluded that both graphic scaling and magnitude estimation were reliable, useful procedures which should be selected and used carefully depending on the objective of a particular experiment.

For sensitivity, Shand et al. (1985) found that category scaling was the most sensitive and line scaling, the least sensitive in detecting differences in meat attributes. Magnitude estimation was as sensitive as category scaling for most treatment differences. This was in contrast with the previous findings by Raffensperger et al., 1956; Baten 1945; Cooper, 1981; McDaniel and Sawyer, 1981; Giovanni and Pangborn, 1983. Raffensperger et al. (1956) scored the tenderness of beef cuts from different grades using a nine point category scale and a modified line scale (nine divisions were marked) and obtained similar results using each method. Baten (1946) reported that the line scaling technique resulted in larger t-values than the category technique. In addition, Giovanni and Pangborn (1983) obtained larger treatment F-values for the line scaling technique than by magnitude estimation. Cooper (1981), too, found line scaling to be more sensitive than magnitude estimation.

McDaniel and Sawyer (1981) compared magnitude estimation with category scaling and concluded that there was little difference in the judges' ability to use either method. There were, however, large differences in other variables. The use of magnitude estimation resulted in far more panelist-sample interaction, while use of the category scale resulted in more panelist and replication variability. In study of New Zealand commercial whole milk powders, Cooper (1981) compared category, line and magnitude estimation scales using a number of criteria. She found that the magnitude estimation scale was the least effective sensory scale. The category scale was easy to use and appeared sensitive to changes in the samples, and very little 'lack-of-fit' occurred. In a study of rating scales for the evaluation of non-food products, Lawless and Malone (1986) found that results indicated that category scaling had a sensitivity advantage over linear scales, and that magnitude estimation was inferior to linear scales. To test reliability, some authors compared the different sensory scales by comparing the values from one scale against another. Cooper (1981) found significant linear relationships between category and linear scales for physical attributes of milk powder, but the scales correlated less closely with magnitude estimation. Linear relationships were not apparent in more complex flavour and aroma attributes.

From the untrained panelists' viewpoint, ease of use is a vital criterion. If a panelist is not comfortable with the task of scaling, sensory performance may be affected (Shand et al., 1985). Both Lawless and Malone (1986) and Cooper (1981) reported that the line scale was the easiest for panelists to comprehend and use, closely followed by category scales, while magnitude estimation was the most difficult for panelists to use. Shand et al. (1985) noted, however, that panelists preferred category scaling over both line scaling and magnitude estimation. Line scaling was rated intermediate in preference.

It appeared that line scales were sensitive, reliable and easy to use. In addition, line scales have been used successfully for product development at Massey University. For these reasons, line scaling was chosen for the product formulation work.

6.4 CROSS-CULTURAL SENSORY PERCEPTION

Few studies have been made on the acceptability and sensory perception of foods by different cultural groups. Moskowitz et al. (1975) reported on a population of Indian labourers who showed high preference for sour and bitter tastes, although the judgements of taste intensity and pleasantness of sweet and salty stimuli were in accord with European population estimates. These workers proposed that dietary history may alter preferences for simple taste stimuli without affecting the gustatory system. In a food system, however, Reber et al. (1983) found that African panelists familiar with the products rated all the food products significantly more acceptable for all characteristics than non-Africans. This indicated that although different cultural groups may perceive the basic tastes in a similar manner, their preference for the tastes in food systems do differ.

6.5 THE EXPERIMENTAL METHOD FOR SENSORY EVALUATION AND PRODUCT FORMULATION

6.5.1 Type of panels

One of the objectives in this project was to investigate the use of small consumer groups in guiding product formulation and generating a sensory profile. Since the formulation and sensory evaluation was carried out in New Zealand, it meant the choice of potential consumers was limited. Malaysian students were available on campus, although there was a major time constraint. The students could not afford to spend long hours on training as well as the subsequent sensory evaluation sessions.

Thus, it was decided to use Malaysian students as panelists, without extensive training. The literature review showed that semi-trained consumers (called pseudo-consumer panels in this thesis) could be used successfully in product formulation and optimisation. In the two reported studies (Moskowitz et al., 1977; Moskowitz and Rabino, 1983), consumers were only used for one session. In this project, panelists were retained throughout the period of formulation (a period of approximately three months).

It was anticipated that tastes change and adapt with a changed environment. Hence, it was decided to select students who had been in New Zealand for the shortest possible length of time. First year students were chosen, since most of them had been here less than 2 years. An additional advantage in selecting first year university students was that they all lived on campus. This meant that they could attend sessions easily, even in the evenings or weekends.

Initially, a sensory panel form was designed for use by students in Malaysia. Attributes that were thought to be important in the product were included. The panel form was given to a group of students in Universiti Sains for evaluating a pie. The purpose of this was to obtain ideals from these students which could be used to guide the pseudo-consumer panelists in New Zealand. The same form was given to students in New Zealand to rate a pie and the "ideals". This was done to check that the students in New Zealand had the same "ideal product

profile" as those in Malaysia, so that the two profiles could be correlated. This approach was not successful because panelists in New Zealand could not relate to the "ideals" which the Malaysian panelists had set up. They also found it difficult to use "moving" ideals and preferred "fixed" ideals. In addition, an identical product to the one profiled in Malaysia could not be made in New Zealand. Thus, it was not possible to match the results of the Malaysian panel with the New Zealand panel. The sensory profile used in Malaysia was drawn up by the author, panelists in New Zealand made several changes to the attributes as well as the format of the panel form. Hence, the final New Zealand profile was not identical to the one used in Malaysia.

To validate the sensory profile obtained from the pseudo consumer panel, consumer groups in Malaysia were used to score the final product. The panel form used by the pseudo-consumer panelists was used for this purpose. The consumer groups in Malaysia consisted of Malay women, Malay university students, Chinese women and Chinese university students.

6.5.2 Recruitment of panelists

To recruit the pseudo-consumer panelists, an information leaflet including a questionnaire was sent out to first year Malaysian students (Malay and Chinese). This explained the project and the task required of taste panelists involved in the project. It was emphasised that involvement over several months would be required, and that motivation and enthusiasm were important. Only students who felt they could make this commitment were asked to reply. Eleven students replied and ten were selected for the taste panel. This number was based on the size of the traditional expert panel, as the function of the panel was to identify and detect differences in samples. There were seven females and three males. Nine of the panelists were Chinese with one Malay. The Malaysian students at Massey University are predominantly Chinese. The majority of panelists were 22 years of age and had been in New Zealand for 1-2 years. The panelists were not screened for their ability to discriminate tastes, as their function was the assessment of the product as consumers and not as "expert" panelists.

The women consumer panelists in Malaysia were recruited by a market research agency. They consisted of Malay and Chinese women between the ages of 25-40 years. The students were recruited from Universiti Malaya in Kuala Lumpur.

6.5.3 Method of sensory analysis

The training and sensory evaluation sessions for the pseudo-consumer panel were carried out in a consumer panel room, with an oval table. The room was lit by white fluorescent light. Generally, each panelist was given a whole pie for evaluation, although for some sessions, half a pie was provided.

During the training and experimental design stage, the pies were made on the same day that they were tested. The pies were baked at 150 C for 20 minutes in an electric oven and served to the panelists straight from the oven. For the evaluation of the final frozen baked pies made in the factory, the pies were thawed and distributed to the pseudo-consumer panelists in New Zealand. They heated up the pie themselves in the hostels.

For the pseudo-consumer panels in New Zealand, water was supplied throughout the entire session and communication between panelists was discouraged. Most sessions were held around 7 p.m. which meant that the sessions could be undisturbed and there was a lapse of 2 hours from mealtime. Each session lasted approximately one hour. During the training period, an additional half an hour was used for discussion. All the samples were coded with a random 3 digit number. In cases where more than one sample was to be tasted, the order in which panelists tasted was fully randomised. The pies were placed on a paper-lined tray with the code number written directly below the pie. A taste panel form, a pencil, as well as a glass of water were also placed in front of the panelists. Erasers, tissue paper, and a jug of water was made available in the middle of the table.

In Malaysia, the pies were thawed and then heated in an ovenette for 10 minutes before serving to the consumer panelists. Unfortunately, uniform temperature could not be achieved as the ovenette did not have a temperature control.

In Malaysia, the consumer panelists were paid to attend only one session and taste one pie. An introduction to the project as well as an explanation on the use of the scales and the meaning of the attributes was given prior to the sensory evaluation. The presentation of the sample and the panel form was the same as for the pseudo-consumer panelists in New Zealand. A Malay translation of the taste panel form was provided for the Malay panelists. For the women consumer panelists, the panels were held in a room situated in an office block. Panels for the students were held in a meeting room in the university hostel. Again, the panelists were seated around a table and were undisturbed for the entire duration of the session.

6.5.4 Development of sensory attributes

During the first session of the pseudo-consumer panel in New Zealand, the panelists were given a form consisting of attributes thought to be important in a pie (see Appendix 6.1). The form divided the sensory testing of the product into five sections: external appearance, top pastry (also known as pie top), bottom pastry (also known as pie bottom), filling, and other non-sensory attributes. A discussion was held after the initial and each subsequent training session to review these attributes. From these discussions, certain features of the original form were modified:

- * the five sections were reduced to three sections.
Important appearance attributes and other non-sensory attributes in the pie were established in one of the early training sessions and it was not necessary to continue measuring them.

- * initially, the texture of the pie top was measured as varying from "very flaky" to "very elastic". The panelists decided that the two attributes were not on the same continuum. The texture of the pie top, was, therefore, separated into "flakiness" (absent to very flaky), and "elasticity" (absent to very elastic).

- * apart from the attributes listed in the first form, panelists also detected the off-flavours, "flour" (absence of flour smell/flavour to strong smell of flour), and "sourness" (absence of sour smell/flavour to strong sour smell/flavour) in both top and bottom pastry. These attributes were also included in the form.

- * the most significant changes occurred in the description of the pie filling. Originally, this section consisted of visual attributes followed by textural and then flavour attributes. An additional sub-section for aroma was included as the panelists felt that "beef aroma" as well as "overall aroma" were important attributes. They recommended that the aroma attributes be placed after the visual but before the texture attributes for ease of assessment. The size of meat and macaroni was also included in the visual subsection.

- * "saltiness" of macaroni and mixed vegetables were discarded as panelists felt that they were the same as the "overall saltiness" of the filling.

From these discussions, a sensory panel form was developed. For the actual sensory testing sessions, the relevant sections of the form were used e.g. for evaluating the pie top, the pie top section of the panel form was used. The final sensory panel form is shown in Figure 6.1.

Figure 6.1: Sensory evaluation form for pie

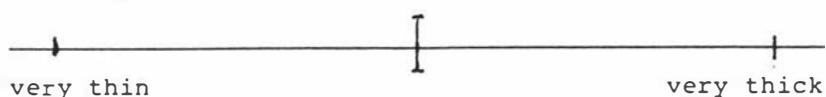
Name: _____

Date: _____

You have been presented with a spicy beef pie. It contains halal mince beef, vegetables, macaroni and spices. Please evaluate it according to YOUR ideal.

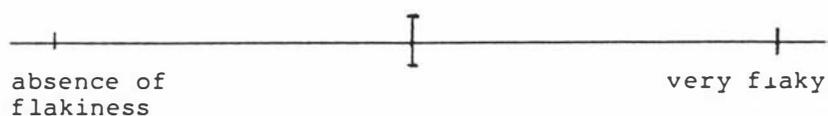
1. Puff Past (top pastry)

1.1 Thickness of pastry

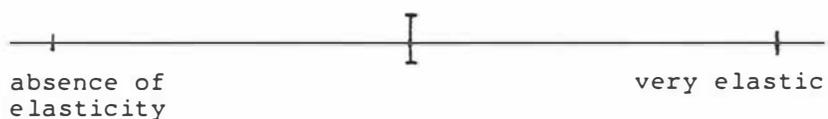


1.2 Texture of pastry

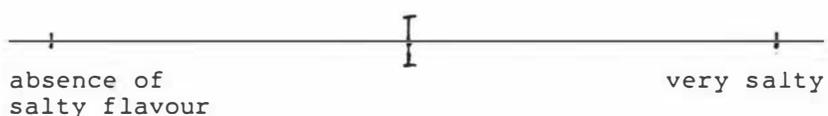
1.2.1 Flakiness



1.2.2 Elasticity



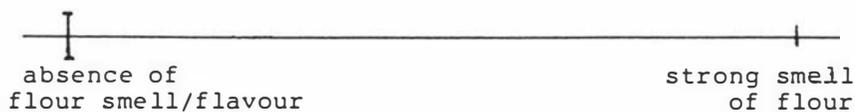
1.3 Saltiness of pastry



1.4 Greasiness/oiliness



1.5 Flour



1.6 Sour smell/flavour



1.7 Acceptability of pastry



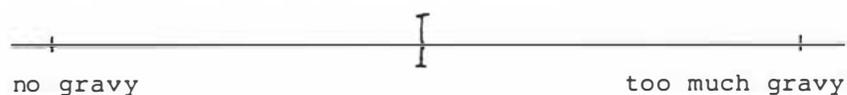
Figure 6.1: continued

3.2 Ratio of meat:mixed vegetables:macaroni

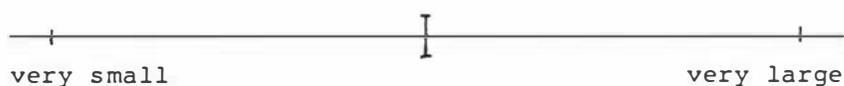
Would you like

 more meat just right less meat more vegetables just right less vegetables more macaroni just right less macaroni

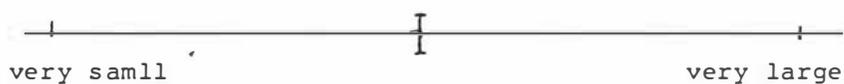
3.3 Amount of gravy (liquid portion of filling)



3.4 Size of meat

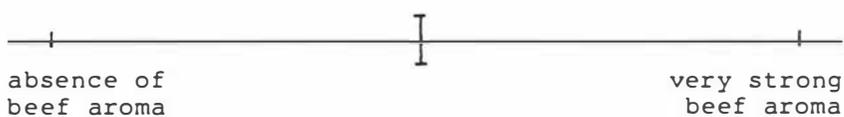


3.5 Size of macaroni



3.6 Aroma (smell)

3.6.1 Beef aroma

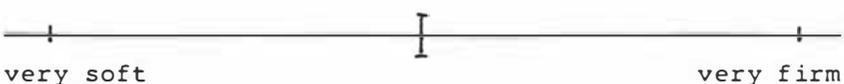


3.6.2 Overall aroma



3.7 Texture of filling

3.7.1 Overall texture of filling



6.5.5 Training of the panelists

Due to the recent emergence of techniques using semi-trained consumers in guiding product development, there were no guidelines to training panel members. The American Society for Testing and Materials (1981), however, has a special technical publication on "Guidelines for the Selection and Training of Sensory Panel Members". Information from this publication was used to assist in training of the panelists.

A system was devised in which the training session was used to both train panelists in the sensory evaluation of the beef pie, as well as establishing the testing method and the levels of the ingredients for formulation. The panelists had no problems in assessing the flavour and appearance attributes but they had difficulties in assessing texture. The panelists discussed the various ways in which they evaluated the texture attributes, and finally developed the definitions shown in Appendix 6.2. The definitions were given to each of the panelists at each session until they were familiar with the method of evaluation.

To train the panelists in the use of the scale, products with various formulations were presented. Panelists became familiar with the range of attributes, such as "saltiness", "texture of macaroni", that they were likely to encounter. Where panelists had difficulties in relating to the word anchors (especially for physical attributes such as size), a physical object was chosen to represent each anchor. For example, in evaluating the size of the meat; "very small" was defined as meat pieces just visible to the eye and "very large" as the size of the light switch in the sensory evaluation room. From these training sessions with the panelists, the area for formulation optimisation was also identified.

6.5.6 Use of "ideal" point on the line scale

Initially, the panelists started off their training by using "floating" or "moving ideals", each panelist filling in their own "ideals" for each attribute. However, panelists felt that it would be easier and more consistent if the "ideals" were fixed for all attributes. The locations of the "fixed ideals" were discussed by panelists and the

final placing was obtained from a panel consensus.

6.5.7 Use of sensory testing in formulation

Sensory testing was used throughout the formulation development but only two experimental designs are discussed in the results - a mixture design and a factorial design. In the experimental designs, equations correlating either acceptability or sensory attributes with ingredients were obtained through regression equations. Both ratio and interval scores were used for the purpose. Quadratic and linear equations and stepwise regression were all examined in an attempt to select the best equation. Equations which appeared logical and which had the highest r values were chosen.

6.5.8 Data analysis

The scores on the line scale for various attributes were measured in centimetres, from the zero end of the scale and were termed "sample scores". "Interval scores" were calculated as the difference between the "ideal score" and sample scores. "Ratio scores" were calculated as the ratio of the "sample score" to the "ideal score". The mean and standard deviation for all three types of scores were computed. The means of the interval and ratio scores were used as a guide to formulation - a negative interval score and a ratio score of less than 1 meant that the attribute was less than ideal, a positive interval score and a ratio score greater than 1 meant that the attributes was greater than ideal, while a 0 interval score and a ratio score of 1 indicated that the attribute was "ideal". MINITAB (Ryan et al., 1976) was used to calculate the mean and standard deviations of the sample, interval and ratio scores. This programme was also used to generate the regression equations which related ratio and interval scores with the ingredients in the formulation. Differences in the mean attribute scores for consumer panelists in Malaysia and pseudo-consumer panelists in New Zealand were analysed using analysis of variance. This was also done with MINITAB. The mean sensory scores of the sensory profiles from the consumer groups and the pseudo-consumer panelists were correlated using MINITAB.

6.6 RESULTS OF SENSORY TESTING IN FORMULATION

6.6.1 Ideals

The ideals for the various attributes, after they had been finalised by the panelists are shown in Table 6.3. For many attributes, the ideal was fixed at the centre of the scale. Attributes, such as off-flavours, had ideals of zero since they should not be detectable. Greasiness was given an ideal of 2.5 as the panelists felt that it was a desirable attribute in small quantities in the pie bottom, pie top and the filling. "Ideals of 10 were used for acceptability attributes such as the acceptability of pie top, bottom and filling, and the overall aroma.

 Table 6.3: Ideal scores for attributes in sensory evaluation of pie

| Pie top | | Pie Bottom | | Filling | |
|-----------------------|-----|---------------|-----|---------------------|-----|
| Thickness | 5 | Thickness | 5 | Amount of filling | 5 |
| Flakiness | 5 | Texture | 5 | Amount of gravy | 5 |
| Elasticity | 5 | Saltiness | 5 | Size of meat | 5 |
| Saltiness | 5 | Greasiness | 2.5 | Beef aroma | 5 |
| Greasiness | 2.5 | Flouriness | 0 | Overall aroma | 10 |
| Flouriness | 0 | Acceptability | 10 | Texture of filling | 5 |
| Sourness | 0 | | | Texture of meat | 5 |
| Acceptability | 10 | | | Texture of macaroni | 5 |
| | | | | Texture of vege. | 5 |
| | | | | Texture of gravy | 5 |
| | | | | Viscosity of gravy | 5 |
| | | | | Greasiness | 2.5 |
| | | | | Beef flavour | 5 |
| | | | | Saltiness | 5 |
| Overall acceptability | 10 | | | | |

6.6.2 Mixture design

The product was formulated in three different parts - the top pastry, the bottom pastry, and the filling (see section 2.4). For the filling, the three major ingredients were water, thickener, and the solid portion (consisting of meat, macaroni, and mixed vegetables). The ratio of meat:macaroni:mixed vegetables had been established in earlier experiments. Since the water, thickener, together with the solids added up to 100% of the filling, it was decided to use a mixture design to optimise the balance of the three components. From the training sessions, a region was identified for optimisation (see Figure 6.2). This region was identified by selecting the following constraints of

the ingredients:

$50\% \leq \text{water} \leq 59\%$

$40\% \leq \text{solids} \leq 49\%$

$1\% \leq \text{thickener} \leq 4\%$

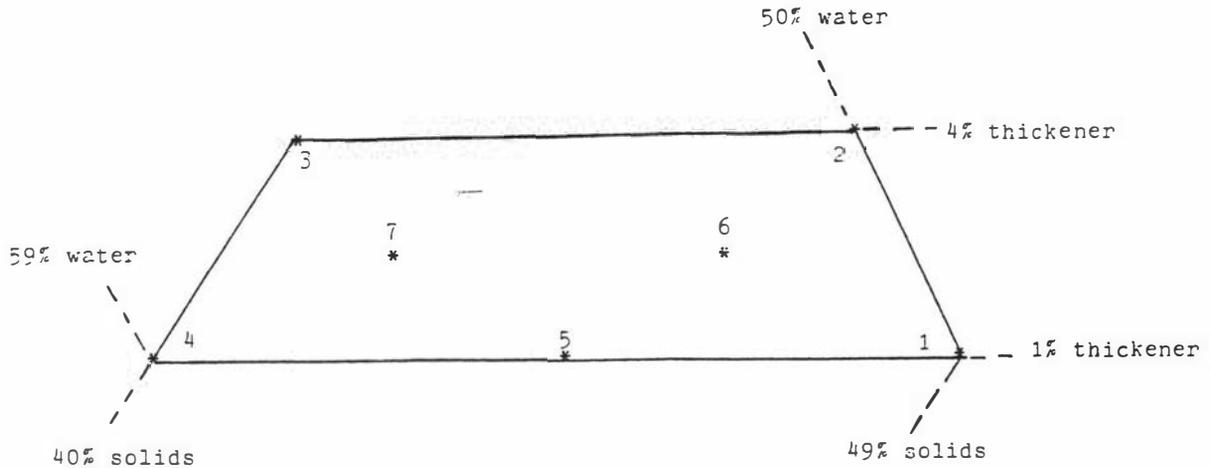


Figure 6.2: Experimental points for mixture design

| | % water | % solids | % thickener |
|---|---------|----------|-------------|
| 1 | 50.0 | 49.0 | 1.0 |
| 2 | 50.0 | 46.0 | 4.0 |
| 3 | 56.0 | 40.0 | 4.0 |
| 4 | 59.0 | 40.0 | 1.0 |
| 5 | 55.0 | 44.0 | 1.0 |
| 6 | 51.4 | 46.0 | 2.5 |
| 7 | 54.5 | 43.0 | 2.5 |

The extreme vertices of the region identified were used, resulting in runs 1-4. The other 3 runs were added as Snee (1971) noted that 6 coefficients are needed in a 3 component mixture design for a quadratic equation (7 was required for a special cubic equation).

The seven pies were evaluated for the "amount of gravy", "texture of the gravy" (smooth to gummy/lumpy), "viscosity" (very thin to very thick) and were also ranked according to "acceptability". The mean sensory scores are shown in Table 6.4. The mean ratio score nearest "ideal" was run 3 for "amount of gravy" (56% water, 40% solids, 4% thickener), run 4 for "texture" (59% water, 40% solids, 1% thickener), and run 5 for "viscosity" (55% water, 44% solids, 1% thickener). It was obvious from the results that the formulations in the design were

close to "ideal". It was not possible to determine easily the next experimental points. For the "amount of gravy", the "ideal" was tending towards the region with more thickener, whereas for "texture", it was tending towards a region with less thickener. Regression equations relating the "amount of gravy" and the "texture of the gravy" with the ingredients were calculated to aid optimisation.

Table 6.4: Results of mixture design

| Sample | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|--------------------|-------|-------|-------------|-------------|-------------|-------|-------|
| Amount of gravy | | | | | | | |
| Sample score | 1.39 | 3.39 | 4.88 | 2.51 | 2.13 | 2.88 | 3.40 |
| Interval score | -3.61 | -1.61 | -0.12 | -2.49 | -2.87 | -2.12 | -1.60 |
| Ratio score | 0.28 | 0.68 | <u>0.98</u> | 0.50 | 0.41 | 0.58 | 0.68 |
| Texture of gravy | | | | | | | |
| Sample score | 5.53 | 6.78 | 6.10 | 5.16 | 5.67 | 6.23 | 5.83 |
| Interval score | 0.53 | 1.78 | 1.10 | 0.16 | 0.67 | 1.23 | 0.83 |
| Ratio score | 1.11 | 1.36 | 1.22 | <u>1.03</u> | 1.14 | 1.25 | 1.17 |
| Viscosity of gravy | | | | | | | |
| Sample score | 6.02 | 5.70 | 6.96 | 6.40 | 4.93 | 6.59 | 5.90 |
| Interval score | 1.02 | 0.70 | 1.96 | 1.40 | -0.07 | 1.59 | 0.90 |
| Ratio score | 1.20 | 1.14 | 1.39 | 1.28 | <u>0.99</u> | 1.32 | 1.18 |

From regression analysis, two sets of equations were obtained. One was obtained using the ratio scores and the other the interval score (see Table 6.5). Only the "amount of gravy" and "texture of gravy" had significant correlations with ingredients, "viscosity" was not significantly correlated.

Table 6.5: Regression equations obtained from mixture design

| <u>Ratio scores</u> | R-squared |
|--|-----------|
| Gravy = $-1.50 + 16.1 \cdot \text{thickener} + 3.20 \cdot \text{water}$ | 94.8 |
| Texture = $1.77 + 5.8 \cdot \text{thickener} + 1.35 \cdot \text{water}$ | 84.5 |
| <u>Interval scores</u> | |
| Gravy = $-12.50 + 80.4 \cdot \text{thickener} + 15.9 \cdot \text{water}$ | 94.8 |
| Texture = $3.83 + 29.2 \cdot \text{thickener} + 6.7 \cdot \text{water}$ | 84.5 |

Setting the ideal ratio score to 1, and the ideal interval score to zero, the 2 sets of equations were solved simultaneously, to give two theoretical optimums.

Table 6.7: Comparison of actual with predicted result

| | empirical prediction | actual result | Sum of rank (for preference) |
|-----------------------|----------------------|---------------|------------------------------|
| <u>2.2% thickener</u> | | | 23 |
| Ratio score | | | |
| amount of gravy | 0.98 | 0.58 | |
| texture of gravy | 1.00 | 1.12 | |
| viscosity of gravy | 0.98 | - | |
| Interval score | | | |
| amount of gravy | -0.16 | -0.21 | |
| texture of gravy | 0.02 | 0.62 | |
| viscosity of gravy | -0.11 | - | |
| <u>2.8% thickener</u> | | | 15 |
| Ratio score | | | |
| amount of gravy | 0.98 | 0.93 | |
| texture of gravy | 1.08 | 1.05 | |
| viscosity of gravy | 1.15 | - | |
| Interval score | | | |
| amount of gravy | -0.17 | -0.33 | |
| texture of gravy | 0.41 | 0.24 | |
| viscosity of gravy | 0.76 | - | |
| <u>3.3% thickener</u> | | | 16 |
| Ratio score | | | |
| amount of gravy | 0.96 | 1.06 | |
| texture of gravy | 1.15 | 1.16 | |
| viscosity of gravy | 1.23 | - | |
| Interval score | | | |
| amount of gravy | -0.26 | 0.32 | |
| texture of gravy | 0.76 | 0.78 | |
| viscosity of gravy | 1.17 | - | |

The two sets of actual and predicted results were very similar with one exception. It was clear that the formulation containing 2.2% thickener had lost some gravy during baking, resulting in an unusually low score for "amount of gravy". As a result of gravy loss, the texture became "gummier" than in the other two formulations. The other samples, with 2.8% and 3.3% thickener were almost identical, 2.8% being considered marginally better. The sum of the preference ranking for the 2.8% and 3.3% thickener was almost identical (15 and 16 respectively) compared to 23 for the sample with 2.2% thickener. The formulation with 3.3% thickener was selected because of ease of production in factory and to prevent "boiling out" during the baking process. When the pie filling is thicker, the commercial filler is more effective in dispensing the pie filling.

6.6.3 Factorial experiment

A pie bottom pastry had to be formulated containing vegetable shortening (all New Zealand pastry margarines contain animal tallow).

A two level factorial experiment was designed to investigate the effects of fat and leavening agent on the pastry. The samples were evaluated for texture, and the results are plotted in Figure 6.3.

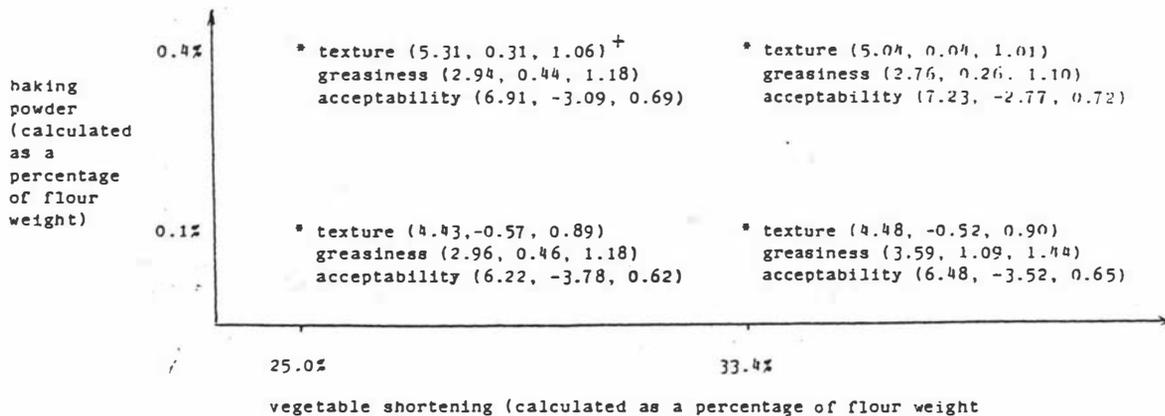


Figure 6.3: Factorial experiment for pie bottom
⁺ (sample score, interval score, ratio score)

The sensory results obtained were correlated and regressed against the experimental factors. The regression equation with the most significant r-squared was the one relating acceptability to fat and leavening agent where the r-squared * 100 was 99.6% (see equation 6.1). The decoded regression equation for the mean ratio was:

$$\text{acceptability} = 0.57 + 0.00069*\text{fat} + 0.006*\text{bp} \dots\dots\text{Equation 6.1}$$

Other regression equations were obtained, but were not selected because of the low r-squared values. They are:

$$\text{texture} = 0.891 + 0.072*\text{bp} \text{ (r-squared} = 86.2\%) \dots\dots\text{Equation 6.2}$$

$$\text{greasiness} = 1.22 - 0.085*\text{bp} \text{ (r-squared} = 18.5\%) \dots\dots\text{Equation 6.3}$$

$$\begin{aligned} \text{acceptability} &= 0.299 + 0.413*\text{texture} - 0.021*\text{greasiness} \\ &\text{(r-squared} = 8.4\%) \dots\dots\text{Equation 6.4} \end{aligned}$$

$$\text{acceptability} = 0.264 + 0.433*\text{texture} \text{ (r-squared=53.7\%)}..\text{Equation 6.5}$$

Unlike the mixture experiment, the sensory attributes did not correlate closely with ingredient levels (see Equation 6.2 and 6.3). However, acceptability was highly correlated with the two ingredients. It was hypothesised that the consumers were taking into account sensory attributes other than texture and greasiness in the overall evaluation of the pie bottom. This was shown by the low correlation between acceptability with texture and greasiness (see Equation 6.4 and 6.5).

Regression equations were obtained using both mean ratio scores and mean interval scores. The solutions to both were identical. It was evident that acceptability increased with increasing fat and leavening agent (a commercial baking powder). However, the optimum lay in a range beyond technical and economic feasibility. For example, at a level of 0.4% baking powder, the level of fat had to be 104% to obtain the predicted ideal score. At a level of 33.4% fat, the level of baking powder had to be 1.8%. However, the level of baking powder could not go higher than 0.4% of the flour or the raw pastry became too fragile to roll into the pie tins. In addition, higher baking powder levels become detectable in the flavour. The amount of fat had to be limited for cost reasons. Solving equation 6.2 to obtain the optimum baking powder level by putting "texture" to be equal to 1 (ideal ratio score), a level of 0.3% baking powder was derived. Thus, in the following experiment, it was decided to set an upper limit of fat and baking powder at 37.6% and 0.4% of the flour respectively. Two experiments were conducted just outside the last experimental design;

one with 0.4% baking powder and 37.6% fat and the other with 0.3% baking powder and 37.6% fat. Both the actual and predicted results are shown in Figure 6.4.

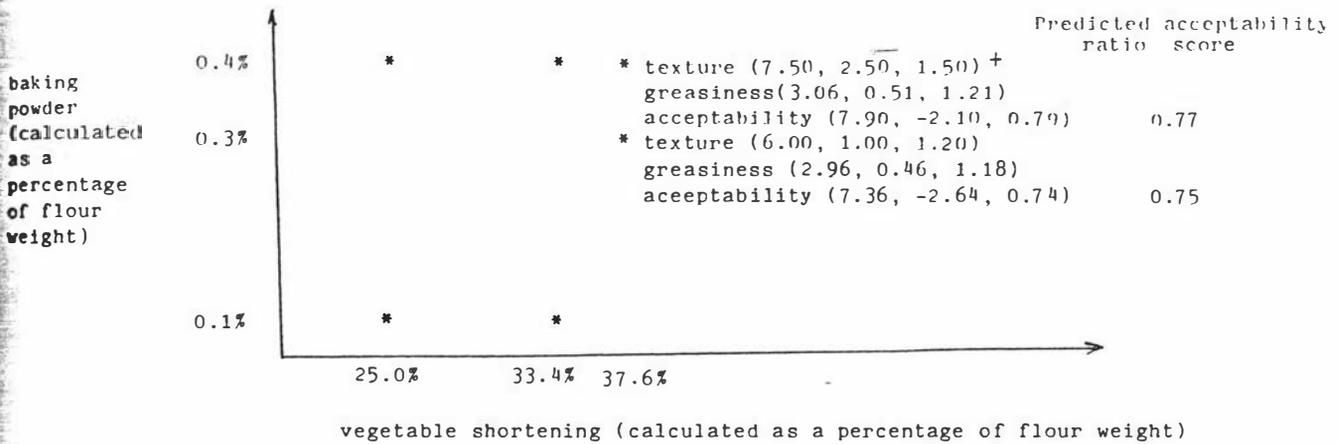


Figure 6.4: Results of second experiment on the pie bottom + (sample score, interval score, ratio score)

The actual results obtained for acceptability were very similar to the results predicted from the equation 6.1. Both "texture" and "greasiness" scores moved away from the ideals in the two experimental points. However, prediction from equation 6.2 was not accurate. The actual results showed that the texture of the pie became tough and hard. This could be due to the fact that the equation did not take fat into consideration, and the equation was true only for the region in the factorial experiment. Acceptability, however, did increase and the formulation with the higher acceptability was chosen.

6.6.4 Attribute and acceptability scores from pseudo-consumer panelists in New Zealand and consumers in Kuala Lumpur

Analysis of variance of the individual acceptability and attribute scores showed that the two groups of panelists were significantly different in their evaluation of the pie bottom at the 5% level (see Table 6.8). No significant differences were found between the different groups of panelists for pie top or the overall acceptability. The standard deviations of all the sensory attribute scores are given in Appendix 6.3. In the other attributes, there was an overall difference for "flakiness", "elasticity" and "beef flavour".

Table 6.8: Mean sample scores of sensory attributes from consumers in Malaysia and pseudo-consumer panelists in New Zealand

| <u>Acceptability</u> | Malay student | Chinese student | Malay women | Chinese women | Panelists in New Zealand |
|------------------------------|---------------|-----------------|-------------|---------------|--------------------------|
| Pie top | 7.8 | 6.9 | 6.7 | 7.1 | 7.4 |
| Pie bottom* | 8.3 | 7.0 | 4.8 | 6.7 | 7.6 |
| Overall | 7.7 | 6.7 | 6.4 | 7.0 | 7.7 |
| <u>Sensory Attributes</u> | | | | | |
| <u>Pie top</u> | | | | | |
| Thickness | 4.5 | 4.6 | 4.3 | 3.9 | 4.7 |
| Flakiness* | 4.8 | 3.5 | 3.1 | 3.4 | 4.9 |
| Elasticity* | 4.8 | 4.3 | 3.4 | 2.9 | 5.3 |
| Saltiness | 4.4 | 4.8 | 3.7 | 4.4 | 5.0 |
| Greasiness | 2.8 | 3.1 | 3.3 | 2.2 | 2.7 |
| Flour | 0.7 | 0.9 | 1.0 | 0.8 | 0.1 |
| Sour | 0.5 | 1.0 | 1.3 | 0.7 | 0.2 |
| <u>Pie bottom</u> | | | | | |
| Thickness | 4.0 | 5.2 | 4.6 | 4.9 | 4.7 |
| Texture | 4.7 | 4.6 | 3.4 | 3.8 | 5.0 |
| Saltiness | 4.3 | 4.9 | 4.1 | 4.6 | 5.3 |
| Greasiness | 3.2 | 2.7 | 2.8 | 2.7 | 2.6 |
| Flour | 0.8 | 1.6 | 1.9 | 1.3 | 0.2 |
| <u>Filling</u> | | | | | |
| Amount of filling | 5.3 | 5.7 | 6.2 | 5.9 | 5.4 |
| Amount of gravy | 6.2 | 6.9 | 5.9 | 6.2 | 4.9 |
| Size of meat | 4.7 | 4.8 | 3.9 | 4.1 | 4.2 |
| Beef aroma | 6.1 | 4.4 | 5.9 | 5.3 | 4.4 |
| Overall aroma | 6.2 | 7.0 | 6.1 | 6.7 | 8.2 |
| <u>Texture of filling</u> | | | | | |
| Texture of filling | 4.1 | 3.3 | 4.0 | 3.7 | 4.0 |
| <u>Texture of meat</u> | | | | | |
| Texture of meat | 4.5 | 4.9 | 3.8 | 4.2 | 4.9 |
| <u>Texture of macaroni</u> | | | | | |
| Texture of macaroni | 2.6 | 3.3 | 2.8 | 2.1 | 1.4 |
| <u>Texture of vegetables</u> | | | | | |
| Texture of vegetables | 3.5 | 3.5 | 2.0 | 2.9 | 3.4 |
| <u>Texture of gravy</u> | | | | | |
| Texture of gravy | 5.5 | 6.0 | 5.6 | 4.4 | 4.7 |
| <u>Viscosity of gravy</u> | | | | | |
| Viscosity of gravy | 3.9 | 4.9 | 4.0 | 4.4 | 5.0 |
| <u>Greasiness of filling</u> | | | | | |
| Greasiness of filling | 3.5 | 3.4 | 3.2 | 2.7 | 2.5 |
| Beef flavour* | 5.4 | 5.9 | 6.4 | 5.1 | 4.2 |
| Saltiness | 4.6 | 5.8 | 4.8 | 5.0 | 5.1 |

* significant at the 5% level

Note: There were 8-10 participants in each group.

Mean sample scores of the sensory attributes in the product profile obtained from the four consumer groups in Malaysia and the pseudo-consumer panelists in New Zealand were correlated with one another (see Table 6.9). With all the attributes included, all the correlations were significant at the 1% level and no difference could be shown between the groups. The sensory attributes with ideals at 0, 2.5 and 10 were excluded from the correlation because the mean scores were close to the ideals which meant that the correlations were affected by the wide range of mean scores. The attributes excluded were "acceptability", "greasiness", "flour", "sour" and "overall aroma".

Table 6.9: Correlation coefficients of sample scores of product profile

| | Malay students | Chinese students | Malay women | Chinese women |
|--------------------------|----------------|------------------|-------------|---------------|
| Chinese students | 0.642 ** | | | |
| Malay women | 0.771 ** | 0.788 ** | | |
| Chinese women | 0.737 ** | 0.825 ** | 0.861 ** | |
| Panelists in New Zealand | 0.576 ** | 0.513 * | 0.358 | 0.577 ** |

** significant at 1% level

* significant at 5% level

The mean scores for the sensory attributes for the different consumers and the panelists in New Zealand correlated well with one exception. The correlation that was not significant was between the Malay women and the pseudo-consumer panelists. There was also a low correlation between the Malay women and the pseudo-consumer panelists.

6.7 DISCUSSION

6.7.1 Comparison of the two methods of analysing attributes and ideal scores in linear scaling

One disadvantage which affects ratio scores more than interval scores is the range of possible scores where an ideal is not fixed or where the ideals for different attributes are fixed at different points on the line scale. In this study, for example, the ideal for most

attributes was fixed in the middle of the line scale (5cm), but for others were placed at different points. Table 6.10 shows the range of scores that was possible on the line and the corresponding interval and ratio scores for the 4 different ideal points used.

Table 6.10: Range of scores and corresponding ratio and interval scores for different ideals

| Ideal = 0 | | |
|-----------------|----------------|-------------|
| Attribute score | Interval score | Ratio score |
| 0 | 0 | 1 |
| 1 | 1 | 10 |
| 2 | 2 | 20 |
| 3 | 3 | 30 |
| 4 | 4 | 40 |
| 5 | 5 | 50 |
| 6 | 6 | 60 |
| 7 | 7 | 70 |
| 8 | 8 | 80 |
| 9 | 9 | 90 |
| 10 | 10 | 100 |

| Ideal = 2.5 | | |
|-----------------|----------------|-------------|
| Attribute score | Interval score | Ratio score |
| 0 | -2.5 | 0 |
| 1 | -1.5 | 0.4 |
| 2 | -0.5 | 0.8 |
| 3 | 0.5 | 1.2 |
| 4 | 1.5 | 1.6 |
| 5 | 2.5 | 2.0 |
| 6 | 3.5 | 2.4 |
| 7 | 4.5 | 2.8 |
| 8 | 5.5 | 3.2 |
| 9 | 6.5 | 3.6 |
| 10 | 7.5 | 4.0 |

| Ideal = 5 | | |
|-----------------|----------------|-------------|
| Attribute score | Interval score | Ratio score |
| 0 | -5 | 0 |
| 1 | -4 | 0.2 |
| 2 | -3 | 0.4 |
| 3 | -2 | 0.6 |
| 4 | -1 | 0.8 |
| 5 | 0 | 1.0 |
| 6 | 1 | 1.2 |
| 7 | 2 | 1.4 |
| 8 | 3 | 1.6 |
| 9 | 4 | 1.8 |
| 10 | 5 | 2.0 |

| Ideal = 10 | | |
|-----------------|----------------|-------------|
| Attribute score | Interval score | Ratio score |
| 0 | -10 | 0 |
| 1 | -9 | 0.1 |
| 2 | -8 | 0.2 |
| 3 | -7 | 0.3 |
| 4 | -6 | 0.4 |
| 5 | -5 | 0.5 |
| 6 | -4 | 0.6 |
| 7 | -3 | 0.7 |
| 8 | -2 | 0.8 |
| 9 | -1 | 0.9 |
| 10 | 0 | 1.0 |

Because the range of interval and ratio scores were different, the standard deviations of these scores were not comparable across attributes with different ideals. This is illustrated in the standard deviation of ratio and interval scores for attributes with different "ideals" (see Table 6.11).

 Table 6.11: Standard deviation of the ratio and interval scores for attributes with different ideals

Interval score

| Ideal | 0 | 2.5 | 5 | 10 |
|--|------|------|------|------|
| mean of standard deviation for trained panelists | 0.44 | 0.38 | 1.06 | 2.26 |
| mean of standard deviation for consumer panels | 1.34 | 1.32 | 1.57 | 2.09 |

Ratio score

| Ideal | 0 | 2.5 | 5 | 10 |
|--|-------|------|------|------|
| mean of standard deviation for trained panelists | 4.18 | 0.15 | 0.21 | 0.23 |
| mean of standard deviation for consumer panels | 13.10 | 0.51 | 0.31 | 0.20 |

Although the results from trained panelists were less affected, there was still a distinct trend for the standard deviation to increase as the ideal increased in interval scores whereas the standard deviation of ratio scores decreased. An approximation of 0.1 was used where the ideal was 0 to avoid infinite ratio scores.

One of the ways to overcome this problem is to compare the coefficients of variation. The coefficient of variation (CV) is obtained by dividing the standard deviation by the sample mean, and multiplying by 100 to give a percentage. In general, a low CV suggests high precision in the data. Variability cannot be judged absolutely as the CV value depends on the type and method of measurement (Sinthavalai, 1986). The CV values were calculated for the ratio and interval scores for all attributes and the range and median values are shown in Table 6.12. It was found that the CV of the interval scores were well over 100%. This meant that the means were greatly affected by the spread in the data. However, the CV values of the ratio data for ideal of 5 were mostly between 20-30% for the trained panelists and 30-40% for the consumers. For the ideal of 0, the CV values were much higher than when the ideal

was at 2.5, 5 or 10. Taking the ratio of the standard deviation to the mean did result in more comparable values for attributes with different ideals, the exception being where the ideal was set at zero.

 Table 6.12: CV values for pseudo-consumer and consumer panelists

| Ideal | Ratio | | Interval | |
|-------|----------------|-----------------|----------------|-----------------|
| | Consumer | Pseudo-consumer | Consumer | Pseudo-consumer |
| | Range (median) | Range (median) | Range (median) | Range (median) |
| 0 | 10-177 (121) | 107-159 (140) | 88-204 (128) | 208-286 (286) |
| 2.5 | 26-82 (25) | 18-19 (19) | 37-516 (343) | 289-343 (316) |
| 5 | 11-93 (32) | 3-69 (21) | 71-2066 (196) | 86-2557 (375) |
| 10 | 16-40 (31) | 26-33 (30) | 38-93 (71) | 83-113 (86) |

For the regression data, there was no difference between the interval and ratio data as both produced identical results with the same r-squared values.

6.7.2 Use of empirical equations in sensory evaluation

For both the factorial and mixture design experiments, linear equations fitted the data very well with highly significant r-squared values and there was no need to go to a higher level equation. The equations selected were used successfully to predict sensory attribute scores and acceptability within the area of experimentation and slightly beyond. However, the second experiment for the pie filling in which "boiling out" was experienced showed the dangers of extrapolating outside the region of experimentation and the need for further experiments.

While the equation in the mixture experiment related sensory attribute scores with ingredient levels very well, only acceptability was related to ingredient levels in the factorial experiment. The ingredients were affecting other factors besides the two sensory attributes identified.

The use of attributes may result in the optimisation of an attribute only and not of the overall acceptability. However, if only the acceptability is measured, there is no information on how the system is changing. In this study, overall acceptability of the pie bottom was not acceptable to the Malay women (they scored it significantly lower than the pseudo-consumers). Without measuring the texture, there would

be no indication as to where the problem might be. If attributes are used, then the panelists used for sensory evaluation have to be trained to identify the important attributes so as to ensure that the attributes affecting acceptability are selected.

6.7.3 Comparison of the sensory evaluation by pseudo-consumer panel and consumer panel

The acceptability scores given by the four consumer groups and by the pseudo-consumer panelists indicated the only significant difference was in the evaluation of the pie bottom. The Malay women scored the pie bottom lower (significant at 5% level) than either the Malay students or the pseudo-consumer panelists. For the pie top, bottom and overall acceptability, the distribution of the sample scores of the Malay students were closest to those of the pseudo-consumer panelists. The Malay women scored all three acceptability factors lowest, whereas the Chinese students and women were intermediate.

An analysis of the attribute scores revealed several interesting trends:

- * generally, the Malays preferred a saltier product than the Chinese. This was shown in the "saltiness" scores for the pie top, pie bottom and "overall saltiness". The Malay women wanted a saltier product than the Malay students, while the panelists in New Zealand thought the "saltiness" scores just right.
- * generally, the pseudo-consumer panelists were more homogeneous in their scoring (reflected by lower standard deviations) than the consumer panels. However, the standard deviation of acceptability scores did not differ from that of the four consumer groups. Thus, it appeared that in this study, although the panelists were semi-trained in evaluating sensory attributes, the process did not affect the way they scored acceptability.
- * the scoring of flouriness was significantly different between the consumers and the pseudo-consumer panelists.

It was not known whether this was because the consumers were more sensitive to flouriness or whether frozen storage had affected those properties in the pie.

- * there was a major difference in the rating of beef flavour by the pseudo-consumer panelists when compared to the consumers. Beef flavour in the filling was considered to be less than ideal by the panelists but all four consumer groups rated these attributes higher than ideal (significant at the 5% level). These differences are probably due to the students in New Zealand adapting to more frequent consumption of beef. From this, they may have acquired a taste for its strong flavour. Interestingly, there was no significant difference in the scoring of beef aroma between the panelists.

6.8 CONCLUSIONS

Panelists adapted to the task of sensory scaling very quickly and became more confident of their abilities during training. The training period aided the formulation work as it was used to obtain a general area for formulation, before optimisation experiments were carried out. A brief training period with discussions was effective in training consumers for sensory evaluation to guide formulation development. The training period was also used successfully to locate a general area for optimisation.

The line scale was easily understood by the panelists, who had no previous experience in the use of the scales. Scaling "ideal" points for attributes did not pose a problem to panelists. Discussions, however, revealed that panelists had difficulties remembering where they scaled the ideals in a previous session, and responded enthusiastically to the suggestion of fixing the ideal.

The line scales together with the ideal scores were used successfully in formulation, and few differences could be found in the two methods of analysing the ideal data. Further study is required in this area. Sensory data (both interval and ratio scores) were found suitable for

regression analysis. Ingredient levels were used to predict acceptability and attribute scores.

Despite the drawbacks in using a pseudo-consumer group in New Zealand (adaptation to New Zealand tastes, and non-representativeness of panelists), the results indicated that scores obtained were very similar to those from consumers (with the exception of the Malay women consumers). There was a strong possibility that the panelists might become conditioned to the product. Thus, it is felt advisable to test a product with consumers when it is close to "ideal". Further work is unlikely to increase greatly the consumer acceptability of the product. The resources are better spent in finding out through consumer testing any major "problem" attributes. Another reason for not "perfecting" the product in the laboratory are the likely changes to the product during production runs as opposed to laboratory scale trials.

CHAPTER 7

PRODUCT TESTING IN A CROSS-CULTURAL ENVIRONMENT

At this stage of the project, a product prototype had been made in a factory trial. The next stage in the product development process was to evaluate the product in terms of its potential acceptance in the marketplace. Although they are interrelated, it is possible to distinguish three major components which require testing before a product can be launched. These are the consumer reaction to the marketing strategies, the consumer reaction to the product, and the sensory acceptance of the product.

Techniques have been developed to evaluate the above factors. Three product testing techniques were selected and compared in the final testing of the meat pie with consumers in Kuala Lumpur, Malaysia.

7.1 LITERATURE REVIEW

One technique which has found widespread commercial acceptance is test marketing (also known as market testing). The purposes of conducting a test market can be to test a new product or new marketing plan under realistic market conditions to obtain a measure of sales or profit potential (Zikmund, 1982). Test marketing can also be used to improve advertising copy and placements, promotion and price, i.e. marketing strategies (Urban and Hauser, 1980).

Since test marketing is so well established, it is a recommended procedure for product testing in many marketing texts, and numerous papers have been published on the subject (Stanton, 1967; Cadbury, 1975; Klompaker et al., 1976). As test marketing is particularly suited to the development of new packaged goods, i.e. branded, low price, frequently purchased consumer products, the use of test markets is universal among major food product companies (Hardin, 1981). Within test marketing, different methods of gathering data exists. These include consumer surveys, consumer diary panels, laboratory test markets, controlled store tests and the test market (Hardin, 1981;

Zikmund, 1982; Crawford, 1983; Narasimhan and Sen, 1983).

Product use testing is a concept that is perhaps more important in consumer durables and industrial products. With food products, product use is strongly linked to the sensory properties of the food, although other factors such as packaging and cooking instructions also have a role to play. In-home tests (or home use tests) are often employed for food products (ASTM, 1979; Gatchalian, 1981). Focus groups, on the other hand, have been recommended for obtaining information about the reaction to product (ASTM, 1979; Crawford, 1983).

Acceptance tests are often used to evaluate the sensory acceptance of food products. Many techniques have been developed for this purpose including home use testing, central location testing, mail panels, telephone interviews, focus groups and market testing.

7.2 SELECTION OF TECHNIQUES FOR PRODUCT TESTING

With the pie, the most important aspects of the product were the sensory characteristics and the reaction of the consumers to the product concept. An indication was also required of the size of the market segments interested in buying the product.

Formulation of the pie had utilised sensory characteristics optimised by pseudo-consumers who were Malaysian students in New Zealand. To evaluate the relevance of the profile to Malaysians in Malaysia, sensory evaluation of the pie with four different population segments was carried out using the same sensory profile.

Because the development of the product was carried out in New Zealand, consumer perceptions of and reaction to the product were not known. Information was also required on packaging, outlets for sale, product usage, and market potential. A central location test was carried out as it could provide data from a large number of consumers. Sophisticated research techniques such as test marketing, laboratory test marketing, and controlled store tests were not appropriate in this study. In effect, this was the first consumer evaluation of the Prototype and it was expected that further refinements would be

required before the product reached a test market stage. Focus groups were also conducted to evaluate consumer response to the product.

7.3 FOCUS GROUPS IN PRODUCT TESTING

7.3.1 Experimental method

The focus groups were conducted after the sensory testing of the pies, which meant that the participants had an idea of the product's appearance and eating qualities. There were four focus groups - Chinese women, Malay women, Chinese and Malay students (male and female). The focus groups consisted of eight Malay women, nine Chinese women, 10 Malay students and 10 Chinese students. The topics of discussion are given in Table 7.1.

Table 7.1: Sequence of topics used for the focus group discussion

- * General topics to start discussion.
 - Q. You've tasted the pie, what do you think of it?
 - * Product use
 - Q. On what occasions/when would you eat the pie?
If women, ask about other members of the family as well.
 - Q. What time of day will you eat the pie?
 - Q. If you were to have the pie at home, would you heat it up before eating?
 - * Product competition
 - Q. If you were not having the pie, what would you be having instead?
 - Q. Why would you have the pie instead of that?
 - Q. Have you ever eaten any of the locally made pies? How does the new pie compare with the local pie? Can you remember how much it cost? Do you think that it is reasonable? How much would you pay for this pie if it were sold here in Malaysia?
 - * Product features
 - Q. If I were to ask you to describe the pie to your friend, what would you say?
 - Q. What do you like best about the pie?
 - Q. What do you like least about the pie?
 - * Branding
 - Q. What do you think of the name New Zealand Beef Pie?
 - Q. Is the word New Zealand important to you? What about beef?
 - Q. (For Malays) Is the sentence "contains halal beef" important to you? Where should it be on the labelling?
 - Q. How would you translate the name to Chinese or Malay?
 - Q. Have you any suggestions for the name or brand name?
 - Q. Would you doubt that the pie was made in New Zealand if it had that name? Why?
 - Q. Would the word New Zealand attract you to the product?
 - * Promotion
 - Q. This is a completely new product - how would you expect to hear about it (through friends, radio, newspaper, television)?
 - Q. If it was advertised on television or radio or newspaper, what would you want to know about the product?
 - * Retail outlet
 - Q. Where would like to buy the product?
 - * Product presentation
 - Q. Would you rather see the pie packaged or unpackaged?
How would you like it packaged?
 - Q. Do you like the appearance of the pie? What do you like/dislike about it? How can it be improved?
-

7.3.2 Results

7.3.2.1 Comparison between Malay and Chinese women

Generally, the Chinese women reacted more favourably towards the pie whereas the Malays did not like it. This was reflected in the price they were willing to pay for the pie; the Chinese would pay \$1.50 while the Malay women quoted \$1.00-\$1.20 when asked about price. Both groups thought of the pie as a snack and said they would eat it where it was sold. They would also take it home, where the Malays would eat it for breakfast, afternoon tea and as a replacement for lunch. The Chinese, on the other hand, would also eat it for dinner as a meal replacement. Both ethnic groups agreed that the pie could be eaten by the whole family. The Chinese felt that the pie was not suitable for children under eight years old as it was too hot while the Malays felt that the pie was suitable for children above two years.

To find out what they liked or disliked about the pies, the women were asked how they would describe it to their friends and to compare it with existing local pies. All the Malays liked the fact that the pie contained more meat than local pies. The one feature that the Malays liked least was the pastry - they thought that it was not well cooked, the colour was unattractive and that it was not "crunchy". The Chinese, in complete contrast, felt that the best feature of the pie was the pastry. They only briefly referred to the substantial amount of meat in the pie, but concentrated on the smell of the beef which they found too overpowering. The Chinese women also thought the pie to be too soft and too peppery. Both ethnic groups said that the filling was too soggy. The Malays placed a great deal of importance on the appearance of the product.

Although the Malays felt that the local pie was generally better than the beef pie, the Chinese did not like the local pies. The reasons why the Malays liked the local pies included the attractive appearance of the pie, the "crunchy" top pastry, the curry or chilli flavour of the filling. The Chinese, on the other hand, felt that local pies were too oily, the pastry was too thick and that there was too little meat in the filling. The Chinese also preferred the flavour of the beef pie.

"Freshness" was brought up by both Malay and Chinese women during discussion. Although the Chinese women were unanimous in their agreement of the importance of the word New Zealand in "New Zealand Beef Pie", they would be concerned about "freshness" if the pie was imported. The Malays also had similar reservations about an imported pie. Both ethnic groups thought that the pie should be packaged in an aluminium foil tray, promoted on television and be sold through supermarkets. The Malays also suggested fast food chains, hotels and coffee houses as possible outlets.

When asked why they would buy the pie, the Malays mentioned taste, the fact that the pie could replace dinner as it was filling and impulse buying. The Malays indicated that the purchase of bakery products was based on impulse and that they would buy whatever looked most attractive and fresh on that day. The Chinese would buy the pie for convenience. They mentioned that the pie would be replacing bakery products, fast foods e.g. Kentucky Fried Chicken and McDonalds and hawker food. In general, the pie would replace savoury rather than sweet foods. On the other hand, the Malays felt that the pie would be mainly replacing homemade bakery items rather than hawker food as it would mostly be eaten at afternoon tea.

The Malay women felt that a Malay name would be preferable, particularly if the "halal" message was to be credible. It was important that the label included a "halal" guarantee, and they approved of the phrase "certified by the New Zealand Institute of Meat Management". The Chinese, on the other hand, wanted the label to include the phrase "made from the finest New Zealand ingredients" rather than imported from New Zealand as the latter phrase would raise doubts about the product's freshness. The Malay women thought they would buy the pie 3 times/week to once/month while the Chinese women would buy it twice/week to twice/month.

7.3.2.2 Comparison between Malay and Chinese students

Amongst the women, the Chinese were more positive about the pie. However, the reverse was true of the students where the Malays were more enthusiastic. The Chinese students did not like the pie. Again, this showed up in pricing - the Chinese students would not pay more

than \$1.20 while the Malay students would pay \$1.50-\$1.80. The Malay students would eat the pie where it was sold for a snack, brunch, afternoon tea and for supper. They considered the pie as a fast food and thus would not take it home. They also found the pie filling enough for lunch. The Chinese considered the pie more as a snack, to be eaten when they were in a supermarket. They would also eat the pie for a Sunday lunch.

Generally, when asked about what they liked or disliked about the pies, the Malays were more forthcoming than the Chinese. The Malays liked both the filling and pastry while the Chinese liked the filling better than the pastry. Both Malays and Chinese disliked the strong smell of beef and the softness and wetness of the filling. The Malay students appeared to be frequent consumers of local pies and noted that the pastry of the beef pie was better than that of the best pie in Kuala Lumpur. They also mentioned that it was an easy food to eat while studying, and that it had a lot of meat and calories, and thus was suitable as a replacement for a rice meal.

Most of the Chinese students who had tasted the locally made pies said they like the locally made pies better as they did not like beef. They were more used to chicken pies than the concept of a beef pie. Some of the Malay students preferred the local chicken pie as the smell was not so strong. Those who said that they preferred the beef pie gave the following reasons:

- * the fillings in local pies were considered too dry, but in the beef pie, it was just right.
- * the ratio of filling to pastry in the local pies was not in the right proportion.
- * the beef pie was more spicy than the chicken pie.
- * the top pastry of the local pie was too hard.

The Chinese students were concerned that the pie would not be fresh if it was imported. The Malays did not bring up this subject at all. Both, however, wanted an improvement in the appearance of the pie.

The reasons the Malays would buy the pie was that it was cheap, convenient and fast. They said that the main competition for the pie

would come from hamburgers. The pie was considered a better alternative because it was more filling and more nutritious (contained more vegetables). Generally, the pie would compete with fast food, rather than hawker food. Hawker food was inconvenient as one had to wait for it to be cooked and also it had to be eaten with a fork and spoon. Thus, the pie would be eaten when one had no time for hawker food e.g. shopping or at the movies. One Malay student said that there was no "standard" (prestige) in eating hawker food for breakfast and lunch; pies and hamburgers were better alternatives. They also mentioned that the pie was more suitable for supper as it was not too "heavy".

The Chinese and Malays were both undecided about the name for the product. The Chinese thought that naming it as "New Zealand beef pie" would mean that it was new (not local) and different, but they felt that an imported product would not be fresh. The Malays felt that the name was too long, uninteresting, not catchy and too formal. On the other hand, the word New Zealand was quite important as it would differentiate it from other pies. Although the Malay students said they would not doubt the pie if it was labelled as "contains halal beef", they felt it would be better if the phrase "certified by the New Zealand Institute of Meat Management" was used, just below the brand. It would be even better, they said, if the halal symbol was included. A majority of the Malay students preferred the English version of the name as opposed to the Malay version. Both Malay and Chinese students thought that the pie should be promoted on television, in the newspapers and in the cinema. The Chinese wanted the advertisement to tell them where the pie is sold, that it was a new product well known in New Zealand and widely accepted by Malaysians. They suggested that it be promoted as suitable for both adults and children, that it tastes nice and is worth trying. The Malays wanted to know that the pie is "in town", is convenient, and is suitable for most people.

The Chinese wanted the pie in bakeries inside supermarkets, while the Malays wanted it in supermarkets, bread and cake shops, schools, and through hawkers, e.g. hamburger stalls. The Chinese wanted the pie in an aluminium foil tray, while the Malays suggested plastic bags, paper bags, cardboard or polystyrene boxes. The Chinese students said they would buy the pie 1-2 times/month; the Malay students' response ranged

between daily to twice/month, with most indicating 1-2 times/week.

7.3.2.3 Discussion of focus group results

There were slight differences in the way in which the two ethnic groups perceived the product. The Chinese thought of the pie as a snack to be eaten while they were out shopping. The Malay women, on the other hand, perceived it as a replacement for homemade snacks for afternoon tea, while the Malay students thought of it as an alternative to hamburgers and would eat the pie on almost all occasions.

Freshness was of concern to all the focus group participants, with the exception of the Malay students. This clearly confirmed the findings of the first focus group conducted with Malaysian students in New Zealand who noted that bakery products should be fresh.

Appearance was also important to all the participants. They thought that the pie did not look as attractive as local pies and wanted decorations on it. The pseudo-consumer panelists in New Zealand also made similar suggestions in the sensory evaluation of the pie. Unfortunately, this could not be done as it involved extra labour during manufacture.

The Malay women were critical of the pastry of the pie, while the Chinese women and students liked the pastry. There was, however, agreement amongst most of the participants that the beef smell/flavour of the pie was too strong. This was the primary reason why the Chinese students did not like the pie.

"Halal" labelling was obviously very important to the Malays who were concerned about imported products containing meat as they did not know how these products are processed. All the Malay participants wanted reassurance and preferred the phrase "certified by the New Zealand Institute of Meat Management" as opposed to the phrase "contains halal meat" and they also wanted the halal symbol. Nearly all the participants wanted the pie to be sold in supermarkets or in the bakeries in supermarkets. This was in contrast to the initial survey where the respondents also wanted bakery products in canteens.

7.4 CENTRAL LOCATION TEST

7.4.1 Organisation of the central location test

The type of consumer test that could be conducted was restricted by the fact that the pie had to be heated before tasting. It was decided to do a central location test in a supermarket. Supermarkets are popular places for shopping in Malaysia and are thus a convenient way to obtain respondents in one location. Supermarket shoppers tend to be from the lower-middle class upwards and would be the target market for bakery products. An electricity supply would be available in supermarkets. (Electricity was needed for the ovenettes used to heat the pies.)

Three supermarkets were selected, two from a lower middle class area (one with a predominantly Chinese clientele and the other with a predominantly Malay clientele), and one from an upper middle class area. These three locations were chosen to provide a representative profile of the target market.

Permission was sought from the management of the supermarkets for the use of an area for the tasting. A space in the lobby of the supermarket or within the supermarket was used to set up a table. Two ovenettes were placed on the table, and were used to warm up the pies. Each ovenette could heat up two pies simultaneously. After thawing, each pie required 10 minutes of heating. A piece of foil was placed between the top of the pie and the heating element at the top of the ovenette to prevent charring of the top of the pie top. After heating, the pie was placed on a serviette and given to an interviewer.

7.4.2 The interview process

The central location test was conducted as a series of person to person interviews. Each interviewer randomly approached a person in the supermarket, identified himself, and asked the person if he/she would like to participate in a consumer test on beef pies. The interviewer would also explain that the pie was made in New Zealand and participation involved tasting the pie and answering several questions. A whole pie was presented to each respondent (unless they requested otherwise).

Interviewers were recruited from students in Universiti Malaya in Kuala Lumpur. Malay interviewers were recruited for interviewing Malay respondents, and Chinese interviewers for interviewing Chinese respondents.

The questionnaire consisted of questions on the overall liking of the pie, flavour of the pie, purchase intent, price, packaging, and buying frequency. There were also two open-ended questions on why they liked/disliked the pie overall and the flavour of the pie. The questionnaire is shown in Figure 7.1. English, Mandarin, and Malay versions of the questionnaire were also available to the interviewers.

7.4.3 Problem of rejection in the central location test

Rejection rates were quite high, although they varied from supermarket to supermarket (between 20-30% for two supermarkets and around 60% for the third). It was not possible to record the details of the rejection as there were too many to monitor. However, a local market research firm also encounters a rejection rate of approximately 60% (although their method of recruitment is slightly different). The supermarket which had a higher rejection rate than the other two is situated in a predominantly lower middle to middle class Chinese area. There is a reasonably high percentage of conservative Chinese who do not eat beef and thus the high rate of rejection.

7.4.4 Analysis of results

The results of the central location test analysed using SPSS (Nie, 1975). Answers that were incomplete were termed "missing values" and where the respondents did not answer a question, this was termed "non-response".

7.4.5 Profile of respondents

There was a predominance of younger people (21-30 years) amongst the respondents, with slightly more males than females. This was believed to be representative of supermarket shoppers in Malaysia.

Figure 7.1: Questionnaire for central location test

We are conducting a consumer test on a beef pie made in New Zealand. Would you be interested in participating in this questionnaire?

- Yes (IF YES, CONTINUE WITH QUESTIONNAIRE)
 No (IF NO, COMPLETE PANEL BELOW, AND THANK RESPONDENT)

TO BE COMPLETED BY INTERVIEWER

| | | | | | |
|--------------|--------------------------------|----------------------------------|---------------------------------|--------------------------------|------------------------------|
| Location | _____ | | | | |
| Time | _____ | | | | |
| Sex | <input type="checkbox"/> Male | <input type="checkbox"/> Female | | | |
| Ethnic group | <input type="checkbox"/> Malay | <input type="checkbox"/> Chinese | <input type="checkbox"/> Indian | <input type="checkbox"/> Other | |
| Age group | <input type="checkbox"/> 15-20 | <input type="checkbox"/> 21-30 | <input type="checkbox"/> 31-40 | <input type="checkbox"/> 41-50 | <input type="checkbox"/> >50 |

This is a sample of a pie made in New Zealand. It is specially designed for Malaysians and it contains (halal) mince beef, vegetables, macaroni, and spices. I would like you to taste the pie and answer a few questions.

- Generally, do you like the flavour of the pie? (DO NOT READ ANSWERS ALOUD)
 - Yes (IF YES, GO TO Q.2)
 - No (IF NO, GO TO Q.3)
 - Don't know (IF DON'T KNOW, GO TO Q.4)
- What do you particularly like about the flavour? (PROBE)
- What do you particularly dislike about the flavour? (PROBE)
- This product can be sold at a variety of different places. At what shops would you like this pie to be sold? (DO NOT READ, TICK MORE THAN ONE IF NECESSARY. WHEN RESPONDENT HAS FINISHED ASK IF THERE ARE ANY OTHER OUTLETS)
 - supermarket
 - bread and cake shop
 - sundry shop
 - coffee shops
 - fast food outlets
 - school canteens
 - other, please specify _____
- Here is a card showing a series of answers from 'like extremely' to 'dislike extremely'. In general, how do you like the pie? Please use this card to answer and tell me which one is nearest to the way you feel.
 - like extremely } (IF LIKE, GO TO Q.7)
 - like moderately }
 - neither like nor dislike (IF NEITHER, GO TO Q.9)
 - dislike moderately } (IF DISLIKE, GO TO Q.8)
 - dislike extremely }
- Why do you like the pie? (PROBE)
- Why do you dislike the pie? (PROBE)
- If a pie made in Malaysia costs about \$1.20, and this pie made in New Zealand will cost \$1.30, would you be in buying this New Zealand pie? (SHOW CARD TO RESPONDENT)
 - very interested } (IF INTERESTED, GO TO Q.11)
 - somewhat interested }
 - not at all interested (IF NOT AT ALL, GO TO Q.10)
- How much would you like to pay for the pie?
- If the price were \$1.30, how often do you think you would buy this pie? (READ ALOUD, AND TICK ONE ONLY)
 - more than once a week
 - once a week
 - once a fortnight
 - once a month
 - less than once a month
- Do you have any comments you would like to make about the pie?
 THANK RESPONDENT.

Table 7.2: Profile of respondents in central location test

| | Age group | | | | | Total |
|------------------|----------------|----------------|----------------|----------------|---------------|--------------|
| | 15-20 years | 21-30 years | 31-40 years | 41-50 years | > 50 years | |
| Malay - male | 6 | 26 | 16 | 7 | 2 | 57 (22.2%) |
| Malay - female | 10 | 33 | 8 | 3 | 0 | 54 (21.0%) |
| Chinese - male | 5 | 40 | 36 | 5 | 2 | 88 (34.2%) |
| Chinese - female | 8 | 35 | 13 | 2 | 0 | 58 (22.6%) |
| Missing values | - | - | - | - | - | 14 |
| Total | 29 (11.3%) | 134 (52.1%) | 73 (28.4%) | 17 (6.6%) | 4 (1.6%) | 271 (100.0%) |

Note: Percentage was given out of the total number of respondents, i.e. 146 Chinese, 114 Malays and 257 total (missing values were not included).

7.4.6 Comparison between ethnic groups on acceptability of the pie

Generally, a high percentage of Malays and Chinese said that they liked the pie (83% and 84% respectively) as shown in Table 7.3. The biggest percentage (63%) of consumers liked the pie "moderately".

Table 7.3: Overall liking of pie

| | Chinese | | Malay | | Overall | |
|--------------------------|---------|-------|-------|-------|---------|-------|
| | No. | % | No. | % | No. | % |
| Like extremely | 35 | 23.8 | 20 | 17.5 | 55 | 21.1 |
| Like moderately | 89 | 60.5 | 75 | 65.8 | 164 | 62.8 |
| Neither like nor dislike | 12 | 8.2 | 14 | 12.3 | 26 | 10.0 |
| Dislike moderately | 10 | 6.8 | 1 | 0.9 | 11 | 4.2 |
| Dislike extremely | 1 | 0.7 | 4 | 3.5 | 5 | 1.9 |
| Missing value | | | | | 10 | - |
| Total | 147 | 100.0 | 114 | 100.0 | 271 | 100.0 |

Note: Percentage was given out of the total number of respondents, i.e. 147 Chinese, 114 Malays and 261 total (missing values were not included).

There were few differences even when age group was taken into account (see Table 7.4).

Table 7.4: Age group and liking of the pie by respondents

Malay respondents

| | 15-20 years | | 21-30 years | | 31-40 years | | 41-50 years | |
|------------------------------------|-------------|-------|-------------|-------|-------------|-------|-------------|-------|
| | No. | % | No. | % | No. | % | No. | % |
| like (moderately and extremely) | 15 | 93.8 | 54 | 90.0 | 16 | 66.7 | 7 | 70.0 |
| neither like nor dislike | 1 | 6.2 | 5 | 8.3 | 5 | 20.8 | 2 | 20.0 |
| dislike (moderately and extremely) | 0 | 0.0 | 1 | 1.7 | 3 | 12.5 | 1 | 10.0 |
| Total | 16 | 100.0 | 60 | 100.0 | 24 | 100.0 | 10 | 100.0 |

Chinese respondents

| | | | | | | | | |
|------------------------------------|----|-------|----|-------|----|-------|---|-------|
| like (moderately and extremely) | 12 | 92.3 | 64 | 85.3 | 40 | 81.6 | 0 | 0.0 |
| neither like nor dislike | 0 | 0.0 | 5 | 6.7 | 6 | 12.3 | 2 | 100.0 |
| dislike (moderately and extremely) | 1 | 7.7 | 6 | 8.0 | 3 | 6.1 | 0 | 0.0 |
| Total | 13 | 100.0 | 75 | 100.0 | 49 | 100.0 | 2 | 100.0 |

When asked what they liked about the pie, flavour dominated the responses of Malay and Chinese respondents alike. Convenience was also important to 16% of the Malays, while 9% of the Chinese liked the filling. A large variety of other minor reasons for liking the pie were given by only one respondent each, thus they could not be categorised separately. In fact, many respondents found it difficult to explain why they liked the pie (see Table 7.5).

Table 7.5: Reasons for liking pie

| | Chinese | | Malay | | Overall | |
|---------------|---------|------|-------|------|---------|------|
| | No. | % | No. | % | No. | % |
| Flavour | 47 | 32.9 | 40 | 42.1 | 87 | 37.9 |
| Filling | 11 | 8.9 | 3 | 3.2 | 14 | 6.4 |
| Beef | 8 | 6.5 | 2 | 2.1 | 10 | 4.6 |
| Pastry | 8 | 6.5 | 2 | 2.1 | 10 | 4.6 |
| Smell | 7 | 5.6 | 2 | 2.1 | 9 | 4.1 |
| Crispy | 6 | 4.8 | 4 | 4.2 | 10 | 4.6 |
| Soft pastry | 5 | 4.0 | 1 | 1.1 | 6 | 2.7 |
| Convenience | 4 | 3.2 | 17 | 17.9 | 21 | 9.6 |
| It is filling | 1 | 0.8 | 7 | 7.4 | 8 | 3.7 |
| Other | 32 | 25.8 | 28 | 29.5 | 60 | 27.4 |
| Total | 129 | | 106 | | 235 | |

Note: Percentage was taken out of respondents who liked the pie (non-responses were not included), i.e. 129 Chinese, 106 Malays and 235 total. More than one response was permitted, resulting in more responses than the number of respondents who liked the pie.

There were very few respondents who did not like the pie. A majority of the Chinese who did not like the pie (3 out of 7) said it was because of the beef. Detailed results are given in Appendix 7.1.

The flavour of the pie was acceptable to most respondents (see Table 7.6). When asked why they liked the flavour of the pie, there was a remarkably similar response from both ethnic groups. Of greatest importance was the beef smell and flavour, the pie filling, and the pastry. Here again, there were many respondents who gave reasons which were not shared by other respondents, which resulted in a large "other" category (see Table 7.7).

Table 7.6: Response to flavour of pie

| | Chinese | | Malay | | Overall | |
|------------------------|---------|-------|-------|-------|---------|-------|
| | No. | % | No. | % | No. | % |
| Like flavour of pie | 128 | 87.1 | 97 | 85.1 | 225 | 86.2 |
| Dislike flavour of pie | 14 | 9.5 | 7 | 6.1 | 21 | 8.0 |
| Don't know | 5 | 3.4 | 10 | 8.8 | 15 | 5.8 |
| Non-responses | - | - | - | - | 10 | - |
| Total | 147 | 100.0 | 114 | 100.0 | 271 | 100.0 |

Note: Percentage was given out of the total number of respondents, i.e. 147 Chinese, 114 Malays and 261 total (non-responses were not included).

Table 7.7: Reasons for liking flavour of pie

| | Chinese | | Malay | | Overall | |
|--------------------|---------|-------|-------|-------|---------|-------|
| | No. | % | No. | % | No. | % |
| Beef smell/flavour | 27 | 21.1 | 23 | 23.7 | 50 | 19.4 |
| Tastes nice | 20 | 15.6 | 15 | 15.5 | 35 | 13.6 |
| Pastry | 22 | 17.2 | 20 | 28.6 | 42 | 16.3 |
| Filling | 12 | 9.4 | 12 | 12.4 | 24 | 9.3 |
| Crispy pastry | 8 | 6.3 | 6 | 6.2 | 14 | 5.4 |
| Spiciness | 9 | 7.0 | 6 | 6.2 | 15 | 5.8 |
| Everything | 2 | 1.6 | 5 | 5.2 | 7 | 2.7 |
| Different taste | 2 | 1.6 | 2 | 2.1 | 4 | 1.6 |
| Pepper | 6 | 4.7 | 1 | 1.0 | 7 | 2.7 |
| Other | 37 | 28.9 | 23 | 23.7 | 60 | 23.2 |
| Missing value | 2 | - | 1 | - | 3 | - |
| Total | 147 | 100.0 | 114 | 100.0 | 261 | 100.0 |

Note: Percentage was given out of the total number of respondents who liked the pie, i.e. 128 Chinese, 97 Malays and 258 total (non-responses were not included). More than one response was permitted, resulting in more responses than respondents who liked the flavour of the pie.

The reasons for not liking the flavour of the pie were quite different for the two ethnic groups. The Chinese said the beef flavour was too strong while the Malays said they did not like pies as a product (see Appendix 7.2).

7.4.7 Retail outlet

Both ethnic groups had similar ideas as to where they wanted the product sold. Top on the list were supermarkets (38.2% Chinese and 34.5% Malays), followed by fast food outlets, and "others" (which included hawkers, burger stalls, restaurants). This was in contrast to the initial survey where the respondents wanted bakery products to be sold in bread and cake shops.

Table 7.8: Retail outlets preferred for the pie

| | Chinese | | Malay | | Overall | |
|---------------------|---------|------|-------|------|---------|------|
| | No. | % | No. | % | No. | % |
| Supermarket | 118 | 80.3 | 90 | 78.9 | 208 | 79.7 |
| Fast food outlet | 47 | 32.0 | 56 | 49.1 | 103 | 39.5 |
| Bread and cake shop | 46 | 31.3 | 43 | 37.7 | 89 | 34.1 |
| Coffee shop | 19 | 12.9 | 17 | 14.9 | 36 | 13.8 |
| School canteen | 17 | 11.6 | 15 | 13.2 | 32 | 12.3 |
| Sundry shop | 7 | 4.8 | 5 | 4.4 | 12 | 4.6 |
| Other | 55 | 37.4 | 35 | 30.7 | 90 | 34.5 |
| Total | 309 | | 261 | | 570 | |

Note: Percentage was given out of the total number of respondents in test e.g. 147 Chinese, 114 Malays and 261 total. More than one response was permitted.

7.4.8 Buying intentions and proposed frequency of purchase

The price of the pie was set at \$1.30 in the test, and the respondents were asked if they were interested to buy the pie at that price. There was a slightly different response between the ethnic groups (see Table 7.9). More Chinese than Malays were "very interested", while a majority of the Malays fell into the "somewhat interested" category. However, for those respondents interested in buying the pie, the distribution of their intended frequency of purchase was very similar (see Table 7.10).

Table 7.9: Buying intentions

| | Chinese | | Malay | | Overall | |
|-----------------------|---------|-------|-------|-------|---------|-------|
| | No. | % | No. | % | No. | % |
| Very interested | 48 | 33.8 | 24 | 21.4 | 72 | 28.3 |
| Somewhat interested | 71 | 50.0 | 75 | 67.0 | 146 | 57.5 |
| Not at all interested | 23 | 16.2 | 13 | 11.6 | 36 | 14.2 |
| Non-response | 5 | - | 2 | - | 7 | - |
| Total | 147 | 100.0 | 114 | 100.0 | 261 | 100.0 |

Note: Percentage was given out of the total number of respondents i.e. 142 Chinese, 112 Malays and 254 total (non-responses were not included).

Table 7.10: Proposed frequency of purchase

| | Chinese | | Malay | | Overall | |
|------------------------|---------|-------|-------|-------|---------|-------|
| | No. | % | No. | % | No. | % |
| More than once a week | 33 | 28.3 | 26 | 26.3 | 59 | 27.4 |
| Once a week | 43 | 37.5 | 40 | 40.4 | 83 | 38.6 |
| Once a fortnight | 13 | 11.7 | 20 | 20.2 | 33 | 15.4 |
| Once a month | 16 | 13.3 | 12 | 12.1 | 28 | 13.0 |
| Less than once a month | 11 | 9.2 | 1 | 1.0 | 12 | 5.6 |
| Non-response | 3 | - | - | - | 3 | - |
| Total | 119 | 100.0 | 99 | 100.0 | 218 | 100.0 |

Note: Percentage was given out of the total number of respondents who were interested in buying the pie, i.e. 116 Chinese, 99 Malay and 215 total (non-responses were not included).

7.4.9 Discussion of central location test results

The consumer test showed that a majority of Malay and Chinese respondents liked the pie. A large proportion of those who liked the pie said it was because of its flavour. Of those who liked the flavour of the pie, about 20% of the respondents indicated they liked the beef smell and flavour. The focus group discussion as well as the sensory profiling, on the other hand, showed that most respondents found the beef flavour overpowering. It is possible that the 20% of the consumer test respondents who liked the beef flavour of the pie were in the minority, while the majority could have found it too strong, although they liked the overall flavour.

In most respects, the responses from both ethnic groups were remarkably similar. There was perhaps a small difference in the reasons for liking the pie. The Malays thought that convenience was important, whereas the Chinese did not. The Chinese also indicated that they

liked the pie because of the pastry (confirmed by the focus groups where the Chinese women especially liked the pastry).

As in the focus group, the respondents in the consumer test wanted the pie to be sold in supermarkets. A large proportion (about 40% of all respondents) also wanted it in fast food outlets. The focus group participants also suggested fast food outlets.

In the initial consumer survey, respondents were asked whether, apart from bread and cake shops, they would like to see bakery snacks sold in canteens, sundry shops and hawkers. At that stage, fast food outlets and supermarkets were not identified as potential outlets for bakery snacks. However, since the initial survey was carried out, both those outlets have grown in importance in Malaysia.

When asked if they were interested in buying the pie, a majority of the respondents (58%) said they were somewhat interested while 28% indicated they were very interested. Many respondents commented that the scale was skewed, i.e. they felt that there should be a category between "very interested" and "somewhat interested". This, however, did not seem to affect their proposed frequency of purchase where 66% indicated that they would buy it at least once a week. Market potential could not be obtained from the consumer test because of the high rejection rate. This resulted in a sample of respondents which may not be representative of the Malay and Chinese population. Additional data, such as the age distribution of the population and the age groups of people who shop at supermarkets are required. Further data such as sales of pies from bakeries would also provide an indication of the potential size of the market. The figures for Proposed frequency of purchase were thought to be inflated as local pies do not sell very well.

7.4.10 Marketing information from product testing

A price of \$1.30 for the pie was set for the consumer test and it appeared to be acceptable to the respondents. The price which the focus group participants were willing to pay ranged between \$1.00 - \$1.80 and that was used as a guideline. It would have been more informative to provide a range of prices for selection by the consumer.

As it is, no information was obtained on how consumers would react if the price was altered.

All the participants in the focus groups wanted the product to be promoted, particularly on television. The Malay students wanted the promotion to be "exciting" with a catchy product name and jingle. The Chinese students, on the other hand, wanted to know that the pie was a new product and is well known in New Zealand and widely accepted in Malaysia. They also wanted to know that it tastes nice and is worth buying. Both Malay and Chinese women did not know how the product should be promoted. It was clear that the "halal" message was important to the Malays. The preferred labelling include the phrase "certified by the New Zealand Institute of Meat Management" together with the "halal" symbol. The brand name was not resolved as the concern for freshness was very strong. The focus group participants wanted to know that the beef was from New Zealand, but did not like the concept of importing the pie. There was an overwhelming preference for the pie to be sold in supermarkets.

7.5 DISCUSSION OF RESULTS FROM CENTRAL LOCATION TEST, FOCUS GROUPS AND SENSORY PROFILING

Both the central location test and sensory profiling results indicated that the pie was acceptable to consumers. The focus group results, however, did not fit completely into this trend. Malay women and Chinese students said they did not like the pie although they rated it acceptable in the sensory profiling.

Sensory properties were obviously important to the respondents in the central location test. These were also mentioned repeatedly in the focus groups. This confirmed the earlier findings that indicated that "taste" was an important factor in a bakery snack. One aspect of the sensory properties of the pie was the beef flavour. Both focus group and central location test results indicated that beef flavour was too strong. The consumer test, however, showed that some respondents liked the beef flavour. Only a small proportion of respondents did not like the pie because of the beef flavour (1%). This could be due to the fact that people who did not like beef tended not to participate in the

test.

In the focus group, the Malay women did not like the pastry of the pie and they also rated it lower than other consumers and the pseudo-consumers. The Chinese, on the other hand, said they liked the pastry very much. This was also the trend in the consumer test where 15% of the Chinese respondents said they liked the pie because of the pastry (compared to only 7% of the Malays).

Convenience was an important feature to the Malays; this was shown both in the consumer test and focus groups. Eighteen percent of the Malays liked it because it was convenient, only 3% Chinese gave the same response. In the focus group, the Malay students liked the pie because it was cheap, fast and easy.

7.6 CONCLUSION

The pie was acceptable to both ethnic groups, although the Malay students perceived the pie differently (as a competitor to hamburgers rather than a bakery snack). The sensory properties of the pie were very important, and could be improved by reducing the intensity of the beef flavour. It was believed further improvements should be made on the pie and then a market test should be conducted.

CHAPTER 8THE USEFULNESS OF CONSUMERS AT DIFFERENT STAGES IN THE
PRODUCT DEVELOPMENT PROCESS8.1 COMPARISON OF MARKET RESEARCH TECHNIQUES IN THE INITIAL STAGES OF
PRODUCT DEVELOPMENT

Three different techniques were used in the initial market research stage: a focus group, a consumer survey and multidimensional scaling. Background information was also sought from the literature in the desk study to provide information about the Malaysian market.

The desk study identified product areas which would represent opportunities in the Malaysian market, defining the scope of the study. It also revealed important trends and consumer attitudes relevant to the project. However, from the information obtained, it was impossible to predict relative acceptabilities of product areas amongst the ethnic groups.

The results of the three techniques used for initial market research are summarised in Table 8.1. The characteristics that were desired in a bakery snack were quite apparent, it had to taste and smell good, be seen to be fresh, need no preparation, have a "clean" image, and be thought to be healthy. The product type preferred was less definite due to slight differences in preference between the two ethnic groups. Bread products were favoured by panelists in New Zealand, and purchased by both ethnic groups from bread and cake shops, but the MDS results indicated a preference for non-bread products by both Malays and Chinese in Malaysia. A savoury product was favoured by both ethnic groups. Foreign products were also clearly favoured, possibly because it was a neutral area. Both ethnic groups indicated a preference for the incorporation of local flavours.

 Table 8.1: Results of initial market research

FOCUS GROUP

Product characteristics found to be important

~~convenience~~
 freshness
 smell
 incorporation of local flavour
 "healthiness" was mentioned

Product area ranked in terms of preference

~~meat pies~~
 special variety bread
 pastry products
 cake/biscuit mixes, and pastry dough for consumers and caterers
 local kuihs

Outlet preferred

~~bread and cake shops~~

CONSUMER SURVEY

Product characteristics found to be important

taste, cleanliness, freshness
 healthy (i.e. good for you)
 convenient to obtain

Types of products most commonly purchased by respondents

| | |
|-------------------|-------------------|
| Malay | Chinese |
| bread | filled baked buns |
| cake | bread |
| filled baked buns | curry puff |
| curry puff | cake |
| pie | pie |

Outlet other than bread and cake shop preferred

canteens

MULTIDIMENSIONAL SCALING

Perception of bakery snacks

~~taste - sweet to savoury~~
 product type - bread to non-bread
 origin of product - local or foreign

Product area preferred

| | |
|-----------|-----------|
| Malay | Chinese |
| savoury | savoury |
| non-bread | non-bread |
| foreign | foreign |

The important characteristics in bakery snacks nominated in both the focus group and the consumer survey were consistent. This was an interesting result since the focus group consisted of Malaysian students who were overseas for nearly one year. The characteristics listed as important were convenience, nutrition (health) and freshness. Taste was found to be important in the survey and the MDS. One piece of information that was unique to the MDS technique was the concept of "bread" vs "non-bread" products.

The focus group results showed that participants wanted bakery products to be sold only in bread and cake shops. In the survey, alternative outlets were explored. These included canteens, hawkers and sundry

shops. These outlets were selected from the author's experience, and only the canteens were popular amongst survey respondents. However, at the product testing stage, the results revealed a strong preference for supermarkets. Canteens were selected by only 12% of respondents.

The information from the three techniques used initially were both consistent and complementary. Initial focus groups revealed important attitudes and trends which were used to design the questionnaire for the survey from which quantitative results were obtained. MDS provided a broad picture of the perception and preferences for bakery snacks. It also revealed only minor differences between the two ethnic groups.

From the results of the initial market research, conclusions could be drawn on the use of the three techniques. Firstly, both focus group and MDS provided general information on product areas and product types which could be used to guide product development. They are both exploratory techniques. Extensive knowledge or understanding of the market is not required for their use. They can be conducted quickly and without the expenditure of large amounts of money. Although, in focus groups, care has to be taken in selecting consumers representative of the population of interest, recruitment need not be so stringent for MDS.

On the other hand, an understanding of the market was required before a survey could be conducted, otherwise irrelevant information will be obtained. This was shown in the choice of the outlets (canteens, hawkers, sundry shops) presented as alternatives to the respondents. Supermarkets would probably have been a better choice, but was not selected because of the lack of information. Thus, a survey is best conducted where there is sufficient information to decide on relevant areas that require quantitative information, such as the frequency with which snacks are eaten, buying patterns and differences between population segments.

This agrees with traditional market research thinking which regards focus groups as a qualitative exploratory research technique to guide the design of future quantitative studies.

8.2 USE OF CONSUMERS IN IDEA GENERATION AND SCREENING

The two techniques, brainstorming and nominal group technique were effective in producing good product ideas, but under different conditions. Brainstorming produced more novel and innovative ideas but required skillful moderation. Nominal group technique, on the other hand, was easier to conduct but produced less innovative ideas.

Effort was made to select simple idea generation techniques as the panelists were not specially selected or trained for the purpose. The consumers who participated in the idea generation sessions were also the ones who scaled the bakery product for MDS. The results showed that the use of idea generation techniques was productive and could perhaps be improved by the selection of creative individuals. Good ideas were obtained and they were mostly a cross of ideas (i.e. western products with an asian flavour or filling) rather than completely novel ideas. Thus, use of consumers for idea generation was felt to be particularly suited to line extensions or product modifications. However, it may be possible to generate novel ideas if consumers are recruited who are especially creative.

Due to the large number of product ideas generated, a quantitative screening method was used to reduce the number to seven products for final selection by consumers. Consumers were asked to select the product category that they most preferred and to rank their preference for the products within each product category. This method revealed the preferences of the two ethnic groups for the four product categories (pies, cakes, buns and pizza). The Chinese had a strong preference for pies while the Malays did not show a distinct preference for any one category. Meat pies were identified by the first focus group (consisting of Chinese students) as a suitable imported bakery snack. Meat pies also fell into the region of preference identified in MDS, i.e. it was a foreign, savoury, non-bread product. Because of all these factors, a meat pie was chosen for further development.

8.3 SENSORY EVALUATION METHOD TO GUIDE FORMULATION OF FOOD PRODUCTS

In this project, Malaysian students consisting of Malay and Chinese students in Universiti Sains Malaysia were used to set up an "ideal product profile". The plan was to train a pseudo-consumer panel in New Zealand to use the "ideal product profile" to guide the formulation development. Unfortunately, this was not possible because the formulation of the pie made in Malaysia for the ideal product profiling could not be duplicated in New Zealand. This meant that the New Zealand panelists could not relate to the scoring or the "ideals" of the Malaysian panel. Thus, the pseudo-consumers panelists in New Zealand established their own ideal product profile which was subsequently used to guide formulation of the pie. Sensory data from the profiling was used successfully to derive empirical equations relating product attributes and acceptability to ingredient levels.

Although the pseudo-consumer panelists were not representative of the consumers in Malaysia, using the sensory profiling method with ideals, an acceptable product was achieved. This was confirmed in the product testing with four different groups of consumers in Malaysia (Malay women, Chinese women, Malay students, Chinese students). An identical ideal product profile was used to evaluate the pie. The profiles produced by all the consumer groups correlated significantly with each other and with that of the pseudo-consumer panelists in New Zealand. Thus, the use of consumers who were briefly trained was successful in guiding formulation, together with the use of their own product profile with fixed ideals.

Two issues remain unresolved in this formulation study. One was the location of ideals and the other was the use of interval and ratio scores for analysis of ideals. In this research, the pseudo-consumer panelists were allowed to develop their own ideals. Ideals for each attribute was fixed, and all ideals were placed, by agreement, into positions of 0, 2.5, 5, or 10 cm on the line scale. Because the range of the interval and ratio scores was different, the standard deviation of the scores was not comparable across attributes with different ideals. It is not practicable to have all the ideals at one point on the line scale (e.g. 5), as not all ideals of attributes are wanted in moderation. Ideals of off-flavours should be as low as possible and

ideals for acceptability should be as high as possible. The effect of changing the anchor words on the line scale to allow all ideals to be set at one point was not investigated. The second issue relates to the use of interval or ratio scores. Both were used in preference to sample scores as they gave an indication of how far away the attributes were from the ideal. However, both appeared to be similar in effectiveness in regression equations. More detailed studies are required to establish differences in the two techniques in analysing ideals.

8.4 COMPARISON OF CENTRAL LOCATION TEST, FOCUS GROUP AND SENSORY PROFILING IN PRODUCT TESTING

The three techniques were selected for product testing as they were complementary. The central location test provided data on the percentage of people interested in buying the pie. This could be used to estimate the market potential. The focus group was a qualitative technique which could provide information on the consumer attitudes towards the product and thus, how it could be best positioned. The sensory profile could be used to compare the evaluation of the pie by the consumers with that of the pseudo-consumer panelists in New Zealand.

The results from the central location test correlated well with that obtained from sensory profiling. There was an overall liking of the pie, but the strong beef flavour was unacceptable to some consumers. Results of both techniques also indicated slight differences between ethnic groups. In the sensory profiling, the Malay women did not like the pastry whereas the Chinese women did. From the consumer test, a percentage of the Chinese (15%) indicated that they liked the pastry while fewer Malays did (7%).

Contradictory evidence was obtained from the focus group and sensory profiling. In the focus group, the Malay women and Chinese students indicated that they did not like the pie, but their sensory score for the overall acceptability was 6.4 and 6.7 respectively. This could have been due to the influencing of group opinion by a few dominant participants.

Market potential could not be estimated due to a high rejection rate and a lack of statistical information on the proportion of the population who shop in supermarkets. The estimates of buying frequency obtained from the central location test and the focus groups were thought to be higher than the normal buying pattern for bakery products. Thus, the central location test was only useful in quantifying the information from the sensory profiling and focus groups. A test market would be more useful in obtaining market potential.

The focus group and sensory profile were very useful in eliciting information on whether the product needed improvement and how it could be improved. It would be more useful to employ these two techniques after formulation. Then, if necessary, the product could be reformulated before conducting a central location test or test market to predict market potential. The central location test is an expensive and time consuming exercise and should only be carried out at the final stages of the product development. The greatest drawback of using central location test to predict market potential, however, is the lack of information on consumer awareness, repeat purchase, and depth of repeat.

8.5 THE STAGES AT WHICH CONSUMERS ARE MOST USEFUL IN PRODUCT DEVELOPMENT

In this project, consumers were used in virtually all stages. Their contribution was useful at all stages. However, consumer input was vital during the initial market research, during the formulation stage and during the product testing.

Consumer participation was also found particularly useful for screening. In this project, differences in preference between the Malays and Chinese were revealed during this process. From this research, it is recommended that small groups of consumers be used at as many of the product development stages as possible. This strategy reduces the chance of spending excessive amounts of time and money on erroneous or inaccurate data. Use of consumers at the various stages

helps guide the development and also provides a means of checking the information obtained previously. For example, the outlets selected as alternatives to bread and cake shops in the first survey and the focus group were not confirmed by the central location test or focus groups. Between the time when the initial market research and the product testing was conducted, supermarkets had grown in importance in Malaysia. If the focus groups in the product testing phase had been conducted earlier, this trend would have been detected.

8.6 THE TECHNIQUES SUITED FOR USE BY CONSUMERS, PARTICULARLY IN A CROSS-CULTURAL SITUATION

In almost all the techniques used, the two ethnic groups were kept separate to enable comparison. Language was not a major problem as the Malays spoke Malay while a majority of the Chinese spoke English or a Chinese dialect. In all cases except the initial survey and the central location test, the author conducted the research and there were only minor problems in communicating. Malay and Chinese translations of forms for use by consumers were provided where necessary.

The only technique where there was a cross-cultural problem was in the initial consumer survey and central location test. It was found that the Malays were reluctant to answer questions. The Chinese, on the other hand, responded well. No problems were found in focus groups where discussions were involved.

8.7 RECOMMENDATIONS FOR FUTURE WORK

The two ethnic groups were kept separate in all but one of the techniques used. At the formulation stage, the pseudo-consumer panelists were mostly Chinese with one Malay. Although the final product was acceptable to the four groups of consumers used in the product testing, there were some differences in the evaluation of the pie bottom, and beef aroma between the Malay women and the pseudo-consumer panelists. Further work could be done to see if formulation using two separate panels consisting of Malays and Chinese would produce two completely different formulations or one which is

acceptable to the two ethnic groups.

The first focus group produced results which were useful in the product development process. However, some of the results of the focus groups in the product testing phase did not correlate well with sensory profiling. This could be because the groups were not representative of the population. More focus groups need to be carried out before the results can be confirmed. Further research could be done as to the number of focus groups that need to be used at each stage before results can be regarded as quantitative, e.g. should the focus group be repeated 3, 5 or 10 times before the results are regarded as—representative of the target market.

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APPENDIX 2.1

FACTORS CONSIDERED IMPORTANT IN SCREENING

| Author | Factors |
|------------------------|--|
| Mottley & Newton, 1959 | Chances of technical success Time to completion Cost of project Market need Market gain |
| O'Meara, 1961 | Marketability Durability (stability and breath of market Production ability Growth potential |
| Harris, 1964 | Financial Research and development aspects Product and engineering aspects Marketing and product aspects |
| Earle, 1973 | Product factors Market factors Development work Processing and marketing Relationship to company Profit Future opportunities |
| Anderson, 1977 | General compatability with company strategy Market need Competition Timing Presentation Product requirements Selling price Likely trade reaction Return on investment Selling price |
| Merrifield, 1978 | Sales/profit potential Growth rate Competitor analysis Risk distribution Industry restructure opportunity Special factors Company needs vs availability In-house marketing capability In-house marketing capability Strength of technology base Raw material availability Management and other skills |
| Cooper, 1984 | Product superiority, quality and uniqueness Overall project/company resource compatibility Market need, growth and size Economic advantage to user Newness to firm Technological resource compatibility Market competitiveness Product scope |

APPENDIX 2.2

SEQUENTIAL SCREENING OF PRODUCT IDEAS

Bread and bread-related products

| | Technical Feasibility | Raw Material Availability | Cost of Product | General Acceptability |
|--|--------------------------|------------------------------|--------------------|--------------------------|
| <u>Products that failed Sequential Screening</u> | | | | |
| bread with pizza topping | F | | | |
| beef rendang bun | F | | | |
| garlic and shallots bun | F | | | |
| blackcurrant bread | | F | | |
| chilli bread | | F | | |
| dried prawn bread | | F | | |
| saibal udang bun | | F | | |
| saibal chicken bun | | F | | |
| chocolate chips in bread | | | F | |
| mint bread | | | | F |
| fibre bread | | | | F |
| herb bread | | | | F |
| rhubarb and date jam in bun | | | | F |

PieProducts that failed sequential screening

| | | | | |
|--------------------------|---|---|---|--|
| sweet potato pie | F | | | |
| pineapple pie | F | | | |
| raspberry pie | F | | | |
| chaya pie | F | | | |
| chickpea pie | F | | | |
| coconut pie | F | | | |
| cheat floss pie | F | | | |
| laksa-Otak pie | F | | | |
| rawan curry pie | F | | | |
| apple pie | F | | | |
| laksa gravy pie | F | | | |
| apple and prune pie | | F | | |
| rhubarb with custard pie | | | F | |

APPENDIX 2.2: continued

| <u>Cakes</u> | Technical Feasibility | Raw Material Availability | Cost of Product | General Acceptability |
|--|--------------------------|------------------------------|--------------------|--------------------------|
| <u>Products that failed sequential screening</u> | | | | |
| biscuit, jam cake | F | | | |
| cheesecake | F | | | |
| layer cake | F | | | |
| mixed fresh fruit cake | F | | | |
| durian cake | | F | | |
| lychee cake | | F | | |
| chempedak cake | | F | | |
| papaya cake | | F | | |
| prune cake | | F | | |
| sugar cake | | F | | |
| sponge cake with santan | | F | | |
| pineapple cake | | F | | |
| rum baba | | | F | |
| sherry trifle | | | F | |
| torte walnut | | | F | |
| <u>Other products</u> | | | | |
| <u>Products that failed sequential screening</u> | | | | |
| pancake | F | | | |
| bun meido | F | | | |
| yam puff | F | | | |
| local fruit flan | | F | | |
| pineapple tart | | F | | |
| almond tart | | | F | |
| scones | | | | F |

APPENDIX 2.3

PRODUCTS REMAINING AFTER SEQUENTIAL SCREENING

Bread and bread-related products

~~banana bread~~
orange bread
oat bread
chocolate flavoured bread
potato bread
sesame bread
malt bread
garlic bread
vegetable bread
bun with egg custard filling
fruit and nut bun
mixed fruit bun
hot cross bun
sardine roll
cheese roll
cinnamon bun
sultana bun
chicken with sesame oil and seed bun

Pies

~~Kiwi~~fruit pie
strawberry pie
lemon meringue pie
McDonalds apple pie
pumpkin pie with mixed spice
potato pie
cornish meat pie
chicken curry pie
macaroni and minced meat pie
vegetable with mushroom gravy pie
minced meat pie
mutton pie
vegetarian pie
chicken pie

Cakes

~~banana~~ cake
carrot cake with raisins
date cake
chocolate cake with chocolate pieces
sponge cake
swiss roll with peanut butter
spice cake
ginger cake

Other products

~~cheese straw~~
cheese puff
custard tart
egg tart
jam tart
shortcrust pastry with peanut and sugar filling
cream puff
pizza
quiche lorraine

APPENDIX 2.4

CHECKLIST SCREENING

| Product Ideas | Product Acceptability | Product Convenience | Raw Material Availability | Utilisation of Equipment | Cost of Raw Materials | Competition | Nutritional Value | Total Score |
|------------------------------------|-----------------------|---------------------|---------------------------|--------------------------|-----------------------|-------------|-------------------|-------------|
| | 19 | 16 | 15 | 13 | 13 | 12 | 11 | 100 |
| banana cake | 7 | 10 | 8 | 10 | 10 | 8 | 9 | 62 * |
| orange bread | 8 | 10 | 9 | 10 | 9 | 8 | 10 | 64 * |
| oat bread | 12 | 10 | 10 | 11 | 11 | 8 | 10 | 72 * |
| chocolate flavoured bread | 12 | 10 | 12 | 10 | 9 | 8 | 9 | 70 * |
| potato bread | 8 | 10 | 13 | 10 | 11 | 8 | 9 | 69 * |
| sesame bread | 13 | 10 | 7 | 11 | 9 | 8 | 9 | 67 * |
| malt bread | 11 | 12 | 9 | 11 | 10 | 8 | 9 | 70 * |
| garlic bread | 10 | 10 | 9 | 10 | 9 | 8 | 8 | 64 * |
| vegetable bread | 11 | 10 | 12 | 11 | 11 | 9 | 10 | 74 * |
| bun with egg custard filling | 9 | 14 | 9 | 10 | 10 | 8 | 8 | 68 * |
| fruit and nut bun | 13 | 14 | 12 | 11 | 9 | 8 | 9 | 76 |
| mixed fruit bun | 13 | 14 | 12 | 11 | 9 | 8 | 9 | 76 |
| hot cross buns | 13 | 14 | 12 | 11 | 11 | 9 | 8 | 78 |
| sardine roll | 14 | 14 | 11 | 9 | 10 | 8 | 8 | 74 * |
| sausage roll | 14 | 14 | 13 | 9 | 11 | 8 | 8 | 77 |
| cheese bun | 11 | 14 | 13 | 11 | 11 | 8 | 9 | 77 |
| cinnaeom bun | 9 | 14 | 12 | 11 | 11 | 8 | 8 | 73 * |
| sultana bun | 13 | 14 | 12 | 11 | 9 | 8 | 9 | 76 |
| chicken with sesame seed & oil bun | 15 | 14 | 7 | 10 | 8 | 8 | 10 | 72 * |
| kiwifruit pie | 13 | 14 | 9 | 9 | 9 | 10 | 8 | 72 * |
| strawberry pie | 14 | 14 | 9 | 9 | 10 | 10 | 8 | 74 * |
| lemon meringue pie | 14 | 14 | 9 | 9 | 11 | 10 | 8 | 75 |
| McDonalds apple pie | 12 | 14 | 11 | 9 | 10 | 9 | 8 | 74 * |
| pumpkin with mixed spice pie | 10 | 14 | 10 | 9 | 11 | 11 | 7 | 72 * |
| potato pie | 12 | 14 | 11 | 9 | 9 | 9 | 8 | 72 * |
| cornish meat pie | 15 | 14 | 11 | 9 | 9 | 9 | 9 | 76 |
| chicken curry pie | 15 | 14 | 10 | 9 | 9 | 8 | 9 | 74 * |
| macaroni and minced meat pie | 15 | 14 | 11 | 10 | 10 | 11 | 9 | 80 |
| vegetable with mushroom gravy pie | 14 | 14 | 10 | 10 | 9 | 11 | 9 | 77 |
| minced pie | 15 | 14 | 11 | 10 | 9 | 9 | 9 | 77 |
| mutton pie | 13 | 14 | 11 | 10 | 10 | 10 | 9 | 77 |
| vegetarian pie | 14 | 14 | 11 | 9 | 9 | 9 | 9 | 75 |
| chicken pie | 15 | 14 | 11 | 10 | 9 | 8 | 9 | 76 |

* products eliminated after checklist screening.

ENDIX 2.4: continued

CHECKLIST SCREENING

| Product Ideas | Product Acceptability | Product Convenience | Raw Material Availability | Utilisation of Equipment | Cost of Raw Materials | Competition | Nutritional Value | Total Score |
|------------------------------------|-----------------------|---------------------|---------------------------|--------------------------|-----------------------|-------------|-------------------|-------------|
| banana cake | 16 | 14 | 7 | 9 | 10 | 8 | 8 | 72 * |
| carrot cake with raisins | 15 | 14 | 10 | 9 | 9 | 9 | 9 | 75 |
| date cake | 12 | 14 | 8 | 10 | 9 | 9 | 8 | 70 * |
| chocolate cake with chocolate | 17 | 14 | 12 | 9 | 9 | 9 | 9 | 77 |
| sponge cake | 15 | 14 | 12 | 10 | 10 | 8 | 8 | 77 |
| Swiss roll with peanut butter | 12 | 14 | 11 | 9 | 9 | 8 | 8 | 71 * |
| spice cake | 13 | 14 | 11 | 10 | 9 | 9 | 8 | 75 |
| ginger cake | 12 | 14 | 11 | 10 | 9 | 9 | 7 | 73 * |
| muffin | 9 | 14 | 13 | 10 | 11 | 8 | 9 | 74 * |
| cheese straw | 13 | 14 | 14 | 7 | 10 | 8 | 8 | 74 * |
| cheese puff | 13 | 14 | 14 | 7 | 10 | 8 | 8 | 74 * |
| custard tart | 12 | 14 | 13 | 9 | 11 | 8 | 8 | 75 |
| egg tart | 12 | 14 | 12 | 9 | 10 | 8 | 8 | 73 * |
| jam tart | 13 | 14 | 12 | 9 | 10 | 8 | 8 | 74 * |
| shortcrust pastry & peanut & sugar | 11 | 14 | 10 | 9 | 9 | 8 | 8 | 69 * |
| cream puff | 15 | 14 | 12 | 9 | 9 | 8 | 8 | 75 |
| pizza | 13 | 14 | 10 | 9 | 8 | 11 | 10 | 75 |

APPENDIX 2.5
PRODUCTS REMAINING AFTER CHECKLIST SCREENING

fruit and nut roll/bun
mixed fruit bun
hot cross buns
sausage roll
cheese bun
sultana bun
lemon meringue pie
cornish meat pie
macaroni and minced meat pie
vegetable with mushroom gravy pie
minced meat pie
mutton pie
vegetarian pie
chicken pie
carrot cake with raisins
chocolate cake with chocolate
sponge cake
spice cake
cream puff
pizza

APPENDIX 2.6
PROBABILITY SCREENING

Important factors and their levels

Factor Weights

| | | |
|----|--------------------------------------|-----|
| 1. | Compatibility to ideal | 30 |
| 2. | Cost of final product | 25 |
| 3. | Competition from local manufacturers | 25 |
| 4. | Nutritional value | 20 |
| | | 100 |

Levels

| | |
|---------------|------|
| Very good | 10 |
| Good | 8 |
| Average | 6 |
| Poor | 4 |
| Very poor | 2 |
| Total utility | 1000 |

Calculation

Let W = Weight for each factor
 L = Level for each factor
 P = Potential at each level
 Expected level weight = $(P \times L) = E$
 Contribution to total expected utility = EXW
 Total utility = (EXW) for all factors.

APPENDIX 2.7

PROBABILITY SCREENING TABLES

FRUIT AND NUT ROLL

| | Weight | Levels | | | | | Expected level weight | Contribution to total utility |
|---------------|--------|--------|----|----|----|----|-----------------------|-------------------------------|
| | | 10 | 8 | 6 | 4 | 2 | | |
| Compatibility | 30 | | | .3 | .5 | .2 | 4.2 | 126 |
| Cost | 25 | | .2 | .2 | .5 | .1 | 5.0 | 125 |
| Competition | 25 | .1 | .4 | .3 | .2 | | 6.6 | 165 |
| Nutrition | 20 | .2 | .5 | .2 | .1 | | 7.6 | 152 |
| | | | | | | | --- | 568 |

MIXED FRUIT BUN/ROLL

| | Weight | Levels | | | | | Expected level weight | Contribution to total utility |
|---------------|--------|--------|----|----|----|----|-----------------------|-------------------------------|
| | | 10 | 8 | 6 | 4 | 2 | | |
| Compatibility | 30 | | | .3 | .5 | .2 | 4.2 | 126 |
| Cost | 25 | | .2 | .3 | .5 | .1 | 5.6 | 140 |
| Competition | 25 | | .3 | .4 | .3 | | 6.0 | 150 |
| Nutrition | 20 | .2 | .5 | .2 | .1 | | 7.6 | 152 |
| | | | | | | | --- | 568 |

HOT CROSS BUNS

| | Weight | Levels | | | | | Expected level weight | Contribution to total utility |
|---------------|--------|--------|----|----|----|----|-----------------------|-------------------------------|
| | | 10 | 8 | 6 | 4 | 2 | | |
| Compatibility | 30 | | | .4 | .5 | .1 | 4.6 | 138 |
| Cost | 25 | .1 | .2 | .4 | .3 | | 6.2 | 155 |
| Competition | 25 | | .4 | .3 | .3 | | 6.2 | 155 |
| Nutrition | 20 | .1 | .4 | .5 | | | 7.2 | 144 |
| | | | | | | | --- | 592 |

SAUSAGE ROLL

| | Weight | Levels | | | | | Expected level weight | Contribution to total utility |
|---------------|--------|--------|----|----|----|----|-----------------------|-------------------------------|
| | | 10 | 8 | 6 | 4 | 2 | | |
| Compatibility | 30 | .1 | .1 | .3 | .4 | .1 | 5.4 | 162 |
| Cost | 25 | | .1 | .2 | .5 | .2 | 4.4 | 110 |
| Competition | 25 | .1 | .3 | .4 | .2 | | 6.6 | 165 |
| Nutrition | 20 | | .5 | .2 | .3 | | 6.4 | 128 |
| | | | | | | | --- | 565 |

APPENDIX 2.7: continued

CHEESE ROLL

| | Weight | Levels | | | | | Expected level weight | Contribution to total utility |
|---------------|--------|--------|----|----|----|----|-----------------------|-------------------------------|
| | | 10 | 8 | 6 | 4 | 2 | | |
| Compatibility | 30 | | .1 | .2 | .6 | .1 | 4.6 | 138 |
| Cost | 25 | .1 | .2 | .4 | .3 | | 6.2 | 155 |
| Competition | 25 | | .3 | .4 | .3 | | 6.0 | 150 |
| Nutrition | 20 | .2 | .4 | .2 | .1 | | 6.8 | 136 |
| | | | | | | | --- | 579 |

SULTANA ROLL

| | Weight | Levels | | | | | Expected level weight | Contribution to total utility |
|---------------|--------|--------|----|----|----|----|-----------------------|-------------------------------|
| | | 10 | 8 | 6 | 4 | 2 | | |
| Compatibility | 30 | | | .3 | .5 | .2 | 4.2 | 126 |
| Cost | 25 | | .3 | .3 | .4 | .1 | 6.0 | 150 |
| Competition | 25 | | | .2 | .4 | .4 | 3.6 | 90 |
| Nutrition | 20 | .2 | .5 | .1 | .2 | | 7.4 | 148 |
| | | | | | | | --- | 514 |

LEMON MERINGUE PIE

| | Weight | Levels | | | | | Expected level weight | Contribution to total utility |
|---------------|--------|--------|----|----|----|----|-----------------------|-------------------------------|
| | | 10 | 8 | 6 | 4 | 2 | | |
| Compatibility | 30 | | | .2 | .4 | .4 | 3.6 | 108 |
| Cost | 25 | | .1 | .2 | .5 | .2 | 4.4 | 110 |
| Competition | 25 | .2 | .4 | .2 | .2 | | 7.2 | 180 |
| Nutrition | 20 | | .1 | .3 | .4 | .2 | 4.6 | 92 |
| | | | | | | | --- | 490 |

CORNISH MEAT PIE

| | Weight | Levels | | | | | Expected level weight | Contribution to total utility |
|---------------|--------|--------|----|----|----|----|-----------------------|-------------------------------|
| | | 10 | 8 | 6 | 4 | 2 | | |
| Compatibility | 30 | | .2 | .3 | .5 | | 5.4 | 162 |
| Cost | 25 | | | .3 | .4 | .3 | 4.0 | 100 |
| Competition | 25 | | .2 | .4 | .4 | | 5.6 | 140 |
| Nutrition | 20 | | .2 | .5 | .3 | | 5.8 | 116 |
| | | | | | | | --- | 518 |

APPENDIX 3.1

Description of kuihs used in initial focus group

Bingkang ubi - A traditional Malay kuih which is a baked tapioca cake. The cake consists of tapioca, coconut, palm sugar and sugar. It is sweet with a sticky and dense texture.

Bingkang roti
berjagung - This is similar to bingkang ubi, except that sweet corn is used instead of tapioca.

APPENDIX 3.2

SAMPLE COPY OF SURVEY QUESTIONNAIRE

SURVEY OF MALAYSIAN SNACKING HABITS

| |
|---|
| Race: Sex: Age Group: Address: |
|---|

Good morning/afternoon/evening.

I am _____ from USM. I am conducting a confidential survey for the University and I should like to ask some questions. Could I please speak to (READ ONE OF THE FOLLOWING):

the male head of household, under 40 years
the female head of household, under 40 years
a male member of household aged 21-30 years
a female member of household aged 21-30 years
a male member of household aged 15-20 years
a female member of household aged 15-20 years.

(ONCE YOU HAVE THE PERSON, SAY)

Good morning/afternoon/evening.

I am _____ from USM. I am conducting a confidential survey for the University, and I should like to ask some questions. The purpose of this survey is to determine the snacking habits of Malaysians. The results of this survey will be used to aid in the development of a new bakery snack for Malaysians. There are no right or wrong answers. We just want your views. Just so that you can be sure that I am a market researcher and not selling anything, here is my calling card. (HAND OVER CARD). This interview should take about 15 minutes.

For the purpose of this survey, snacking includes any food eaten between breakfast, lunch and dinner. Morning tea, afternoon tea and supper are considered a snack.

1. Do you eat between meals, that is do you snack? (DO NOT READ. TICK ONE ONLY.)

Yes

No -----> (PROBE): Do you absolutely NEVER eat between meals? READ ALOUD AND TICK ONE ONLY.)

Yes

No -----> (THANK RESPONDENT AND GO TO Q.21.)

2. Other than today, when was the last time you snacked? (DO NOT READ. TICK ONE ONLY.)

Yesterday

2 days ago

3 days ago

4 days ago

5 days ago

more than 5 days ago

APPENDIX 3.2: continued

3. How many times in total during that day did you snack?
(DO NOT READ. TICK ONE ONLY.)

- Once
 Twice
 3 times
 4 times
 more than 4 times

4. On that day, did you snack?
(READ ALOUD. TICK MORE THAN ONE IF NECESSARY.)

- by yourself
 with the family
 with friends
 Other. Please specify _____

(PLEASE RECORD RESPONSES TO Q.5, Q.6 and Q.7 IN GRID FOLLOWING Q.7.)

5. What were the occasions during that day when you snacked?
(READ OUT OPTIONS IN GRID. TICK MORE THAN ONE IF NECESSARY.)
6. What did you eat during each occasion?
7. Where was that snack bought?
(READ OUT CARD B AND RECORD ANSWER IN GRID BELOW.)

| Q.5 Occasions | Q.6 What you ate | Q.7 Where bought |
|--|--------------------------|------------------------|
| In the morning, after breakfast but before lunch, eg. morning tea | <input type="checkbox"/> | _____ |
| In the afternoon, after lunch but before dinner, eg. afternoon tea | <input type="checkbox"/> | _____ |
| Supper | <input type="checkbox"/> | _____ |
| Recess time in school | <input type="checkbox"/> | _____ |
| Shopping | <input type="checkbox"/> | _____ |
| At the movies | <input type="checkbox"/> | _____ |
| Watching TV | <input type="checkbox"/> | _____ |
| Family outing | <input type="checkbox"/> | _____ |
| Waiting for someone or something | <input type="checkbox"/> | _____ |
| Other. (please specify) | <input type="checkbox"/> | _____ |

APPENDIX 3.2: continued

8. The last time you bought from a bread and cake shop, what did you buy?
(DO NOT READ. TICK MORE THAN ONE IF NECESSARY.)

- Absolutely never buy from a bread and cake shop
- Bread Type _____
- Filled baked buns Type _____
- Curry Puff Type _____
- Cake Type _____
- Pies Type _____
- Other (please specify) _____

9. (FOR MALAYS ONLY. FOR CHINESE RESPONDENTS, PLEASE GO TO Q.11)

Do you think the foods sold in bread and cake shops are "halal"?
(DO NOT READ. TICK ONE ONLY.)

- Yes -----> (IF YES, GO TO Q.11)
- No
- Don't know

10. Would you buy from bread and cake shops more frequently if you knew all the foods were "halal"? (DO NOT READ. TICK ONE ONLY.)

- Yes
- No
- Don't know

11. Now I'm going to read out some statements about bread and cake shops. Please try to answer even if you never buy from bread and cake shops as I am interested in your opinion from what you know or have heard. I would like you to tell me for each statement whether you personally agree or disagree. (READ EACH STATEMENT IN TURN. TICK ONE ONLY FOR EACH STATEMENT. SKIP QUESTION IF RESPONDENT IS NOT FAMILIAR WITH BREAD AND CAKE SHOPS.)

| | Agree Strongly | Agree Slightly | Neutral | Disagree Slightly | Disagree Strongly |
|---|-------------------|-------------------|---------|----------------------|----------------------|
| * The food is good for you | | | | | |
| * Everything is delicious to eat | | | | | |
| * I like the smell of the bread and cake shop | | | | | |
| * There is a variety of food in the shop | | | | | |
| * The foods sold there are expensive | | | | | |
| * The bread and cake shop have something different to offer | | | | | |

APPENDIX 3.2: continued

12. Do you think that bakery products, such as those sold in bread and cake shops should be sold through school canteens, and the canteens at places of work? (DO NOT READ. IF RESPONSE IS "DON'T KNOW", REPEAT QUESTION: "Consider it again, do you think that bakery products such as those sold in bread and cake shops should be sold through school canteens and the canteens at places of work?")

Yes
 No
 Don't know -----> (IF DON'T KNOW, GO TO Q.13.)

Why do you say that? (PROBE FULLY)

13. Do you think that bakery products, such as those sold in the bread and cake shops should be sold through sundry shops? (DO NOT READ. IF RESPONSE IS "DON'T KNOW", REPEAT QUESTION: "Consider it again, do you think that bakery products such as those sold in the bread and cake shop should be sold through sundry shops?")

Yes
 No
 Don't know -----> (IF DON'T KNOW, GO TO Q.14)

Why do you say that? (PROBE FULLY)

14. Do you think that bakery products, such as those sold in the bread and cake shops should be sold through hawkers? (DO NOT READ. IF RESPONSE IS "DON'T KNOW", REPEAT QUESTION: "Consider it again, do you think that bakery products such as those sold in the bread and cake shop should be sold through hawkers?")

Yes
 No
 Don't know -----> (IF DON'T KNOW, GO TO Q.15)

Why do you say that? (PROBE FULLY)

15. Other than today, when did you last eat a homemade snack? Homemade snack means that the snack has been made at home. This includes sandwiches. (DO NOT READ. TICK ONE ONLY.)

| | |
|-------------------------------------|---|
| <input type="checkbox"/> Yesterday | <input type="checkbox"/> 5 days ago |
| <input type="checkbox"/> 2 days ago | <input type="checkbox"/> 6 days ago |
| <input type="checkbox"/> 3 days ago | <input type="checkbox"/> more than 6 days ago |
| <input type="checkbox"/> 4 days ago | <input type="checkbox"/> do not eat homemade snacks |

APPENDIX 3.2: continued

16. The last time you ate a homemade snack, what was it? (DO NOT READ. TICK MORE THAN ONE IF NECESSARY.)

- Cake Type _____
- Biscuit Type _____
- Kuih Type _____
- Leftover food
- Soup
- Other (please specify) _____

17. When you have a snack, how important are the following to you? (READ OUT EACH ITEM. TICK AS APPROPRIATE.)

| | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|
| <p>How important is:</p> <ul style="list-style-type: none"> * The price of the snack * That it is good for you * That it is easy to obtain * That it doesn't need any preparation * That it tastes good * That it is not fattening | <table border="1" style="border-collapse: collapse; width: 40px; height: 100px;"> <tr><td> </td></tr> </table> | | | | | | | | <table border="1" style="border-collapse: collapse; width: 40px; height: 100px;"> <tr><td> </td></tr> </table> | | | | | | | | <table border="1" style="border-collapse: collapse; width: 40px; height: 100px;"> <tr><td> </td></tr> </table> | | | | | | | | <table border="1" style="border-collapse: collapse; width: 40px; height: 100px;"> <tr><td> </td></tr> </table> | | | | | | | | <table border="1" style="border-collapse: collapse; width: 40px; height: 100px;"> <tr><td> </td></tr> </table> | | | | | | | |
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18. Do you ever buy snacks that are imported, that is snacks that are not produced in this country, including fruits? (DO NOT READ. TICK ONE ONLY.)

- Yes (IF YES, GO TO Q.19)
- No -----> (GO TO Q.20)
- Don't know

19. Generally, what two imported snacks do you like best? (PROBE FULLY)

20. Why do you like those imported snacks? (PROBE FULLY)

Now, I'd like to ask you some questions about you and your household to make sure that we have spoken to a cross-section of Malaysians.

APPENDIX 3.2: continued

21. (RECORD SEX AND RACE OF RESPONDENT.)

Male

Malay

Female

Chinese

(RECORD RESPONSES TO Q.22 AND Q.23 IN GRID FOLLOWING Q.23.)

22. How many people in your household, not including yourself, are in each of these age groups at present? (READ EACH AGE GROUP AND FILL IN THE NUMBER IN THE APPROPRIATE BOX.)

23. Which of those groups include your present age? (TICK ONE ONLY.)

| Q.22 Numbers | Age Group | Q.23 Respondent |
|----------------------|---------------|----------------------|
| <input type="text"/> | 0-12 years | <input type="text"/> |
| <input type="text"/> | 13-20 years | <input type="text"/> |
| <input type="text"/> | 21-30 years | <input type="text"/> |
| <input type="text"/> | 31-40 years | <input type="text"/> |
| <input type="text"/> | Over 40 years | <input type="text"/> |

24. What is your occupation? (PROBE FULLY)

25. What is the occupation of the principal breadwinner of your family (that is the person who earns the most money)? (PROBE FULLY)

26. What is the combined monthly income of this household (that is the total income of all persons who work)?

- a. more than \$200/month (IF NO, THEN TICK BOX.)
- b. more than \$500/month
- c. more than \$1,000/month
- d. more than \$1,500/month
- e. more than \$2,000/month

THANK YOU VERY MUCH FOR YOUR COOPERATION.

APPENDIX 3.3

Purchasing patterns of Malays and Chinese from bread and cake shops

| | Malay | | Chinese | | Overall | |
|-------|-------|--------|---------|--------|---------|--------|
| | No. | % | No. | % | No. | % |
| Yes | 89 | 89.9% | 95 | 88.8% | 184 | 89.3% |
| No | 10 | 10.1% | 12 | 11.2% | 22 | 10.7% |
| Total | 99 | 100.0% | 107 | 100.0% | 206 | 100.0% |

APPENDIX 3.4

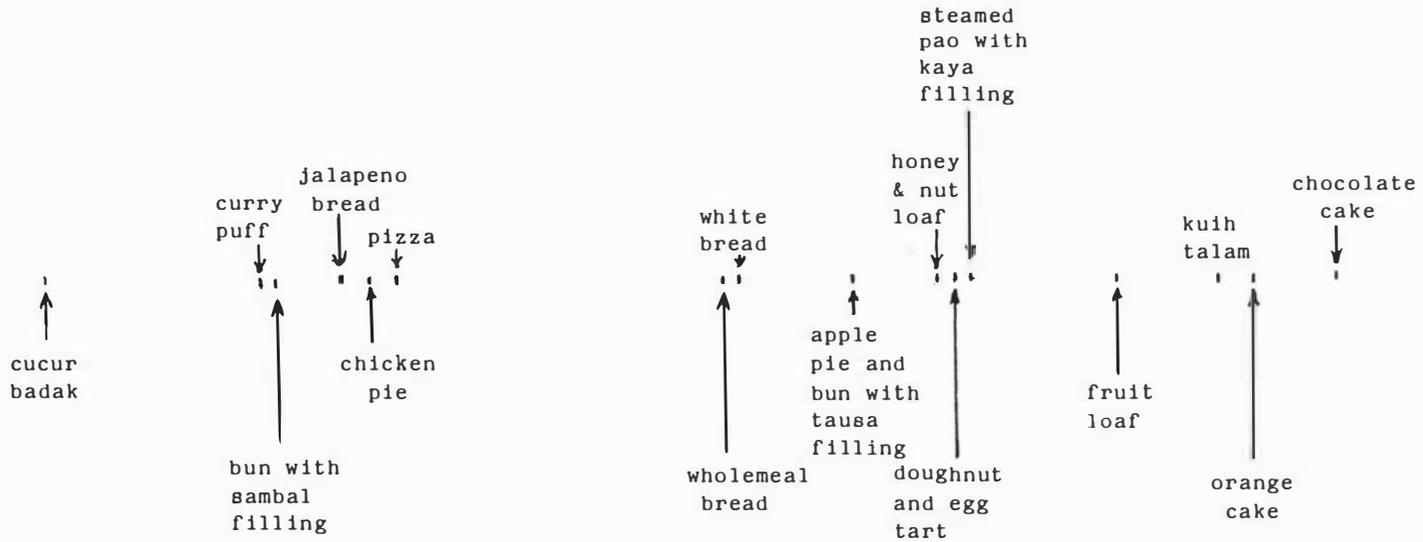
Places where bakery snacks were bought

| | No. | % |
|------------------------|-----|-------|
| Bread and cake shop | 20 | 27.8 |
| Homemade | 18 | 25.0 |
| Restaurant/coffee shop | 9 | 12.5 |
| Supermarket | 7 | 9.7 |
| Sundry shop | 5 | 6.9 |
| School canteen | 4 | 5.6 |
| Canteen at work | 3 | 4.2 |
| Hawker | 3 | 4.2 |
| Other | 3 | 4.2 |
| Non-response | 13 | - |
| Total | 85 | 100.0 |

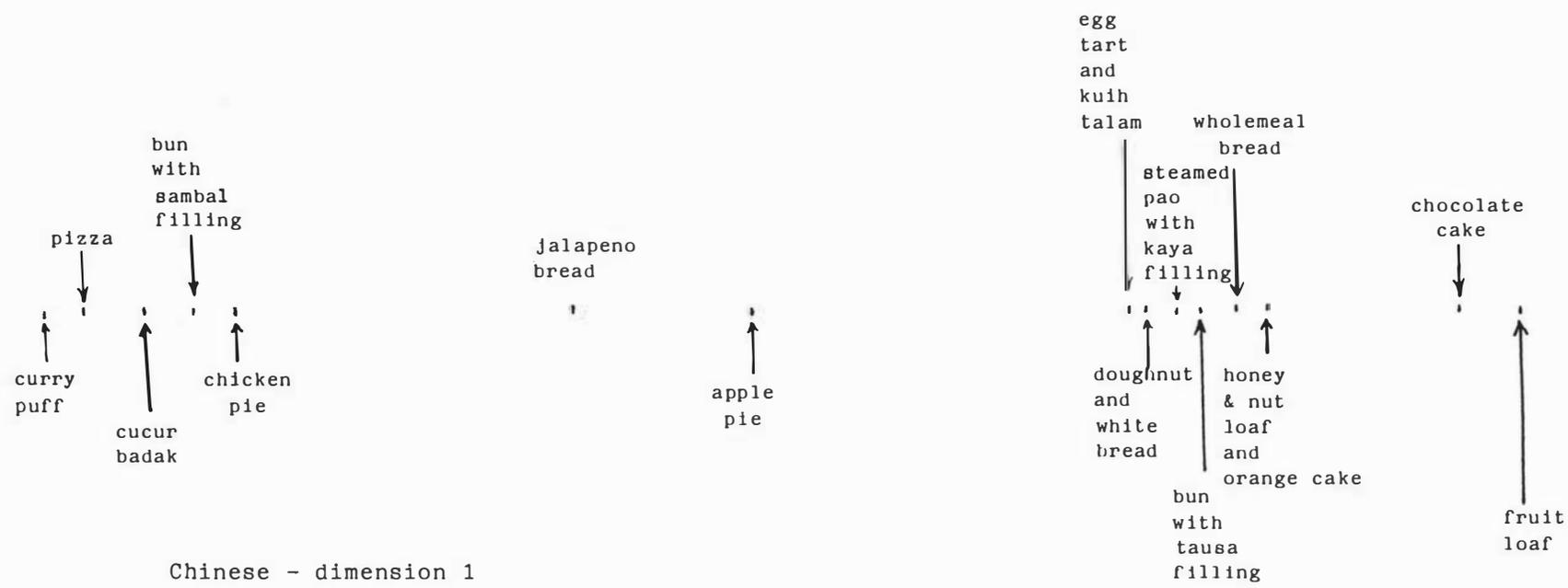
APPENDIX 4.1

LIST OF BAKERY PRODUCTS USED FOR MULTIDIMENSIONAL SCALING

| | |
|--------------------|--|
| white bread | ordinary white bread |
| wholemeal bread | bread made with wholemeal flour |
| chocolate cake | chocolate flavoured cake |
| fruit loaf | fruit cake shaped in the form of a loaf |
| tausa bun | (bun with tausa filling) baked bun with black bean paste filling |
| sambal bun | (bun with sambal filling) baked bun with hot savoury filling |
| doughnut | American ring doughnut coated with sugar |
| steamed pao | (steamed pao with kaya filling) steamed bun with coconut jam filling |
| kuih talam | steamed kuih made with rice flour, sago flour, pandan leaves, coconut milk |
| cucur badak | savoury deep fried snack made with wheat flour, shortening, egg yolk, prawn, onion, green and red chilli, turmeric and lemongrass |
| curry puff | deep fried product consisting of wheat flour and shortening, and filling is made with meat, potato, onion and curry |
| egg tart | similar to jam tart with sweet shortcrust pastry but with egg custard filling instead of jam |
| honey and nut loaf | a white bread flavoured with liquid clover honey and crushed peanuts. It contains flour, sugar, yeast, shortening, salt, nuts and honey |
| jalapeno bread | a Mexican savoury bread which is mildly hot. It contains cornmeal to give it a slightly gritty texture (similar to wheat in wholemeal bread). The characteristic flavour is derived from red and green pepper (capsicum), onions, and chilli powder |
| chicken pie | a pastry product with shortcrust pastry for the base while the top is made with puff pastry. The savoury filling is made with chicken, chicken stock, and mixed vegetables. |
| apple pie | this is similar to chicken pie except that it is made with shortcrust pastry only and apple filling |
| orange cake | this is a cake flavoured with orange peel. It has a distinct orange flavour and light texture |
| pizza | originally from Italy, pizza is a bread dough base with a basic topping of a special tomato sauce and grated cheese. The topping can be any combination of the following foods: onions, mushroom, pineapple, salami, bierstick, red and green pepper, shrimps, oyster, mussels, egg, minced meat, and chilli |

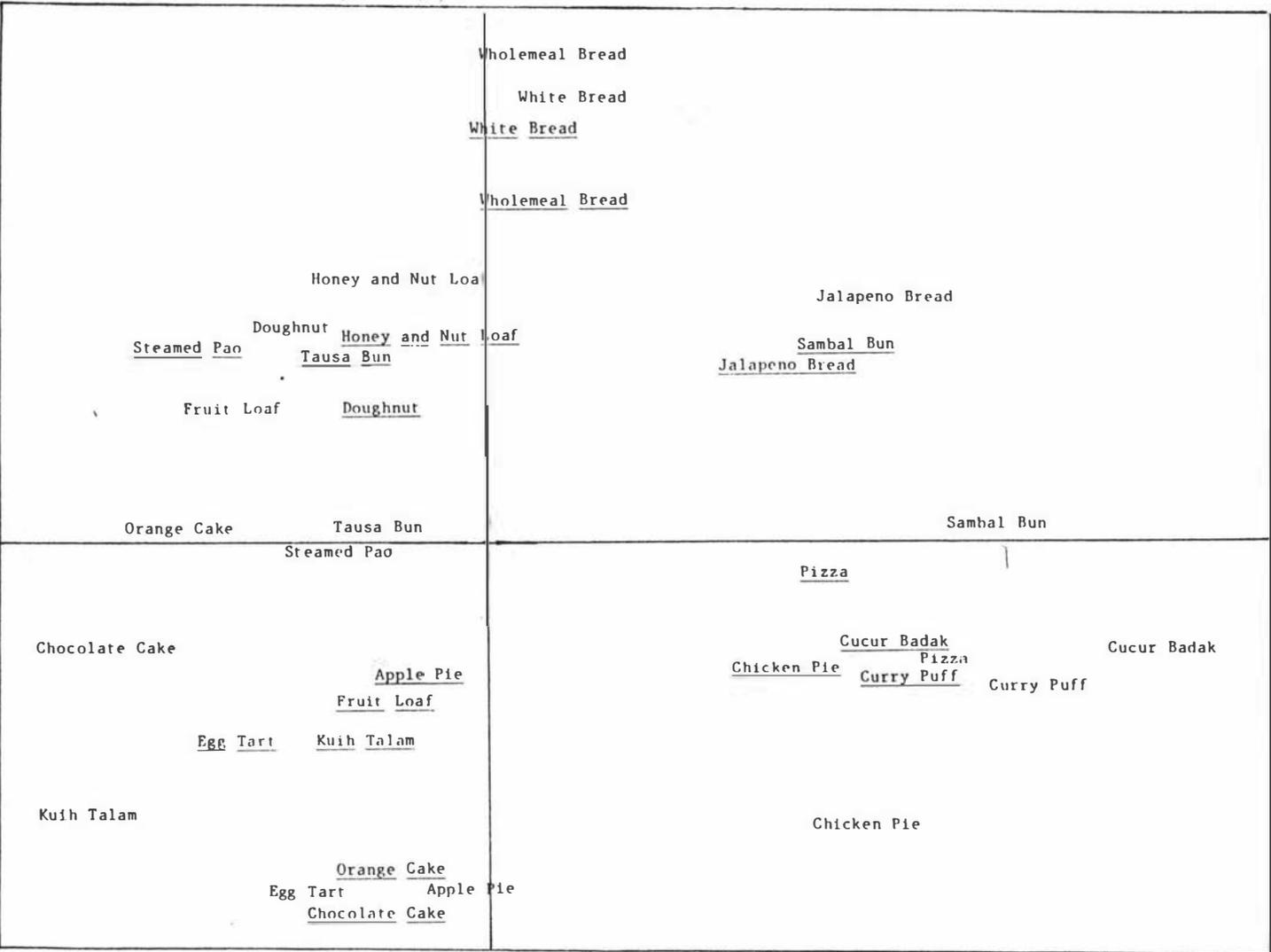


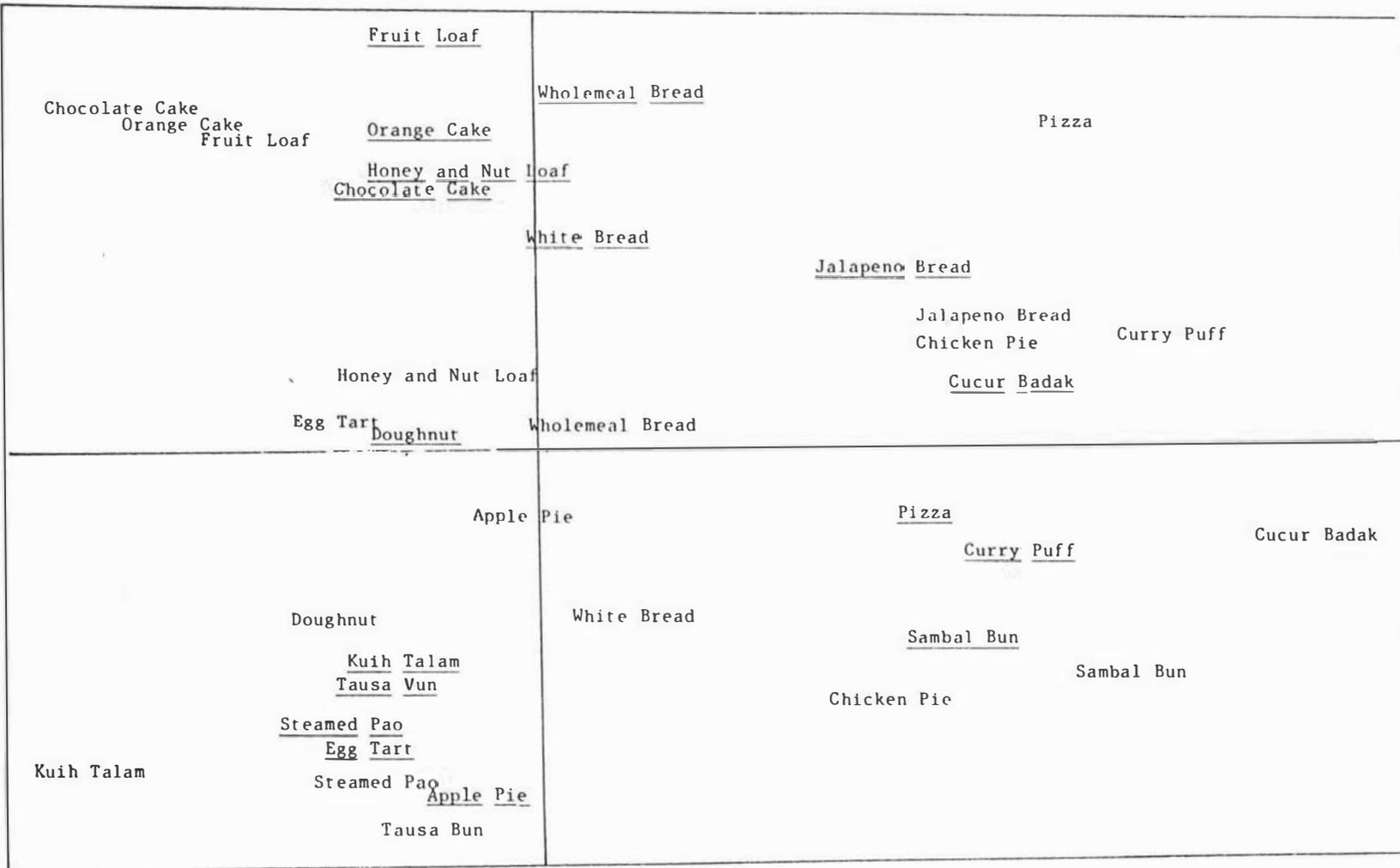
Malay - dimension 1



Chinese - dimension 1

PLOT OF MULTIDIMENSIONAL SPACE FOR ALL SUBJECTS - INDSGAL
(dimension 2 vs dimension 1)



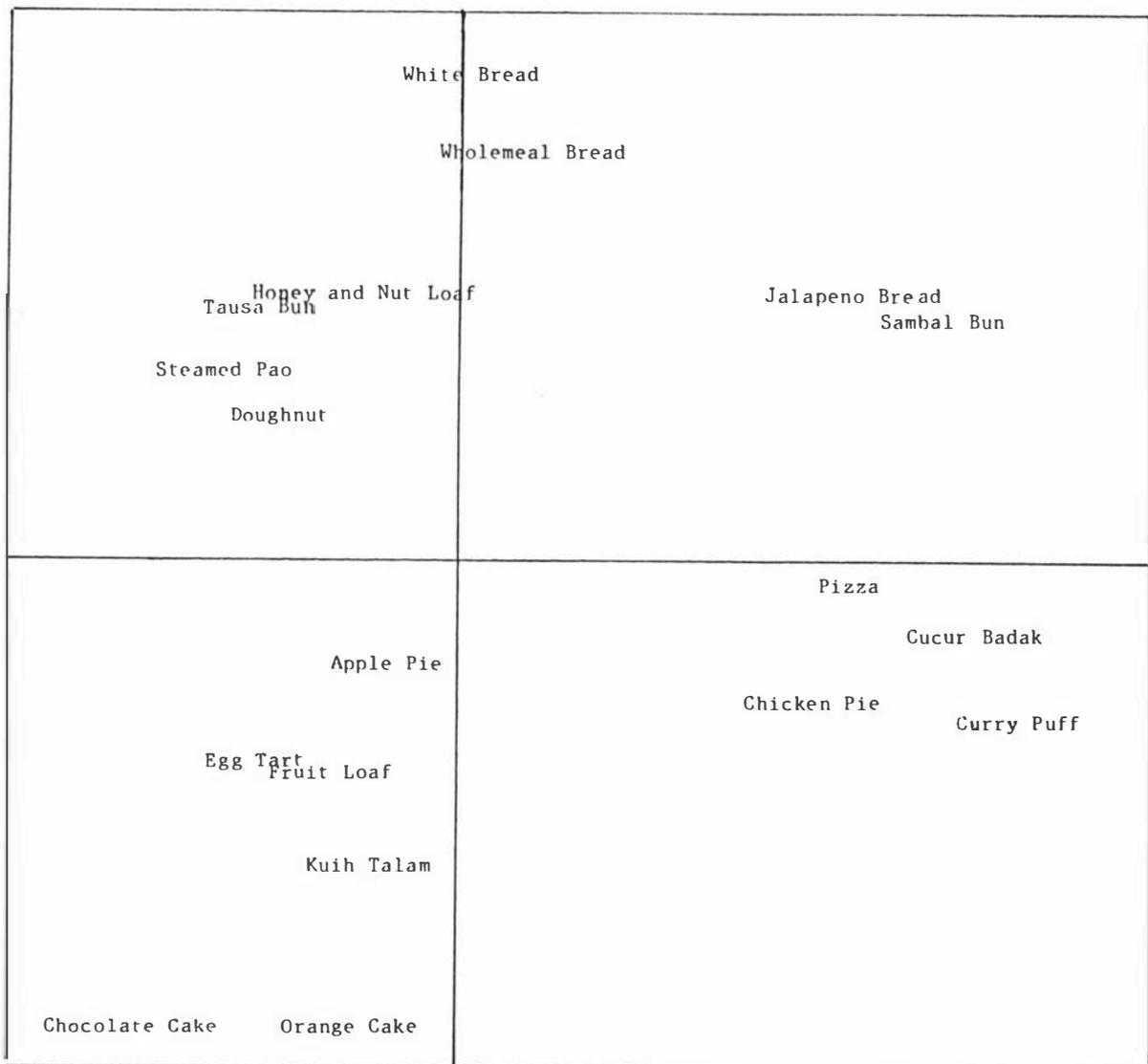


PLOT OF MULTIDIMENSIONAL SPACE FOR ALL SUBJECTS - INDSICAL
(dimension 3 vs dimension 1)

APPENDIX 4.4

PLOT OF MULTIDIMENSIONAL SPACE FOR MALAYS - INDSICAL (dimension 2 vs dimension 1)

APPENDIX 4.5

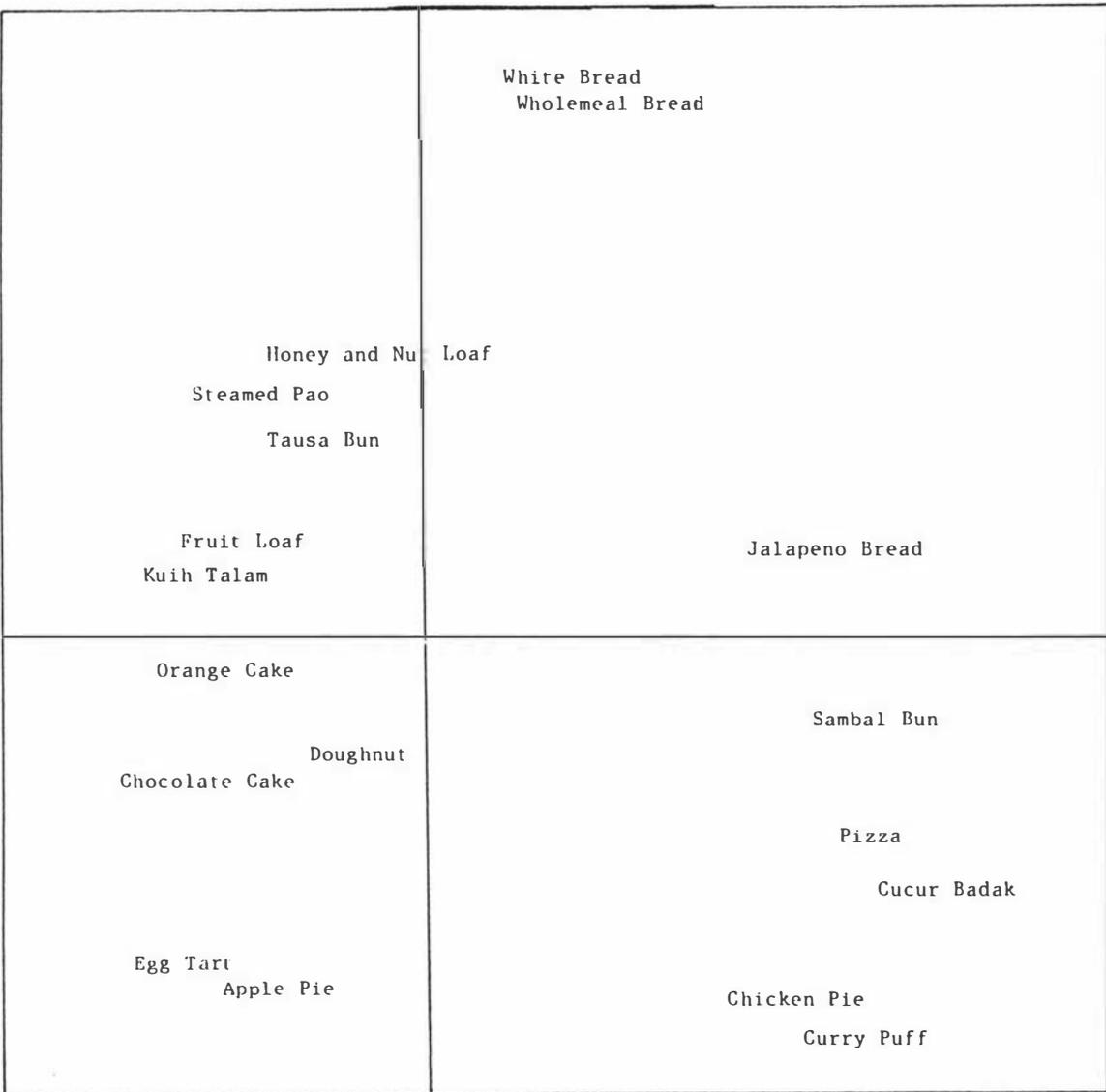


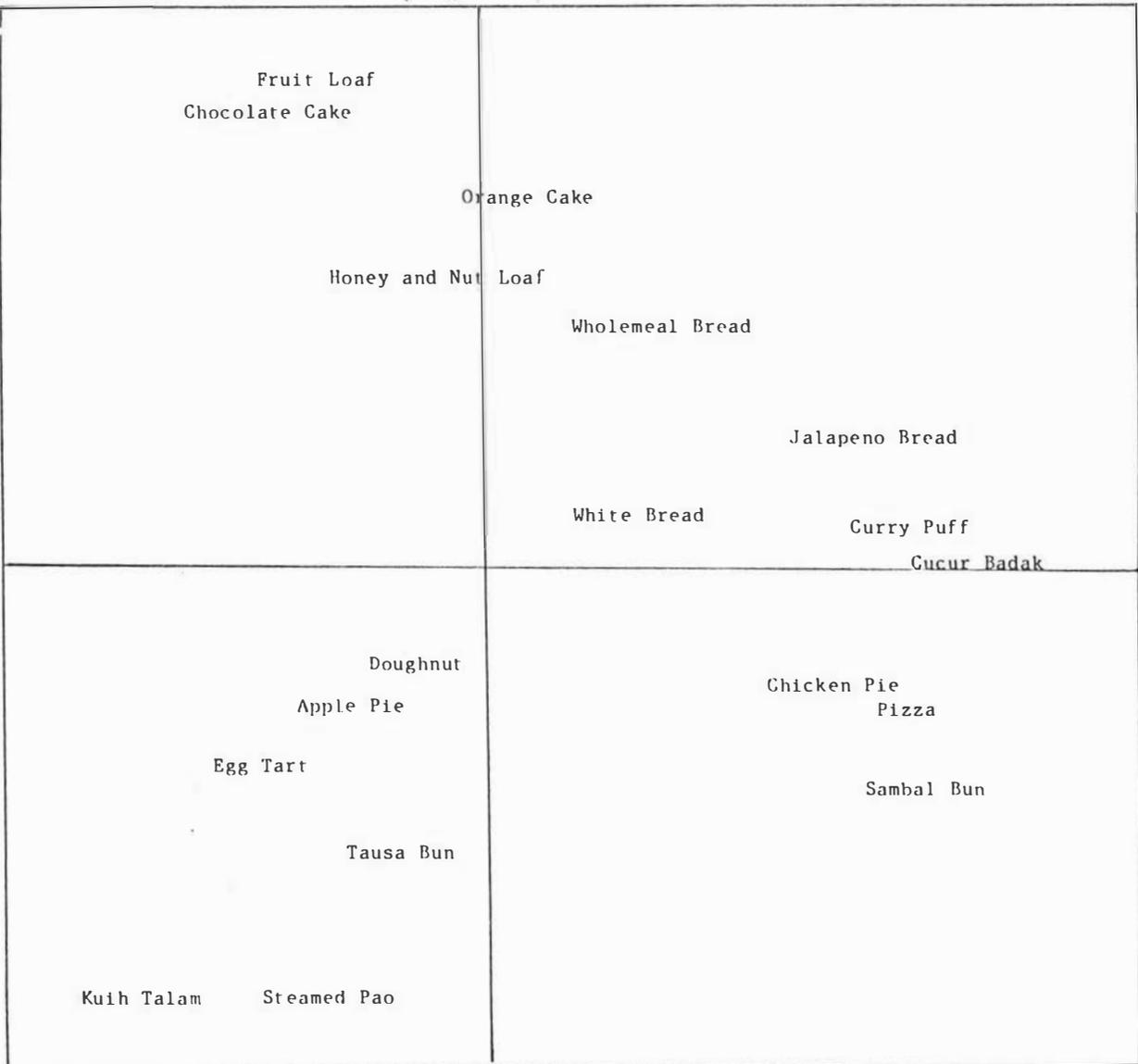


PLOT OF MULTIDIMENSIONAL SPACE FOR MALAYS - INDSICAL (dimension 3 vs dimension 1)

APPENDIX 4.7

PLOT OF MULTIDIMENSIONAL SPACE FOR CHINESE - INDSICAL (dimension 2 vs dimension 1)

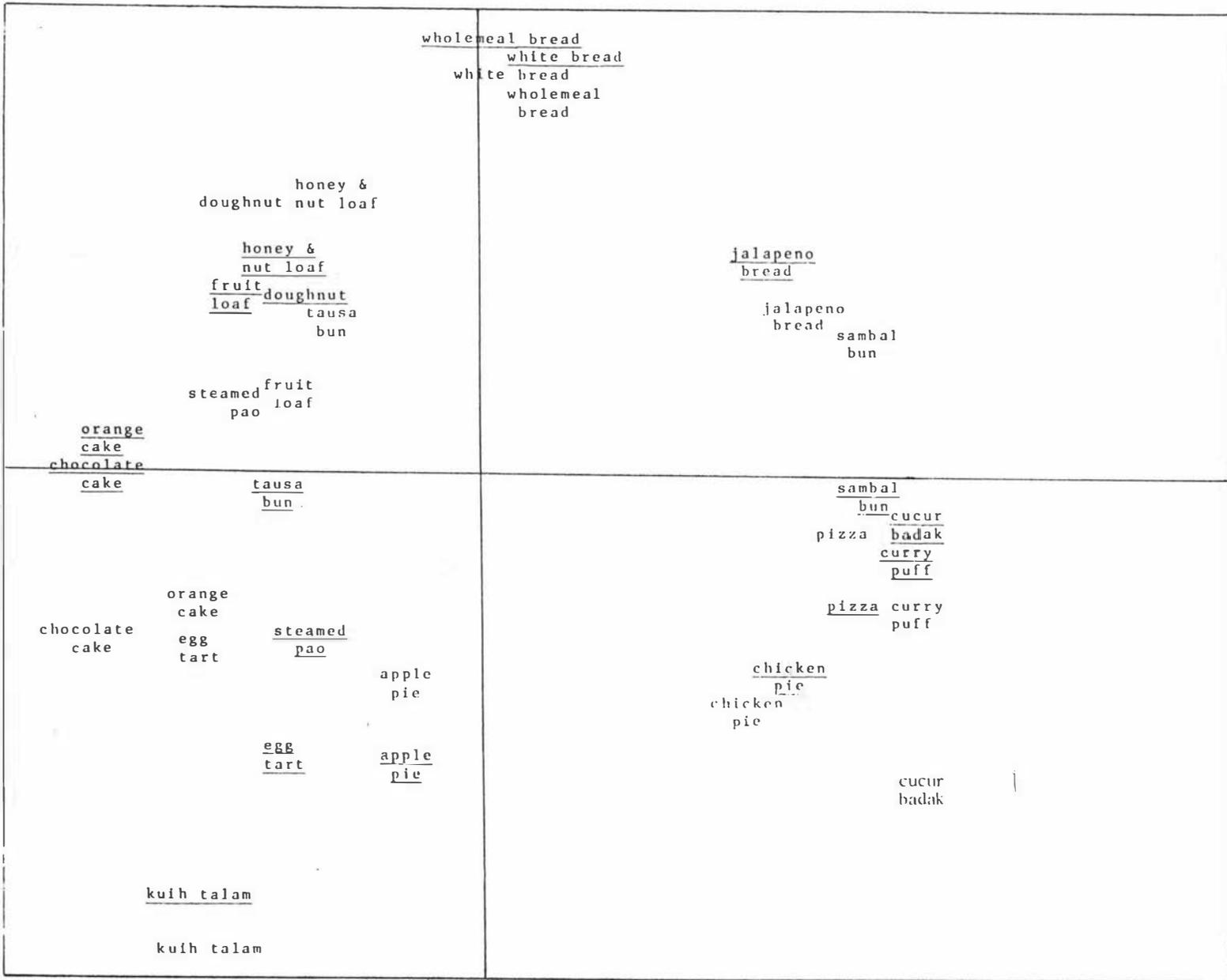




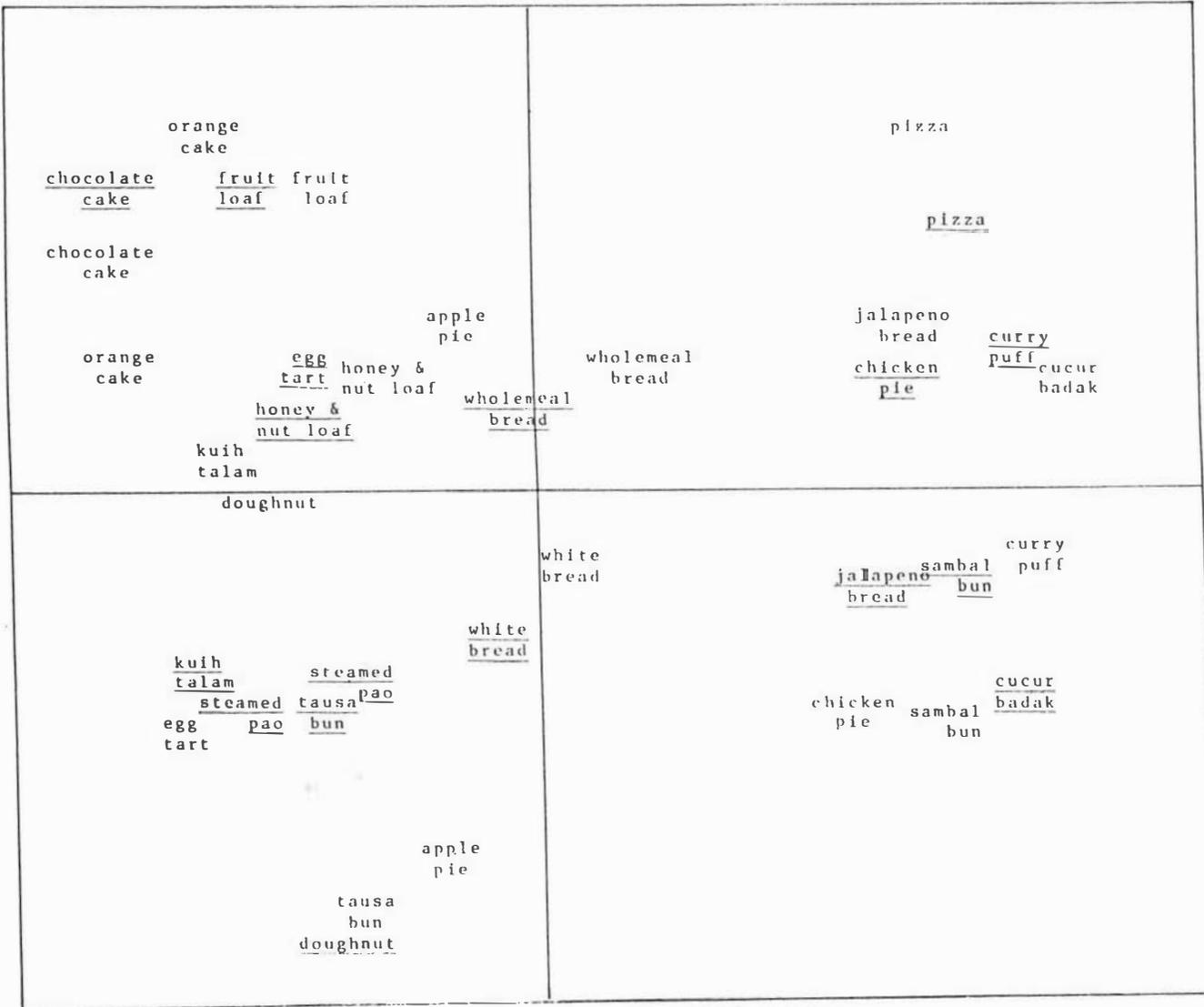
PLOT OF MULTIDIMENSIONAL SPACE FOR CHINESE - INDSICAL (dimension 3 vs dimension 1)

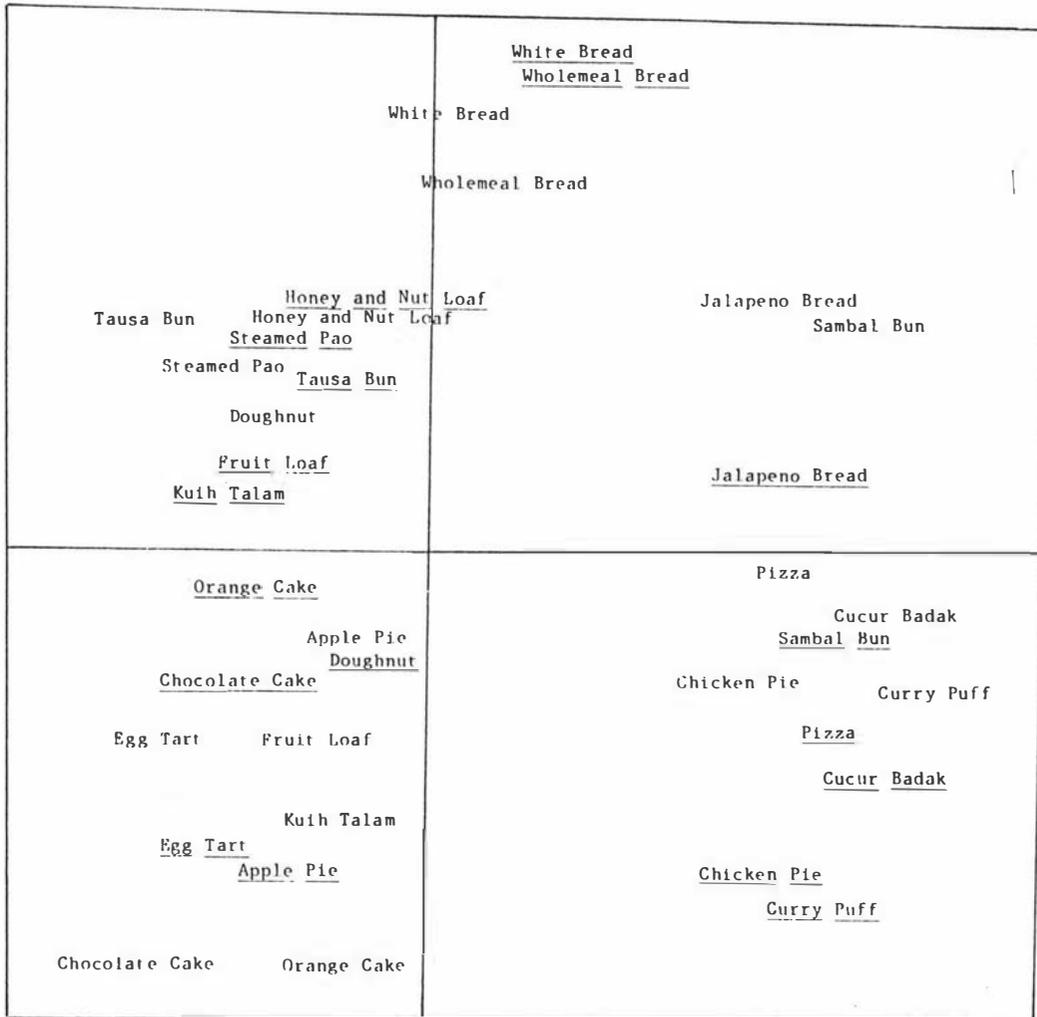
APPENDIX 4.8

APPENDIX 4.9
 PLOT OF MULTIDIMENSIONAL SPACE FOR MALAYS AND CHINESE - KYST
 (dimension 2 vs dimension 1)



PLOT OF MULTIDIMENSIONAL SPACE FOR MALAYS AND CHINESE - KYST
 (dimension 3 vs dimension 1)

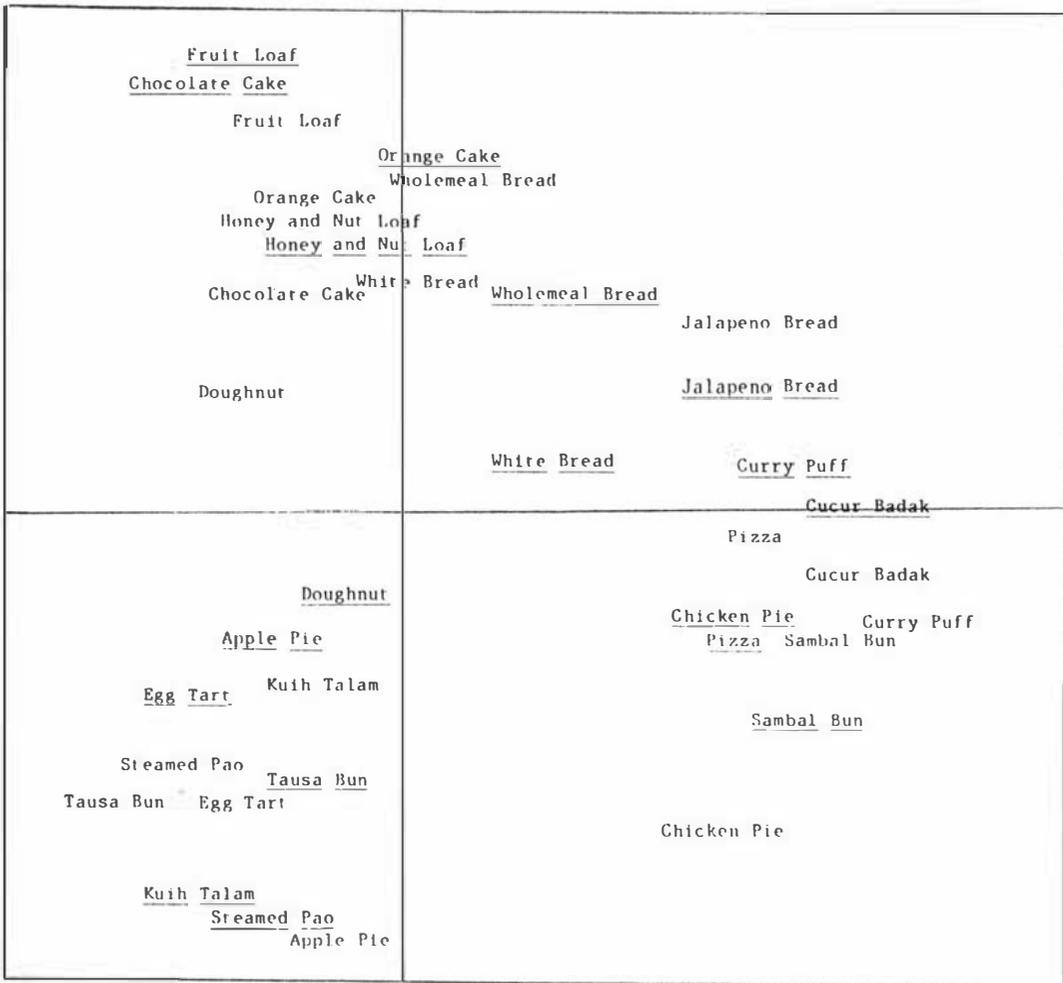


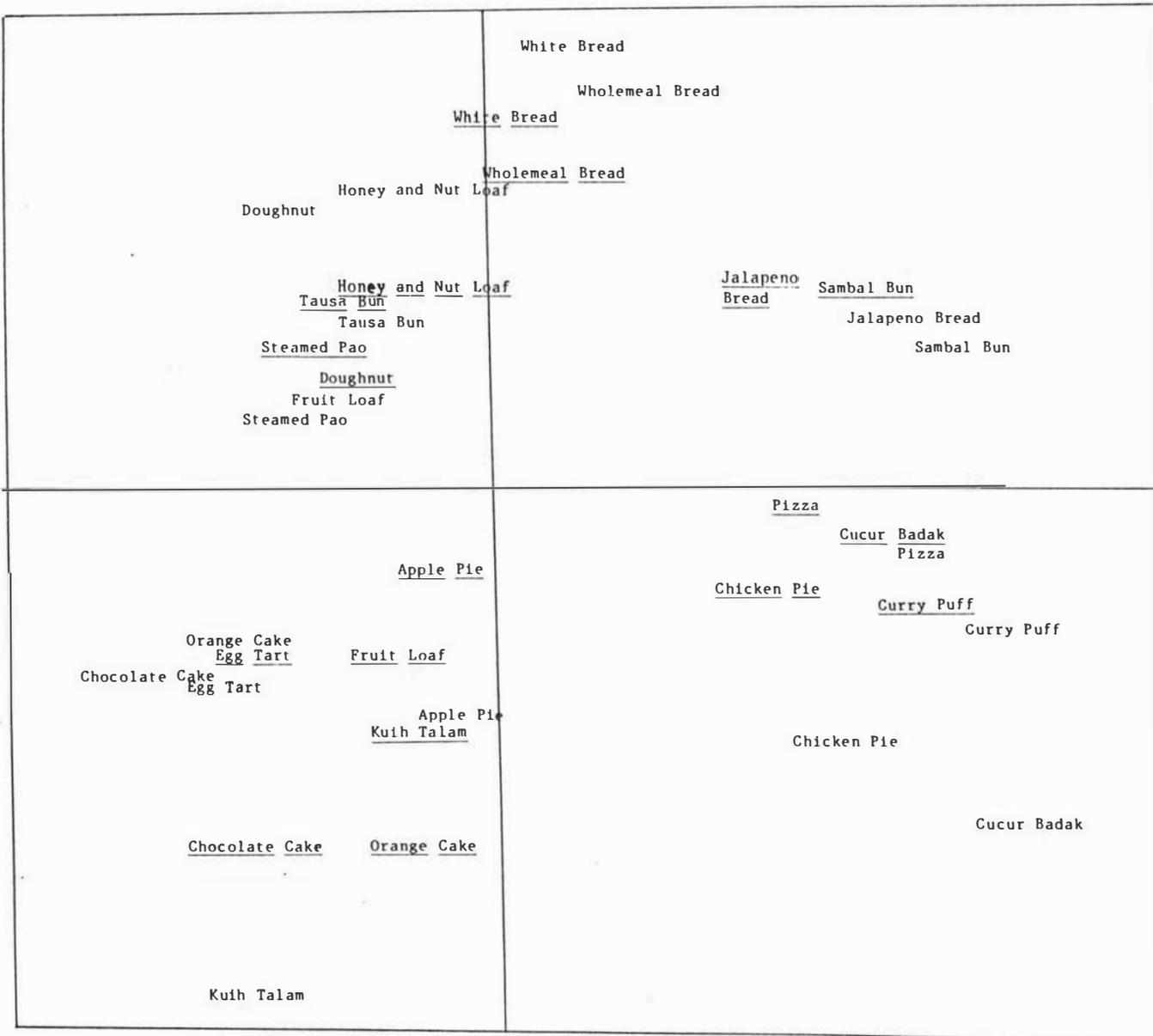


APPENDIX 4.11
 PLOT OF MULTIDIMENSIONAL SPACE FOR MALAYS AND CHINESE - INDSICAL
 (dimension 2 vs dimension 1)

APPENDIX 4.12

PLOT OF MULTIDIMENSIONAL SPACE FOR MALAYS AND CHINESE - INDSICAL
(dimension 3 vs dimension 1)



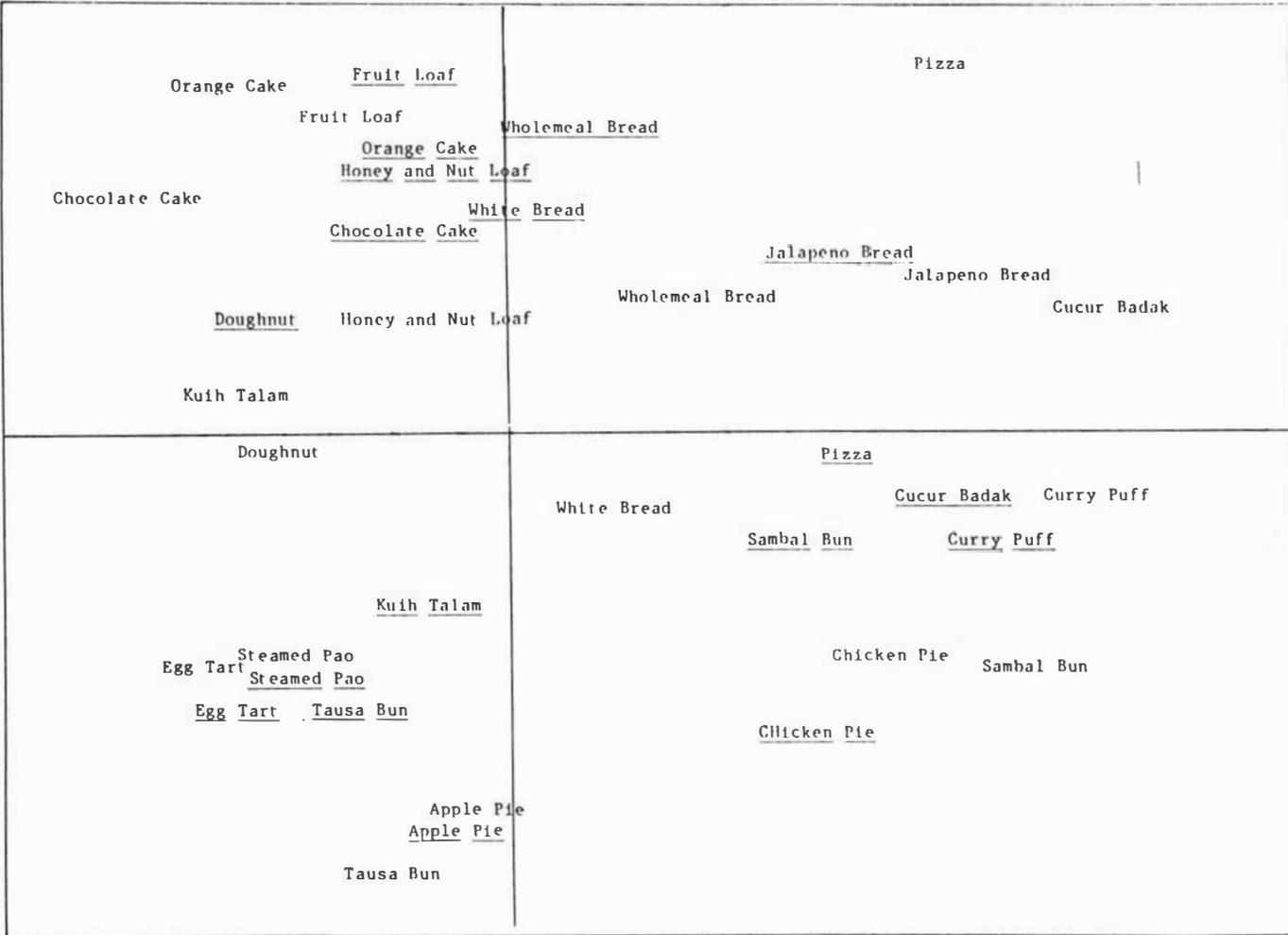


PLOT OF MULTIDIMENSIONAL SPACE FOR MALAYS WITH KYST AND INDSCAL
 SUPERIMPOSED (dimension 2 vs dimension 1)

APPENDIX 4.13

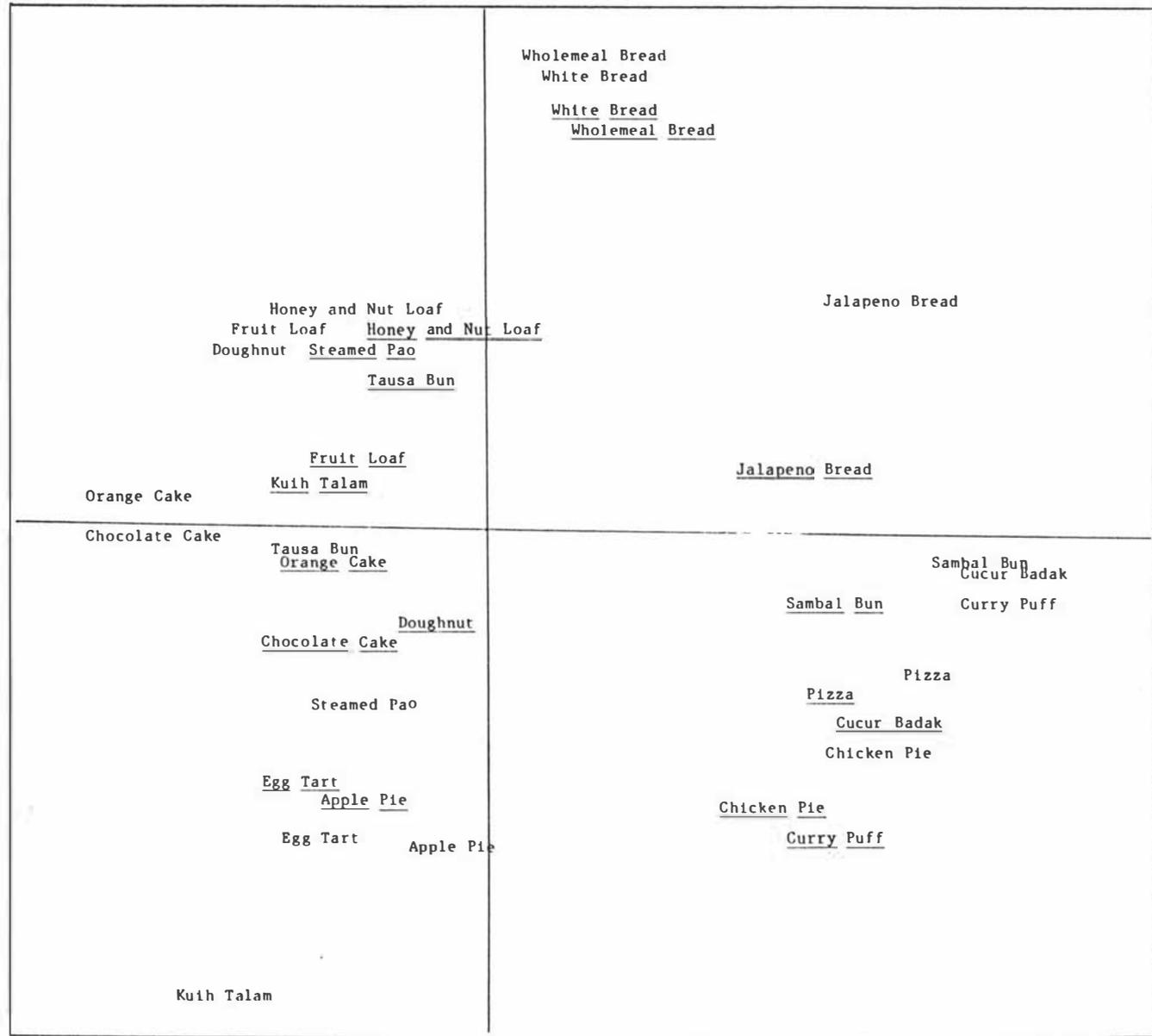
APPENDIX 4.14

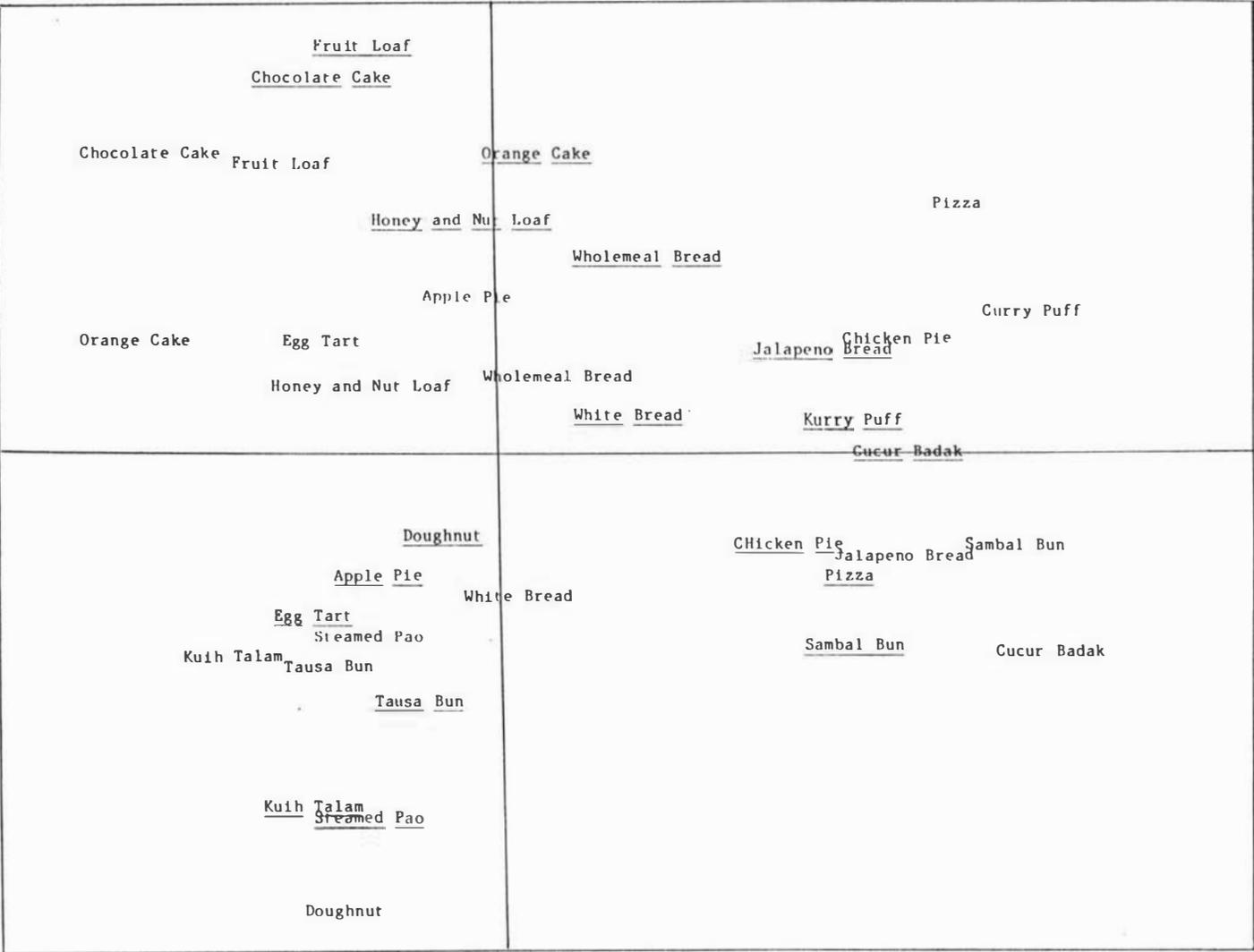
PLOT OF MULTIDIMENSIONAL SPACE FOR MALAYS WITH KYST AND INDSICAL
 SUPERIMPOSED (dimension 3 vs dimension 1)



APPENDIX 4.15

PLOT OF MULTIDIMENSIONAL SPACE FOR CHINESE WITH KYST AND INDSCAL
SUPERIMPOSED (dimension 2 vs dimension 1)

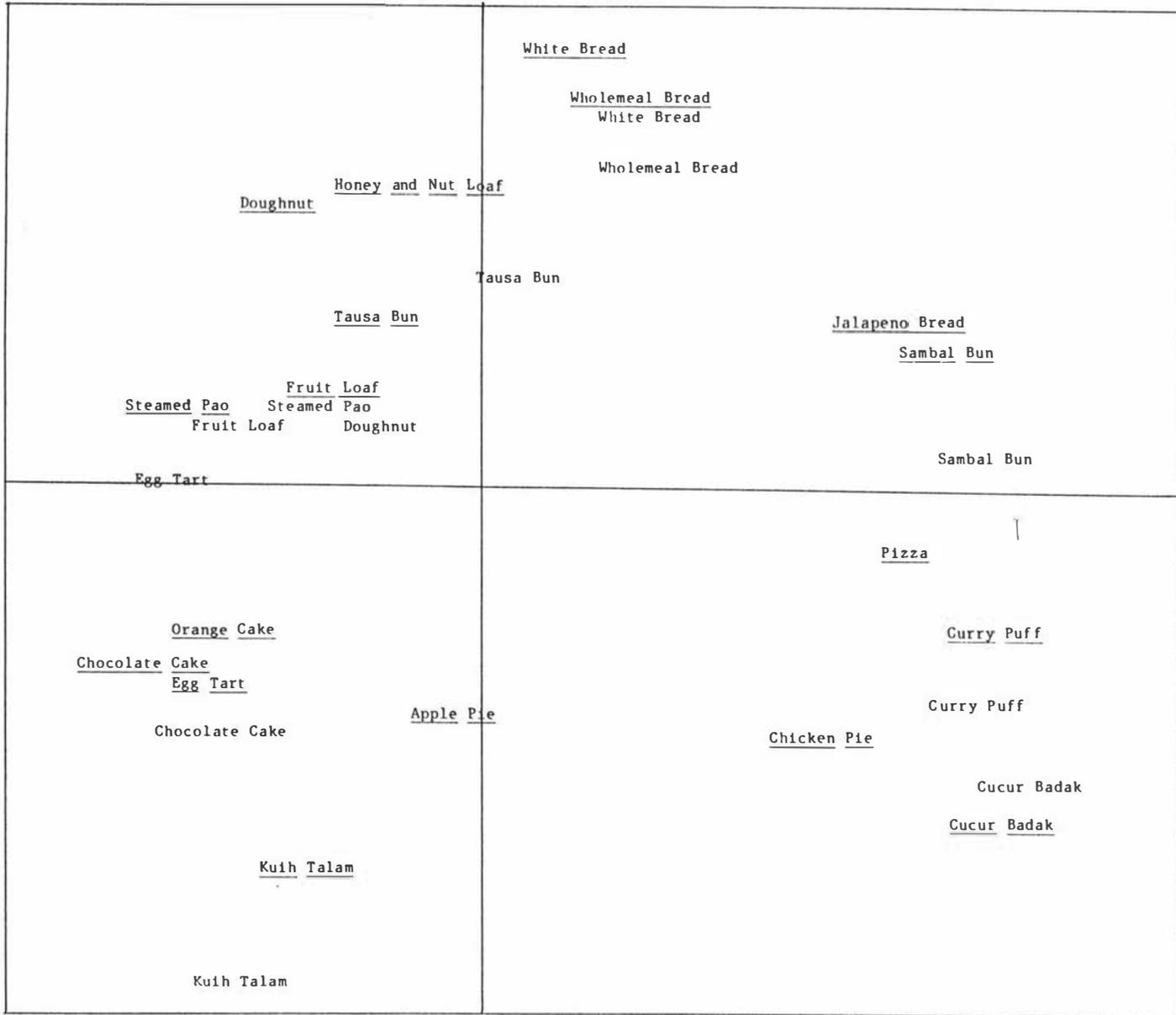




PLOT OF MULTIDIMENSIONAL SPACE FOR CHINESE WITH KYST AND INDSCAL SUPERIMPOSED (dimension 3 vs dimension 1)

APPENDIX 4.17

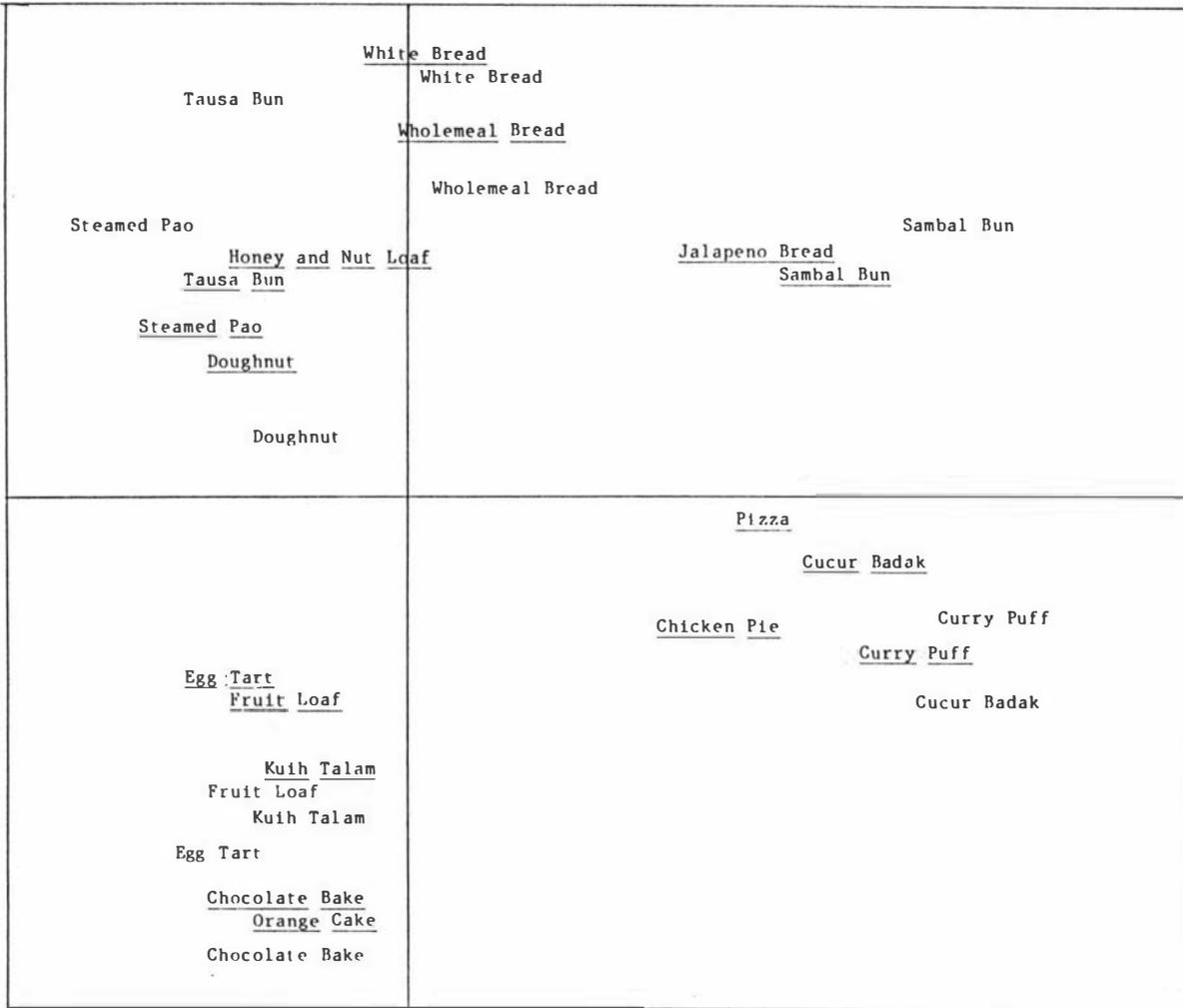
PILOT OF MULTIDIMENSIONAL SPACE FOR MALAYS - KYST - WITH 12 and 18 PRODUCTS SUPERIMPOSED (dimension 2 vs dimension 1)



| | |
|---|---|
| <p><u>Orange Cake</u></p> <p>Fruit Loaf <u>Fruit Loaf</u> Chocolate Cake</p> <p><u>Chocolate Cake</u></p> <p>Doughnut</p> <p><u>Kuih Talam</u></p> <p><u>Egg Tart</u></p> | <p><u>Pizza</u></p> <p>Wholemeal Bread</p> <p><u>Wholemeal Bread</u></p> <p><u>Jalapeno Bread</u></p> <p>Curry Puff</p> <p><u>Cucur Badak</u></p> |
| <p><u>Doughnut</u></p> <p>Steamed Pao</p> <p><u>Steamed Pao</u> <u>Egg Tart</u></p> <p>Kuih Talam</p> <p><u>Apple Pie</u></p> <p><u>Tausa Bun</u></p> | <p>White Bread</p> <p>White Bread</p> <p><u>White Bread</u></p> <p>Chicken Pie <u>Sambal Bun</u></p> <p>Sambal Bun Cucur Badak <u>Curry Puff</u></p> <p>Tausa Bun</p> |

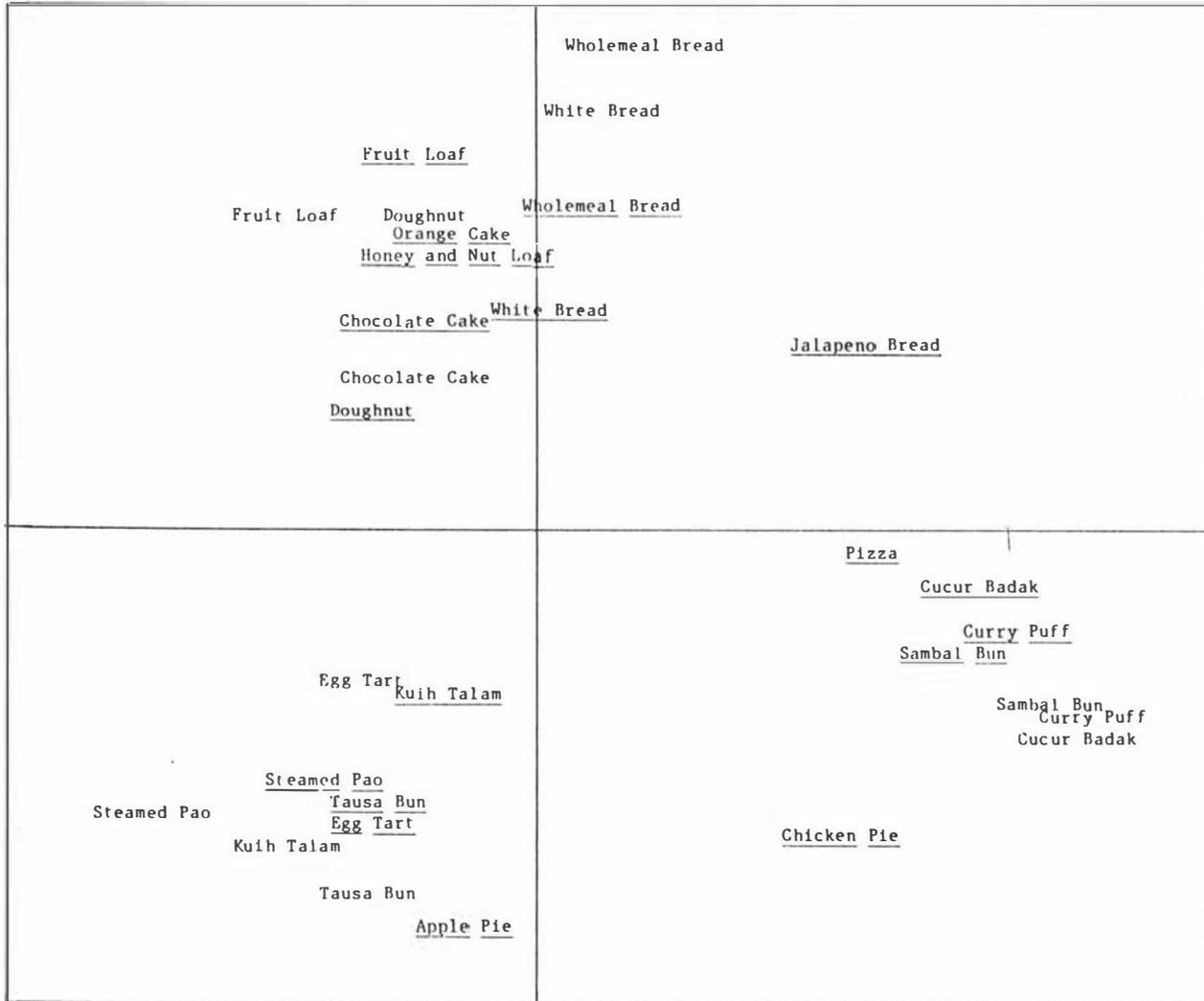
PLOT OF MULTIDIMENSIONAL SPACE FOR MALAYS - KYST - WITH 12 and 18 PRODUCTS SUPERIMPOSED (dimension 2 vs dimension 1)

PLOT OF MULTIDIMENSIONAL SPACE FOR MALAYS - INDSICAL - WITH 12 and 18 PRODUCTS SUPERIMPOSED

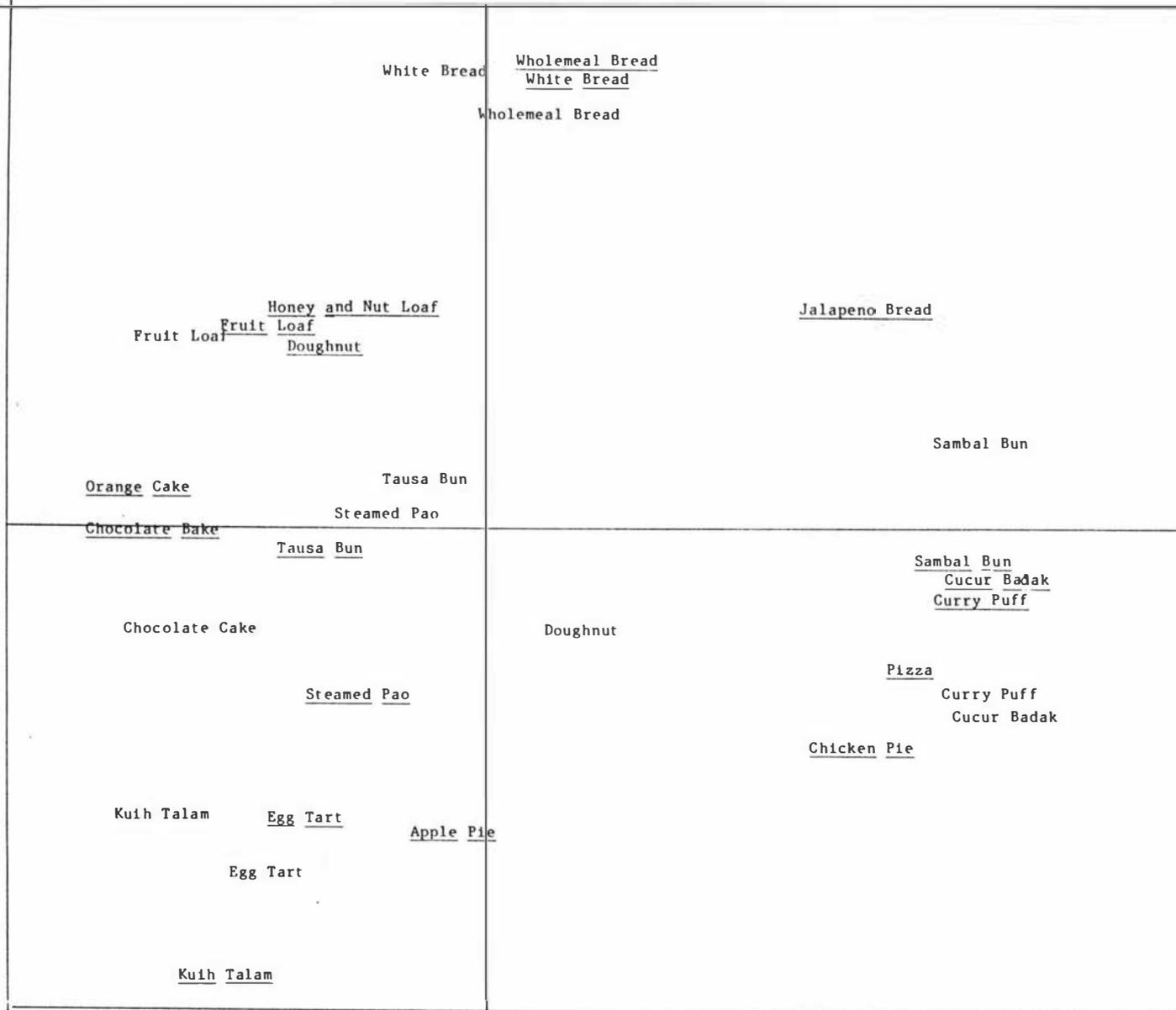


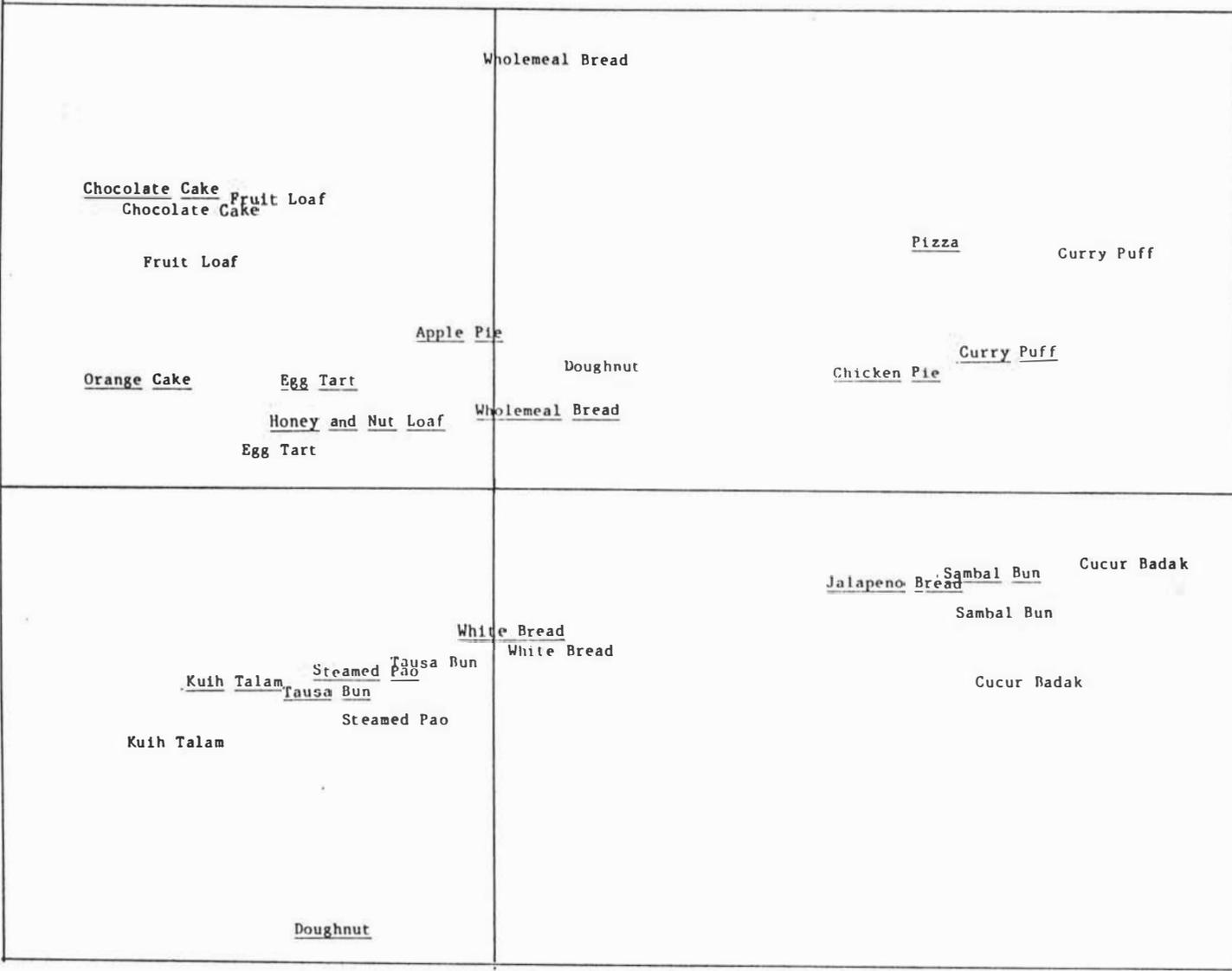
PLOT OF MULTIDIMENSIONAL SPACE FOR MALAYS - INDSICAL - WITH
 12 and 18 PRODUCTS SUPERIMPOSED

APPENDIX 4.20



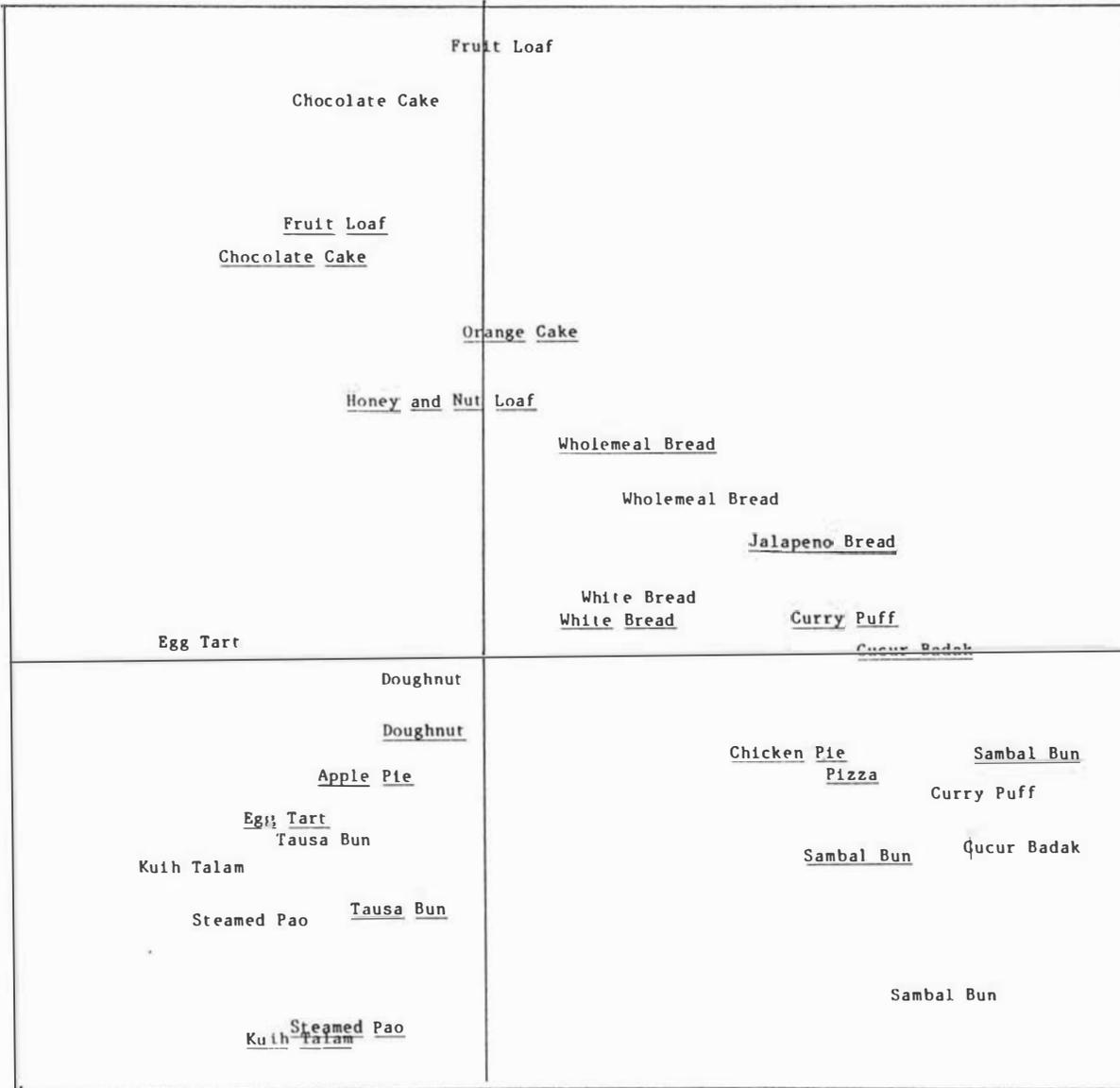
APPENDIX 4.21
 PLOT OF MULTIDIMENSIONAL SPACE FOR CHINESE - KYST - WITH 12 and 18
 PRODUCTS SUPERIMPOSED (dimension 2 vs dimension 1)





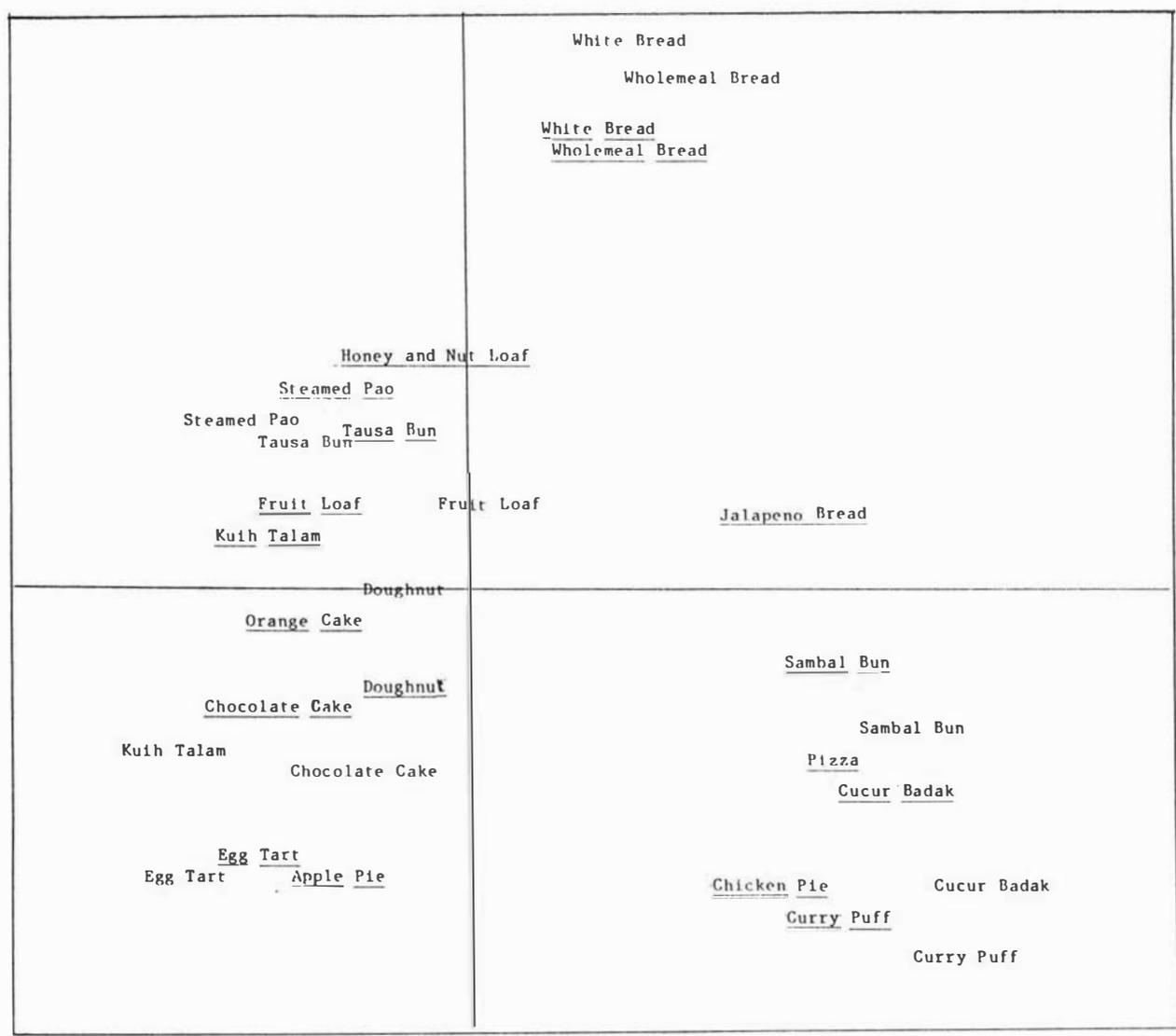
PLOT OF MULTIDIMENSIONAL SPACE FOR CHINESE - KYST - WITH 12 and 18 PRODUCTS SUPERIMPOSED (dimension 3 vs dimension 1)

PLOT OF MULTIDIMENSIONAL SPACE FOR CHINESE - INDSGAL - WITH 12 and 18 PRODUCTS SUPERIMPOSED (dimension 2 vs dimension 1)



PLOT OF MULTIDIMENSIONAL SPACE FOR CHINESE - INDSICAL - WITH 12 and 18
 PRODUCTS SUPERIMPOSED (dimension 3 vs dimension 1)

APPENDIX 4.24



APPENDIX 6.1

INITIAL SENSORY EVALUATION FORM

Name _____

Date _____

You are presented with two samples of macaraoni and minced beef pie. The product is meant to be taken as a snack by Malaysians. Please evaluate the samples and fill in the questionnaire. You are required to tick where there are boxes, and make vertical lines on the horizontal line to indicate the rating of the two samples as well as your ideal sample. Label each vertical line with the code number of the sample it represents and 1 for the ideal.

1. External appearance

1.1 Diameter of the top surface of the pie is 9.0 cm.

Is this too small
 too large
 just right?

If pie is too small or too large, please state the diameter you want

1.2 Diameter of the bottom of the pie is 7.0 cm.

Is this too small
 too large
 just right?

If pie is too small or too large, please state the diameter you want

1.3 Depth of pie is 3.0 cm.

Is this too shallow
 too deep
 just right?

If the depth of the pie is too shallow or deep, please state the depth you want

Comments:

2. Puff Pastry (top pastry)

2.1 Thickness of pastry

very thin very thick

2.2 Colour of pastry

very yellow very brown

2.3 Texture of pastry

very flaky very elastic

APPENDIX 6.1: continued

4. Filling

4.1 Appearance

4.1.1 The ratio of meat: mixed vegetables: macaroni is $1:1\frac{1}{2}:\frac{1}{2}$ for sample 452 and $1:1:\frac{1}{2}$ for sample 931.

Which ratio do you prefer?

| | | |
|--------------------------|-----------------------------------|-------|
| <input type="checkbox"/> | sample 452 | |
| <input type="checkbox"/> | sample 931 | |
| <input type="checkbox"/> | neither. I prefer the ratio to be | _____ |

4.1.2 Amount of gravy (liquid portion of filling)

no gravy plenty of gravy

4.1.3 Amount of filling

no filling plenty of filling

Comments:

4.2 Texture

4.2.1 Overall texture of filling

very soft very firm

4.2.2 Texture of meat

very soft very firm

4.2.3 Texture of macaroni

very soft very firm

4.2.4 Texture of mixed vegetables

very soft very firm

4.2.5 Texture of gravy

very smooth very gummy/lumpy

4.2.6 Viscosity of gravy

very thin very thick

APPENDIX 6.1 continued

4.2.7 Greasiness of filling


 absence of greasiness very greasy

Comments:

4.3 Flavour

4.3.1 Beef flavour


 absence of beef flavour very strong beef flavour

4.3.2 Overall saltiness


 absence of salty flavour very salty

4.3.3 Saltiness of macaroni


 absence of saltiness very salty

4.3.4 Saltiness of mixed vegetables


 absence of salty flavour very salty

4.3.5 Additional ingredients

Would you like the addition of the following flavours?

Tick more than one if necessary

tomato
 chilli
 cheese
 spice _____

herb _____
 curry
 pepper
 other, please specify _____

5. Other attributes

5.1 Price

What do you consider a reasonable price for the pie? _____

5.2 Please list other attributes in addition to sensory attributes, that you think are important.

5.3 List the five most important attribute of this product which will affect your purchase of this product.

APPENDIX 6.2
METHOD OF SENSORY EVALUATION

| Product attribute | Textural characteristic | Method of evaluation |
|---|--|--|
| Texture of puff pastry | flakiness | Bite into sample with incisors |
| Texture of puff pastry | elasticity | Masticate sample between molar teeth and evaluate number of chews required to reduce sample to a state ready for swallowing. |
| Texture of shortcrust pastry | soft, crumbly to tough, hard | Masticate sample between molar teeth and evaluate force required to compress sample. |
| Texture of macaroni | soft to firm | Masticate sample between molar teeth and evaluate force required to disintegrate sample. |
| Greasiness/oiliness of pastry (& filling) | absence of greasiness/oiliness to very greasy/oily | Degree of coating perceived in the the mouth or throat after swallowing. |
| Moistness | dry to moist | Amount of moisture available during mastication |

Overall evaluation

Take 2-3 bites of sample, chew in molar teeth until ready for swallowing. Swallow sample and evaluate overall odour, flavour, texture and acceptability of product samples.

APPENDIX 6.3

STANDARD DEVIATIONS OF SENSORY ATTRIBUTES

Pie top

| | | | | | |
|---------------|-----|-----|-----|-----|-----|
| Thickness | 1.1 | 0.6 | 2.0 | 1.0 | 1.1 |
| Flakiness | 1.2 | 1.8 | 1.8 | 1.6 | 1.0 |
| Elasticity | 1.1 | 2.2 | 2.2 | 1.7 | 1.1 |
| Saltiness | 1.3 | 0.7 | 1.7 | 1.7 | 0.1 |
| Greasiness | 0.8 | 1.0 | 2.7 | 1.2 | 0.5 |
| Flour | 1.2 | 1.1 | 1.0 | 0.7 | 0.2 |
| Sour | 1.1 | 1.4 | 1.6 | 1.2 | 0.6 |
| Acceptability | 2.1 | 2.0 | 2.3 | 2.5 | 2.2 |

Pie bottom

| | | | | | |
|---------------|-----|-----|-----|-----|-----|
| Thickness | 1.7 | 0.9 | 1.3 | 0.9 | 0.6 |
| Texture | 1.3 | 1.0 | 1.7 | 2.0 | 0.9 |
| Saltiness | 1.2 | 0.8 | 1.4 | 0.9 | 0.8 |
| Greasiness | 0.8 | 1.2 | 1.0 | 0.9 | 0.5 |
| Flour | 1.1 | 1.7 | 2.0 | 2.0 | 0.5 |
| Acceptability | | | | | |

Filling

| | | | | | |
|-----------------------|-----|-----|-----|-----|-----|
| Amount of filling | 1.0 | 0.8 | 1.8 | 1.7 | 0.6 |
| Amount of gravy | 1.2 | 1.1 | 2.3 | 2.1 | 0.8 |
| Size of meat | 0.9 | 1.5 | 1.8 | 2.0 | 1.3 |
| Beef aroma | 1.7 | 3.4 | 2.2 | 0.7 | 1.6 |
| Overall aroma | 3.0 | 1.3 | 3.2 | 2.0 | 1.6 |
| Texture of filling | 1.3 | 2.2 | 2.1 | 2.4 | 1.5 |
| Texture of meat | 0.5 | 2.0 | 2.0 | 2.1 | 1.8 |
| Texture of macaroni | 1.7 | 1.8 | 2.7 | 1.7 | 1.0 |
| Texture of vegetable | 1.2 | 1.3 | 2.6 | 1.5 | 1.4 |
| Texture of gravy | 1.0 | 0.9 | 2.1 | 2.3 | 1.5 |
| Viscosity of gravy | 1.4 | 1.0 | 2.4 | 2.3 | 0.7 |
| Greasiness | 1.5 | 1.4 | 2.8 | 0.9 | 0.1 |
| Beef flavour | 1.1 | 1.0 | 2.3 | 0.8 | 1.4 |
| Saltiness | 0.8 | 1.4 | 1.4 | 0.6 | 0.3 |
| Overall acceptability | 1.3 | 1.7 | 0.6 | 2.2 | 2.6 |

APPENDIX 7.1

REASONS FOR DISLIKING PIE

| | Malay | Chinese |
|-----------------|-------|---------|
| Beef | 0 | 3 |
| Don't like pies | 2 | 0 |
| Not tasty | 0 | 1 |
| Pie too soft | 2 | 2 |
| Other | 1 | 1 |
| Total | 4 | 7 |

APPENDIX 7.2

REASONS FOR DISLIKING FLAVOUR OF PIE

| | Malay | Chinese |
|------------------|-------|---------|
| Beef | 0 | 9 |
| Wet/waterY | 0 | 2 |
| Filling too soft | 1 | 2 |
| Don't like pies | 2 | 1 |
| Other | 4 | 4 |
| Total | 7 | 18 |