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EFFECT OF PROCESSING CONDITIONS, ADDITIVES AND STARCH SUBSTITUTION ON THE QUALITY OF STARCH NOODLE

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EFFECT OF PROCESSING CONDITIONS, ADDITIVES AND STARCH SUBSTITUTION ON THE QUALITY OF STARCH NOODLE

By

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To my dear family whose support and encouragement make all things seem possible

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF PLATES

LIST OF ABBREVIATIONS

kg	kilogram
g	gram
mg	milligram
mm	millimetre
ml	millilitre
cm	centimetre
sec	second
min	minute
hr	hour
%	percent
°C	degree Celcius
g	gravity (relative centrifugal force)
mmole	millimole
db	dry basis

Abstract of Thesis Presented to the Senate of Universiti Putra Malaysia
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Starch noodle is a popular noodle in Asian countries, including Malaysia. In China and Thailand, the noodle is usually made from mungbean starch but in Malaysia it is made from a mixture of 95% potato starch and 5% mungbean starch. Although uncooked potato starch noodle has similar characteristics with noodle made from 100% mungbean starch, it becomes sticky, experiences high cooking loss and does not retain its shape well when cooked in water. In this project, methods for improving the quality of potato starch noodle were studied. It was found that both dough moisture content and freezing temperature of wet noodles significantly affect transparency, dimension, cutting stress, cooking loss and swelling index of noodles. They did not affect noodle stickiness. Based on the results obtained using Response Surface Methodology (RSM), the dough moisture content and freezing temperature of wet noodles suitable for potato starch noodle processing were 51.5 to 54.3% and -5 to -7°C, respectively. The

strength, dimensions and transparency of the uncooked noodle produced were comparable to that of commercial potato starch noodle and mungbean noodle. Its cooking loss and swelling index, however, were lower than that of commercial potato starch noodle but higher than that of mungbean noodle. Addition of a mixture of potassium alum (0.64-0.86%) and alginic acid (0.30-0.46%) in the dough formula reduced cooking loss, swelling index and stickiness of cooked noodle to that comparable to those of mungbean noodle. In addition, they improved dough consistency, strength of uncooked noodle and firmness of cooked noodle and resulted in cooked noodle with acceptable dimension, transparency, elasticity and taste. The effects of these additives on the noodle, in particular on cooked noodle mimicked their effects on potato starch paste. Potassium alum and alginic acid, when added separately or together into a starch slurry, delayed starch gelatinization and viscosity breakdown, decreased hot paste viscosity and set-back, and reduced swelling power and solubility of potato starch paste. Substitution of potato starch up to 17% with tapioca starch phosphate, up to 35% with MTS283 (commercial tapioca starch phosphate) or up to 35% with sago starch phosphate improved the quality of potato starch noodle. The noodle produced is less brittle when uncooked, and is more elastic, firmer and experience lower cooking loss and less swelling when cooked. Out of the three types of noodles made using modified starches, starch noodle containing MTS283 was the most preferred. Substitution of potato starch with native tapioca or sago starch up to 17% is also possible. The noodle prepared using modified starches, however, is more transparent and less brittle when uncooked, and is more elastic, firmer and more acceptable in terms of taste when cooked.

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Suun adalah salah satu jenis mi yang dikenali di Asia, termasuk di Malaysia. Di China dan Thailand, suun biasanya dibuat daripada kanji kacang hijau, tetapi di Malaysia suun terutama dibuat daripada campuran 95% kanji kentang dan 5% kanji kacang hijau. Suun kentang mentah mempunyai sifat yang sama dengan suun mentah kacang hijau, tetapi ianya adalah lebih lekit, mengalami kehilangan pepejal yang tinggi dan mengembang lebih semasa dimasak. Dalam projek ini, cara memperbaiki kualiti suun kentang telah dikaji. Kandungan air dalam adunan dan suhu penyejukbekuan suun basah memberikan kesan bererti ke atas lutsinar, ukuran, kekerasan, kehilangan pepejal semasa pemasakan dan indeks pengembangan kepada kualiti suun yang terhasil. Keduanya bagaimanapun tidak memberi kesan yang bererti ke atas kelekitan suun. Kandungan air dalam adunan sebanyak 51.5 hingga 54.3% dan suhu

penyejukbekuan pada -5 hingga -7°C adalah yang paling sesuai untuk pemprosesan suun kentang. Suun mentah yang dihasilkan mempunyai kekerasan, ukuran dan kejernihan yang sama dengan suun kentang dan suun kacang hijau komersil. Kehilangan pepejal semasa pemasakan dan indeks pengembangan suun dapat dikurangkan, tetapi suun lebih lekit dibanding dengan suun kacang hijau. Penambahan potasium alum 0.64-0.86% dan asid alginik 0.30-0.46% dalam adunan dapat memperbaiki kualiti suun kentang. Kehilangan pepejal selama pemasakan, indeks pengembangan dan kelekitan suun masak dapat dikurangkan. Ianya juga memperbaiki konsistensi adunan, kekuatan suun mentah dan kekerasan suun masak tanpa memberi kesan yang bererti pada ukuran, lutsinar, keanjalan dan rasa. Kesan ini ada kaitannya dengan kemampuan potasium alum dan asid alginik dalam menunda gelatinisasi kanji, mengurangi kelikatan, retrogradasi, kemampuan pengembangan dan kelarutan daripada kanji kentang. Penggantian kanji kentang dengan 17% kanji ubi kayu terfosforilasi, 35% kanji MTS283 (kanji ubi kayu terfosforilasi komersil) atau 35% kanji sagu terfosforilasi dapat memperbaiki kualiti suun yang dihasilkan. Suun mentah yang dihasilkan memiliki tekstur yang lebih kuat, sedangkan suun setelah pemasakan lebih elastik, lebih keras, mengurangkan kehilangan pepejal dan kurang mengembang. Diantara ketiga-tiga jenis sagu terfosforilasi yang digunakan, penggantian dengan kanji MTS283 lebih disukai. Penggantian kanji kentang dengan 17% kanji ubi kayu atau sagu asal juga boleh diterima. Bagaimanapun, kanji terfosforilasi menghasilkan suun mentah yang lebih jernih dan lebih kuat, sedangkan suun masak lebih elastik, lebih keras dan memberikan kesan rasa yang lebih diterima.

CHAPTER I

GENERAL INTRODUCTION

Starch noodle is one of the popular oriental noodles in East Asian countries, particularly Taiwan, China, Thailand and Japan. The art of starch noodle making is believed to have originated in China, and spread out throughout East Asia. Traditionally, this typical transparent noodle was made during the winter season and consumed in soup or fried dishes. Nowadays, starch noodle is also popular and consumed in Malaysia, Indonesia, Philippines, Netherlands, Saudi Arabia and USA (Moleeratanond, 1987).

Starch noodle has specific characteristics. It is transparent, slippery, glossy, and in thin strips when uncooked. The cooked noodle is elastic, transparent, smooth, non-sticky and has bland taste and good mouthfeel. In China and Thailand, mungbean starch is the major raw material for starch noodle. Noodle made from 100% mungbean starch is usually classified under special quality. In Malaysia, mungbean starch is mostly imported from China and Thailand and it is rather expensive (RM 6.0/kg). Consequently, the use of mungbean starch in starch noodle production is costly.

Nowadays, most commercial starch noodles are made from mungbean and other starch mixtures. Some researchers have investigated and reported the use of other starches to substitute mungbean starch, such as broad bean, pigeon pea, kidney pea, sweet potato, canna and corn. However, they found that starch

noodle made from these starches are of lower quality compared to that of mungbean noodle. These noodles were softer and less transparent with higher cooking loss.

Potato starch is a preferred substitute for mungbean starch in starch noodle rather than other starches. Potato starch is cheaper than mungbean starch (RM 1.60/kg). The only starch noodle produced commercially in Malaysia is made up of 95% potato and 5% mungbean starches. The noodle is transparent, glossy, smooth, and moderately strong when uncooked, but becomes sticky, experience high cooking loss and does not retain its shape well when cooked in water. The lower quality may be due to different starch characteristics, processing techniques and formula. Therefore, improvement in the formulation and substitution with other starches may result in starch noodle with better quality.

The colour, texture and taste of starch noodle vary with different raw materials and processing techniques. The production of this noodle mostly involves continuous processing operations, but sometimes batch processing techniques are applied in a small-scale production. Some processing variables in mungbean starch noodle making which affect its final product are the amount of gelatinized starch used, moisture content of dough, cooking time and the freezing time and temperature of wet noodle (Galvez *et al.*, 1994). However, no study has yet been conducted concerning effects of processing variables on potato starch noodle under local processing conditions and techniques.

Li; *et al.* (1979) studied the effect of adding potassium alum in starch noodle. They revealed that it lowered hygroscopicity and increased crystallinity of noodle. Alginic acid is also commonly used in pasta products, such as macaroni and spaghetti. It stabilizes consistency of dough, improves texture, colour, cohesiveness and smoothness, and reduced susceptibility to overcooking and stickiness of the products (Glicksman, 1969; Charalambous and Doxastakis, 1989). In connection, the addition of potassium alum or alginic acid in formulation is expected to improve the quality of potato starch noodle.

Tapioca and sago starches are abundantly available in Malaysia and other tropical countries. They can be potential products to replace or substitute potato and mungbean starches. These starches are cheaper than potato or mungbean starch (RM 0.90-1.20/kg). Their usage will reduce the production costs and consequently investors may interest to develop starch noodle factory. In addition, it would be able to reduce the dependence of this country on imported potato and mungbean starches.

The characteristics of tapioca and sago starches are however different from mungbean or potato starch which may affect the starch noodle quality. With modification of their characteristics, blends of tapioca or sago starch and potato starch might yield better quality starch noodle. In this study, distarch phosphates will be produced through phosphorylation because it is a common modification method employed for food application (Rutenberg and Solarek, 1984). The U.S. Food and Drug Administration allows starch for use in foods to be modified with sodium trimetaphosphate, sodium tripolyphosphate and

phosphorus oxychloride (CFR, 1991). The usage of starch phosphate in starch noodle has been investigated and reported by some researchers, such as phosphorylated sweet potato and potato starch (Chiu and Chua, 1990), tapioca starch (Maneepun and Sirijona, (1992) and canna starch (Chang and Lii, 1987; Lii and Chang, 1991).

The general objective of this study is :

1. To study the effect of moisture content of dough and freezing temperature of wet noodle on the quality of starch noodle.

2. To study the effect of potassium alum or alginic acid addition on the quality of starch noodle.

3. To study the effect of substituting with native or phosphorylated tapioca or sago starch on the quality of starch noodle.