



***EFFECTS OF HIGH PRESSURE PROCESSING ON SAFETY AND
QUALITY OF DURIAN (*Durio zibethinus* L.) PASTE AND PULP***

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By

TAN PEH FEN

**Thesis Submitted to the School of Graduate Studies, Universiti Putra Malaysia,
in Fulfilment of the Requirements for the Degree of Master of Science**

May 2018

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Abstract of thesis presented to the Senate of Universiti Putra Malaysia in fulfilment of the requirement for the degree of Master of Science

EFFECTS OF HIGH PRESSURE PROCESSING ON SAFETY AND QUALITY OF DURIAN (*Durio zibethinus* L.) PASTE AND PULP

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May 2018

Chairman : Professor Tan Chin Ping, PhD
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High pressure processing (HPP) or high hydrostatic pressure (HHP) is a method of applying high pressure in the preservation of food products. In this study, HPP with the pressures of 300, 400, 500 and 600 MPa combined with time of 3, 5, 10 and 15 min were studied. The effect of HPP on the physicochemical (proximate composition, colour, total soluble solids, pH and titratable acidity), microbiological (total plate count, coliforms, yeasts and moulds, and psychrophilic bacterial counts), enzymatic (reduction of polygalacturonase and pectin methyl esterase activities) properties, and sensory evaluation was carried out in durian paste and pulp.

It was observed that HP-treated durian paste and pulp showed no significant changes ($p > 0.05$) in terms of their proximate composition, colour, total soluble solid, pH, titratable acidity and sensory attributes. In addition, the reduction of microbial counts to below detection level (< 20 CFU/g) in both durian paste and pulp were observed at treatment pressures of above 500 MPa and 400 MPa, respectively. Meanwhile, pressure as a treatment factor was found to exhibit a significant effect ($p < 0.05$) in reducing both polygalacturonase and pectin methyl esterase activities for both durian paste and pulp. This finding showed that HPP is a promising method in preserving durian. After several HPP parameters were evaluated, optimum parameters of 600 MPa for 5 min and 500 MPa for 5 min were selected for durian paste and pulp, respectively, with microbial safety being set as the primary deciding factor.

The selected optimum parameters were applied onto nylon-packed durian paste, nylon-packed and skin film-packed durian pulps. Then, the treated durian paste and pulp were stored at -18°C and subjected to a 56-day shelf life study. During the storage period, it was observed that the total soluble solids, pH, titratable acidity and colour of HP-treated durian paste and pulp did not show any significant changes ($p > 0.05$).

Meanwhile, the microbial counts of HP-treated samples were shown to be lower than those of the untreated samples and did not show any significant changes throughout the storage period. Furthermore, the enzymatic activities of durian paste and pulp were lower than those of the untreated samples during the storage period. In this study, it was also showed that there was little difference between durian pulp packaged using nylon and skin film packaging, suggesting the minimal effect of packaging types on the durian pulp.

Overall, HPP showed promising result in maintaining the overall qualities of durian paste and pulp. At the same time, the effective reduction of microbial and enzymatic activities pointed to the possibilities of shelf life extension with minimal quality deterioration in durian paste and pulp.



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**KESAN PEMROSESAN TEKANAN TINGGI KE ATAS KESELAMATAN
DAN KUALITI DURIAN (*Durio zibethinus L.*) PES DAN PULPA**

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Pemprosesan tekanan tinggi atau pemprosesan hidrostatik tinggi adalah teknologi menggunakan tekanan tinggi dalam pengawetan bahan makanan. Dalam kajian ini, pemprosesan tekanan tinggi menggunakan gabungan tekanan sebanyak 300, 400, 500, 600 MPa dengan masa 3, 5, 10 dan 15 min telah dikaji. Kesan tekanan tinggi ke atas sifat-sifat fizikokimia (komposisi proksimat, warna, jumlah pepejal larut, pH dan keasidan boleh titrat), mikrobiologi (jumlah kiraan plat, koliform, yis dan kulat, dan bakteria psikrofilik), enzim (pengurangan aktiviti enzim poligalakturonase dan pektin metil esterase) dan sifat deria pes dan pulpa durian telah dinilai.

Ianya didapati bahawa pes dan pulpa durian yang telah dirawat menggunakan tekanan tinggi tidak menunjukkan perubahan signifikan ($p > 0.05$) dari segi komposisi proksimat, warna, jumlah pepejal larut, pH, keasidan boleh titrat dan penilaian deria. Tambahan lagi, pengurangan kiraan mikrob ke tahap bawah pengesanan (< 20 CFU/g) telah diperhati bagi pes durian pada tekanan melebihi 500 MPa dan pulpa durian pada tekanan melebihi 400 MPa. Sementara itu, faktor tekanan menunjukkan kesan yang lebih signifikan ($p < 0.05$) dalam pengurangan aktiviti poligalakturonase dan pektin metil esterase pes dan pulpa durian. Kajian ini menunjukkan bahawa pemprosesan tekanan tinggi adalah teknologi yang sangat berpotensi dalam pengawetan durian.

Setelah menilai beberapa parameter pemprosesan tekanan tinggi, parameter optimum iaitu 600 MPa untuk 5 min dan 500 MPa untuk 5 min masing-masing telah dipilih untuk pes dan pulpa durian, dengan memberi keutamaan kepada tahap mikrobiologi yang selamat. Parameter optimum yang terpilih telah digunakan untuk memproses pes durian yang dibungkus menggunakan pembungkusan nilon dan pulpa durian yang dibungkus menggunakan pembungkusan filem kulit dan nilon. Pes dan pulpa durian yang telah dirawat kemudiannya telah disimpan pada suhu -18°C untuk kajian hayat

simpan selama 56 hari. Sewaktu tempoh simpanan, kajian ini mendapati bahawa jumlah pepejal larut, pH, keasidan boleh titrat dan warna pes dan pulpa durian yang dirawat tidak menunjukkan perubahan yang signifikan ($p > 0.05$). Sementara itu, aktiviti mikrob bagi sampel-sampel yang dirawat didapati lebih rendah daripada durian yang tidak dirawat, dan tidak menunjukkan perubahan yang signifikan sepanjang tempoh simpanan. Tambahan pula, aktiviti enzim dalam pes dan pulpa durian juga adalah lebih rendah berbanding dengan durian yang tidak dirawat sepanjang tempoh simpanan. Menerusi kajian ini juga didapati bahawa tiada perbezaan di antara pulpa durian yang dibungkus menggunakan pembungkusan nilon dengan yang dibungkus menggunakan filem kulit. Ini menunjukkan bahawa jenis pembungkusan hanya memberi kesan yang minimum ke atas kualiti pulpa durian.

Secara keseluruhannya, pemprosesan tekanan tinggi menunjukkan keputusan yang memberangsangkan dalam mengekalkan kualiti keseluruhan pes dan pulpa durian. Pada masa yang sama, pengurangan aktiviti mikrobiologi dan enzim yang berkesan memberi petunjuk ke arah kemungkinan pemanjangan hayat simpan pes dan pulpa durian dengan degradasi kualiti yang minimum.

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LIST OF ABBREVIATIONS

%	Percent
&	And
<	Less than
>	Greater than
±	Plus minus
°C	Degree Celsius
μL	microliter
ANOVA	Analysis of variance
AOAC	Association of Official Analytical Chemists
CFU	Colony-forming unit
EMB	Eosin Methylene Blue
GDP	Gross domestic product
g	gram
HPP	High pressure processing
HP	High pressure
kg	Kilogram
mg	milligram
mL	milliliter
NAP	National agriculture policy
PCA	Plate Count Agar
PDA	Potato Dextrose Agar
PG	Polygalacturonase
PME	Pectin methyl esterase
SD	Standard deviation

TPC

Total plate count

w/v

Volume(mL) per volume (mL)



CHAPTER 1

INTRODUCTION

Durian (*Durio zibethinus*) is a tropical fruit that belongs to the family of Bombacaceae. It is crowned the 'king of fruits' even though it is a controversial fruit due to its distinctive, unique and indescribable odour (Subhadrabandhu and Ketsa, 2001). Tropical fruits are defined as fruits that yield seasonally but not all year long in tropical countries. This limitation contributed directly to the low production volumes of tropical fruits worldwide. As a result, tropical fruits hold a high value and are considered by worldwide consumers as premium products. Once a minor crop, it is now commonly grown in Southeast Asia countries such as Malaysia, Thailand, Philippines and Indonesia (Voon et al., 2006). The uniqueness of tropical fruits draws the interest of both Asian and non-Asian consumers. Physically, durian is described as having a thick husk (rind) and fleshy fruits (aril). Unlike other tropical fruits, durian has sharp hexagonal thorns, making it a challenge for people to consume it. The inner part normally has five locular with 1-5 durian pulps in each locular. One unit of durian pulp has an edible part called aril that grows from the funiculus of a single seed. The colour of the aril is usually yellow, golden yellow or creamy white (Bhusiri, 1987).

It has been reported that durian possesses many health benefits. Numerous studies have shown that strong antioxidant properties and high nutritional values exist in durian (Leontowicz et al., 2008; Maninang et al., 2009). In addition, durian has also been shown to contain many bioactive compounds (total phenolics, flavonoids, anthocyanins and flavanols) (Feng et al., 2018), and high contents of dietary fibre and minerals (Arancibia-Avila et al., 2008).

In addition to nutritional contents, consumers nowadays are placing equal importance on the quality, safety and functional properties of fruits. Thus, tropical fruits producers and manufacturers have reacted to the demands accordingly by improving the quality of fresh-cut fruits (Brecht, 2011). However, durian has a limited shelf life. Previous reports stated the shelf life of matured durian is between 3 to 4 days (Pauziah et al., 1992). Durian that is stored as a whole fruit has a much shorter storage period of 20 days at 4°C (Praditdoun, 1986) as compared to durian pulp/ aril that can be stored up to 8 weeks at 5°C (Booncherm and Siriphanich, 1991).

Previous commercial practices, such as chemical, irradiation and high temperature treatments, exert negative effects on the quality and nutrients of the treated fruits. However, the consumption of fruits is very much related to their quality and nutrition. Over the past decade, there is a tendency among consumers towards the consumption of fresh, high-quality fruits (Chakraborty et al., 2014). Therefore, farmers, manufacturers and government authorities are working hand-in-hand to produce high-quality and safe fruits for local and international markets. In this aspect, the quality improvement of export fruits via the development of technology is taken seriously by the Malaysian government. Potential technology must not only extend the shelf life of

fruits, but also maintain their freshness, quality and nutritional contents (Osman, 2011). Among the many developed technologies, high pressure processing (HPP) is proposed as the ideal solution to extend the shelf life and maintain the high quality of exported durian fruits. This technology has attracted the interest of researchers working on the preservation of tropical fruits and also well embraced by food manufacturers. This is because the common thermal treatment would invariably cause adverse effect on the heat-sensitive nutrients of food.

However, the impact of HPP on durian products is not well established. Therefore, in this study, the feasibility of using HPP to extend the shelf life and maintain the quality of durian was evaluated by investigating the effect of HPP at different pressures and holding times on the safety and quality of durian paste and pulp. The effect of HPP on the shelf life of durian paste and pulp packed using different packaging materials was also studied.

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