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PROMOTION OF BROWNING IN THE DEVELOPMENT
OF NEW DAIRY PRODUCTS

A Thesis

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Master of Food Technology in Food Processing

by

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"It is not enough to know; we must turn what we
know to account. It is not enough to will; we
must do."

- Goethe

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I N T R O D U C T I O N

One readily demonstratable effect resulting from the prolonged heat treatment of milk is browning. A form of non-enzymic browning due to interaction of aldoses with free amino-groups occurs in many foods, and hence this reaction is of broad significance in the food field; e.g., dry milk products (29), processed potatoes (95), dried fruit (102), dried whole eggs (73), dried meat (99), and liquid and concentrated milk products (33,83). The significance of browning in food technology has two aspects - the desirable and the undesirable.

In many areas of the world today people are undernourished, malnourished, and even starved. At the same time in other parts of the world, food is abundant to the point of substantial excess. Although many factors contribute to this unbalance, food spoilage is an important consideration. Some excess food can be processed and stored in a practical manner involving little or no deterioration, but some of it faces spoilage despite man's preventive efforts. One vexing problem of food spoilage is browning which may affect many food products. These include dried food such as milk, eggs, fruits, fruit juices, meat, fish and vegetables (12); canned milk, fruit, and vegetables; and other foods such as molasses. Loss of palatability and nutritive value as well as undesirable changes in physical properties frequently attend the browning of food to varying degrees of intensity, depending on the stage to which the reaction has progressed. This is the undesirable aspect of browning.

On the other hand, the Maillard reaction can make a positive contribution to food technology by producing desirable colours, flavours and aromas in many foods such as ready-to-serve cereals, toffees, roasted coffee, malted barley, and baked goods (65). Toasting, baking, roasting, and frying are processes

aimed at intentionally browning the food. Although there is some loss of amino acids when these flavours are produced, the loss is not usually of much importance and is accepted as a price worth paying. The Maillard reaction can be exploited for particular purposes by the addition of reducing agents to the food. For example, the inclusion of milk powder in a loaf of bread permits more even toasting at a lower temperature because of the presence of lactose. Another example is the production of chicken and meat-like flavours by heating amino acids with pentose sugars and aldehydes. The distinctive caramel and butterscotch flavours derived from dairy products result from the browning of milk or milk components. Thus, it is clear that browning has two aspects, both of which concern the acceptability of man's food.

It is the latter aspect which is of principal interest in the present work. By promoting browning in milk solids to varying degrees of intensity, a range of palatable caramel flavours may be obtained. It is clear that dairy-caramel flavours are appetizing by the fact that caramelized milk products are very popular, and are eaten extensively in South America, India, and Europe. Traditional products produced domestically include 'Dulce de leche' (Argentina, Uruguay), 'Manjar blanco' (Chile), and 'Khoa' (India). In Argentina, 2,800 tons of 'Dulce de leche' are commercially produced per annum; 98% of this production is consumed internally. Clearly then, many people enjoy dairy-caramel flavours when purposely produced. With the realization that a potential market is already present, the purpose of this thesis is to explore the possibility of diversifying New Zealand dairy products by the promoted caramelization of milk solids.

A review of previous research into the browning reaction in milk showed that much work has been done and copious literature exists, but most of this neglects the beneficial effects of non-enzymic browning in milk and concentrates

on the deteriorative effects. Consequently, methods of measuring browning mainly involve measurements of the reactants and early intermediates as a basis for inhibiting the early stages of browning. As a result of this bias in previous research, the first task of this study was to develop a method of measuring promoted browning ("caramelization") in milk. The method finally chosen was the reflectance measurement of colour.

A reliable method of measuring promoted browning made possible a study of the factors affecting promoted browning, and caramel flavour development, in sweetened condensed milk. The study was restricted to browning in "liquid" systems as the factors affecting browning in "dry" milk powder have been well documented (65,83). In this context, there were two principal areas of interest with regard to browning and associated changes in milk systems. One is practical and concerns the manipulation of process and product variables such as temperature, time, pH, and moisture content, to obtain a controlled amount of browning. The other is fundamental and concerns making the knowledge of milk and its behaviour as complete as possible.

Without incorporation into palatable food structures and textures any flavour is of little value as food. Hence, the remainder of this thesis is an exploration of the possibilities of incorporating dairy caramel flavours into conventional food textures, structures, and types which are of proven palatability. A survey of present food forms marketed, and a consideration of recent trends in food marketing suggests that the following product types are of proven consumer acceptance and worthy of further study and development.

1. Sweet caramelized spread for use in the same way as jams; i.e., spread, pie filling, cakes, etc.
2. Porous wafer or biscuit type of product - perhaps for use as a high protein supplement in a form which the consumer is familiar with.

3. Concentrated dairy caramel flavour in powder or liquid concentrate form for general food flavouring.
4. Confections - sweets, toffees, milk caramel, hokey-pokey, etc.
(The production of caramel confections is well documented and was not studied further.)

With an aim of developing these general product types a fundamental study was undertaken to define the factors affecting flavour, colour, and texture of browned milk solids.
