



**DEVELOPMENT OF
DRAGON FRUIT PEEL-BASED SNACKS BAR**

By
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Sekian, terima kasih.

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LIST OF ABBREVIATIONS

Abbreviations	Captions
DE	Degree of esterification
DFP	Dragon fruit peel
DPPH	2,2, diphenyl-1-picrylhydrazyl
FAO	United Nations Food and Agriculture Organization
FRAP	Ferric reducing antioxidant power
HDL	High density lipoprotein
HPLC	High Performance Liquid Chromatography
ICP-OES	Inductively coupled plasma - optical emission spectrometry
IDF	Insoluble Dietary Fibre
LAB	Lactic acid bacteria
LDL	Low density lipoprotein
SDF	Soluble Dietary Fibre
TFC	Total Flavonoid Content
TPA	Texture Profile Analysis
TPC	Total Phenolic Content
WHO	World Health Organization
YM	Yeast and Mold Count

PEMBANGUNAN BAR SNEK BERASASKAN KULIT BUAH NAGA

ABSTRAK

Kajian ini bertujuan untuk menganalisis komposisi nutrisi dan sifat fiziko kimia bar snek yang diformulasikan dengan tahap serbuk kulit buah naga (DFP) yang berbeza. Bar snek disediakan dengan penambahan DFP secara meningkat iaitu 0g, 5g, 10g dan 15g bagi setiap formulasi. Komposisi proksimat, sifat antioksidan, fizikal dan mikrobiologi serta kajian jangka hayat telah dinilai. Peningkatan penambahan DFP secara signifikan ($p < 0.05$) meningkatkan kandungan lembapan, abu dan serat kasar, dan signifikan ($p < 0.05$) mengurangkan kandungan lemak, protein, karbohidrat serta nilai tenaga. Terdapat perbezaan signifikan ($p < 0.05$) dalam jumlah kandungan fenolik dan jumlah kandungan flavonoid bar snek antara bar kawalan dan snek yang ditambah DFP. Tiada perbezaan signifikan ($p < 0.05$) dalam aktiviti pemuliaan radikal bebas dan potensi antioksidan pengurangan ferik antara bar kawalan dan bar snek yang ditambah DFP. Penambahan DFP telah meningkatkan kemerahan (a^*) secara signifikan tetapi tidak menunjukkan perbezaan signifikan ($p < 0.05$) dalam keterangan (L^*) dan kekuningan (b^*) antara bar kawalan dan bar snek yang ditambah DFP. Analisis profil tekstur menunjukkan perbezaan signifikan ($p < 0.05$) dari segi kekerasan, kekenyalan, kesepaduan dan ketahanan antara bar kawalan dan snek yang ditambah DFP. Jumlah bakteria yang didapati dalam bar snek adalah kurang daripada 25 cfu/ml yang mematuhi had keselamatan untuk makanan sedia makan. Dalam kajian jangka hayat, jumlah bakteria penambahan 0g, 5g dan 10g DFP dalam bar snek adalah selamat selama empat minggu manakala penambahan 15g DFP menunjukkan pertumbuhan kulat pada permukaan pada minggu ke-2 penyimpanan dalam suhu bilik. Hasil kajian ini menunjukkan bahawa DFP berpotensi ditambahkan ke dalam bar snek dalam meningkatkan komposisi nutrisi, sebatian bioaktif dan sifat teksturnya.

DEVELOPMENT OF DRAGON FRUIT PEEL-BASED SNACKS BAR

ABSTRACT

This study was aimed to analyse the nutritional composition and physicochemical properties of snack bar formulated with different levels of dragon fruit peel (DFP) powder. Snack bars were prepared with the addition of increasing amount of DFP in 0g, 5g, 10g and 15g respectively. Proximate composition, antioxidant, physical and microbiological properties along with shelf-life study were assessed. The increase in the addition of DFP significantly increase the moisture, ash and crude fibre content ($p < 0.05$), while significantly decrease the fat, protein, carbohydrate content and energy value ($p < 0.05$). There is significant difference in total phenolic content and total flavonoid content ($p < 0.05$) of snack bar between the control and snack bar incorporated with DFP. There is no significant difference ($p < 0.05$) in free radical scavenging activity and ferric reducing antioxidant potential between the control and snack bar incorporated with DFP. The addition of DFP significantly ($p < 0.05$) increase the redness (a^*) but shows no significant difference ($p < 0.05$) in lightness (L^*) and yellowness (b^*) between the control and snack bar incorporated with DFP. Texture profile analysis shows significant difference ($p < 0.05$) in terms of hardness, springiness, cohesiveness and resilience between the control and snack bar incorporated with DFP. The total plate count and yeast and mold count of snack bar is less than 25 cfu/ml which complies to the safety limit for ready-to-eat foods. In shelf-life study, the addition of 0g, 5g and 10g of DFP into snack bar were microbiological shelf stable during the four weeks while the addition of 15g of DFP shows growth of mold on the surface on Week 2 of storage at ambient temperature. The findings from this study showed that DFP has the potential to be incorporated into snack bar to improve its nutritional composition, bioactive compounds and texture properties.

CHAPTER 1 INTRODUCTION

1.1 Research Background

Dragon fruit (*Hylocereus polyrhizus*) also known as ‘buah naga’ is a tropical fruit belongs to Cactaceae family. In Malaysia, the production of dragon fruit reaches 10,961 tons per year (Then, 2017). The demand for dragon fruit had been increasing due to its outstanding appearance, mouth-watering light sweet and sour taste, unique colour, and economical fruit crop (Ramli and Asmah, 2014).

Dragon fruit is made up of peel, flesh and numerous edible black tiny seeds incorporated in the flesh. The peel accounts for 22% of the whole dragon fruit weight (Jamilah et al., 2013). However, the peel is underutilized and discarded as agricultural food waste as it is not edible in raw form after consuming the flesh or used in dragon fruit juice processing industry. Dragon fruit peel is a potential by-product which is rich in bioactive compounds that possess antioxidant and antimicrobial properties, thickening properties, high fibre content, vitamin, and as natural colouring dye (Bakar et al., 2013).

Dragon fruit peels are rich is betacyanin which gives natural red-purple pigment to the fruit thus it has the potential to replace synthetic dyes used in commercial food and beverages. Betacyanin is also suitable to be used as a stabilizing agent in food processing (Liu et al., 2019). Besides, it is also found to be rich in pectin which could be used as gelling agent, thickening agent, stabilizer in the production of jams, jellies and other confectionery (Vanitha & Khan, 2019). It was found that the peels contain relatively high total phenolic content which displays antioxidant properties to protect the cells against oxidative damage. Moreover, it was found that the peels have high radical scavenging activity due to its high polyphenol content

(Nurliyana et al., 2010). The antioxidants are a strong inhibitor of growth of melanoma cells which helps to lower the risk of cancer. The peel extracts possess good cytotoxic activities against human prostate, breast, and gastric carcinoma cell lines (Cheok et al., 2016). Dragon fruit peels is a potential source of natural antimicrobial agent especially it has high inhibition activity towards Gram-positive bacteria (Hendra et al., 2019). High content of dietary fibre in dragon fruit peels provides health benefits such as improve intestinal regulation, increase stool volume and lower cholesterol. Due to the growing demand for natural health promoting bioactive compound, dragon fruit peel has the potential to be incorporated in snacks industry.

Snacking is a behaviour that any food intake occasion other than main meals, light meals, or drink. Snack bars are convenient and ready-to-eat snacks containing balanced nutrients that provide satiety and provide health benefits when consume by people due to hunger, boredom, convenience, food cravings and energy boost. It is usually consumed by athletes or working adults because of its convenience, provide sufficient energy and satiety. Snack bar can be an instant food where it provides bioactive compound and balanced nutrients that can fulfil daily requirements of human body. Snack bar can be a wholesome nutritious food suitable for all age groups, including elder adults and children. Hence, the dragon fruit peel can be optimized to develop snacks bar as a new food product.

1.2 Rationale of the study

According to United Nations Food and Agriculture Organization (FAO), the food waste produced by increasing demand of dragon fruit is approximately 30-45% from its peel and seeds (Sagar et al., 2018). Food waste causes huge economical losses, climate change and environmental problem resulted from the increasing demand for

dragon fruit. The disposal of waste products which contains biodegradable organic substances contribute harmful greenhouse gases emission during decomposition (Vilarino et al., 2017). The reutilization of dragon fruit peels can increase the yield of raw materials and minimize the environmental issue and also could expand alternative food production (Lee and Latif, 2016).

According to World Health Organization (WHO), Malaysia has the highest rate of obesity or overweight among Asian countries (“Obesity rate”, 2020). The nations worldwide were found that they practice poor dietary habit such as high calorie and fat intake, frequent snacking, reduced consumption of fruits and vegetable, irregular meals, and less physical activities. According to Statista (2020) the sales of manufactured snacks in Malaysia had been increasing from RM 830.86 million in year 2015 to approximately RM 1.68 billion in year 2019. Most snack foods sold in the market contain high calorie, fat, sodium and sugar content, preservatives and artificial colouring which is the root cause cardiovascular disease, obesity, diabetes and hypertension when consume in large amounts.

The nations are looking forward to eating a balanced diet to prevent health problems. The consumers usually opt for ready to eat food which provide convenience to them due to their packed schedule and irregular meals. However, most snack bars available in the market consists high sugar and glycemic index that will increase the risk of diabetes. Dragon fruit peel has the potential to be recovered into alternative sources in producing snacks bar. Meanwhile, processed by-products of dragon fruit are rarely found in the market. Due to the increasing demand for safe and nutritious snacks, the study aims to develop a natural, convenient, nutritive snacks made by dragon fruit peel to promote healthy snacking and to reduce fruit waste products.

1.3 Objectives

This research aims to investigate the potential of dragon fruit peel to be utilized as an ingredient in snack bar formulation. The main objective of this research is:

1. To formulate a snack bar made from dragon fruit peel.
2. To analyse the proximate composition, antioxidant, physical and microbiological properties and study the shelf-life of the dragon fruit peel-based snack bar.