THE SYSTEMATIC DEVELOPMENT OF A CONTROLLED FERMENTATION PROCESS USING MIXED BACTERIAL STARTER CULTURES FOR NHAM, A THAI SEMI-DRY SAUSAGE

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ABSTRACT

The aim of this thesis was to improve the quality of Nham, a traditional Thai fermented sausage, using systematic product development techniques. The traditional Nham fermentation depends upon a random bacterial flora. This study identified the starter cultures which could be used and developed an industrial production method using mixed starter cultures.

Systematic experimental designs were used to guide the development of the Nham fermentation; identification of the important processing factors using a Plackett and Burman experimental design, formulation and process development using full factorial designs in sequence of 2^4, 2^3 and 2^2, and then a storage test of the product, testing of formulation and process in Thailand and finally a production trial of the new process in a factory in Thailand. Chemical, physical, microbiological, and sensory evaluation were used during the systematic product development. The study ended with consumer testing of the prototype product in the target market in Chiang Mai city and two villages - Ban Don Chai and Ban Ma-Kran.

The important factors affecting Nham quality were the mixed starter cultures and the carbon sources used in the Nham formulation. When the Nham base was inoculated with Lactobacillus plantarum 10^3 cfu.g^{-1}, Pediococcus cerevisiae 10^6 cfu.g^{-1} and Micrococcus varians 10^3 cfu.g^{-1} acid production, firmness and colour development were optimum, the product was microbiologically safe and the sensory properties were acceptable to consumers. The addition of carbon sources increased acid development. 0.5% glucose and 6% cooked rice were optimum levels in the Nham formulation.

Temperature and relative humidity also affected the Nham fermentation. Temperature increased the rate of pH reduction, the firmness and colour development. High relative humidity decreased the weight loss. The Nham fermented at 30°C and 97% relative humidity had optimum acid production and sensory properties.

Nham is sold in Thailand between 20°C and 30°C, and at relative humidity as high as 97%. Experimental samples stored under similar conditions had a shelf life of 11 days and 9 days respectively. When the product was chilled at 10°C and 1°C, the shelf life was extended to 63 days and 103 days respectively. Enterobacteriaceae and Staphylococcus aureus counts fell during storage and no yeasts or moulds were observed. Off-flavour development controlled the shelf life.

Product profiles were determined for the Nham by Thai consumers and the ideal ratio method was used during the sensory product testing. A profile test using linear scaling with fixed ideal points was used for the trained sensory panels. The floating ideal point was used with consumer panels when the prototype product was close to ideal profile. Category scaling was used in the consumer testing of the final product. Sensory evaluation by one hundred and twelve families in Chiang Mai province indicated that appearance, texture, and flavour of Nham made with the mixed starter cultures were good.

The Nham successfully developed by using the systematic product development had a high quality in terms of consistency, microbiological safety and long shelf life and was also accepted by the target Thai consumers. The product could be produced in a simple plant with the existing equipment in fermented meat product factories in Thailand but there would need to be an increase in technology of culture preparation and controlled fermentation. The product could be sent from the cottage industry in the North to all provinces in Thailand, particularly to Bangkok, and also had a potential to be exported to overseas countries if chilled conditions were used.

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