THE NUTRITIONAL, TEXTURE PROFILE AND SENSORY EVALUATION OF CUPCAKE USING PUMPKIN PUREE AS A FAT REPLACER

By

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Dissertation submitted in partial fulfilment of the requirements for the degree of Bachelor in Nutrition with Honours

CERTIFICATE

This is to certify the dissertation entitled 'THE NUTRITIONAL, TEXTURE PROFILE AND SENSORY EVALUATION OF CUPCAKE USING PUMPKIN PUREE AS A FAT REPLACER' is the record of research work done by SITI ASMA' BINTI KHALIB, MATRIC NUMBER 156819 during period of October 2024 until January 2025 under my supervision. I have read this dissertation and that in my opinion, it conforms to acceptable standards of scholarly presentation and is fully adequate in scope and quality as a dissertation to be submitted in partial fulfilment for the degree of Bachelor in Nutrition with Honours.

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DECLARATION

I hereby declare that this dissertation is the result of my own investigation, except where otherwise stated and duly acknowledged. I also declare that it has not been previously or concurrently submitted as whole for any other degrees at Universiti Sains Malaysia or other institutions. I grant Universiti Sains Malaysia the right to use the dissertation for teaching, research and promotional purposes.

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SITI ASMA' BINTI KHALIB

Date: 22/2/2025

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF ABREVIATIONS

TPA	Texture Profile Analysis
ANOVA	One-Way Analysis of Variance
AOAC	Association of Official Analytical Chemist
TFAs	Trans Fatty Acids
SFAs	Saturated Fatty Acids
LDL	Low Density Lipoprotein
MWP	Micronized Whey Proteins
WPI	Whey Protein Isolate
FDA	Food and Drug Administration
GRAS	Generally Recognized as Safe

LIST OF SYMBOLS

mg	Milligram
g	Gram
°C	Degree Celsius
<	Lower than
>	Greater than
%	Percentage
kcal	Kilocalorie
H_0	Null hypothesis
H_a	Alternative hypothesis
cm	Centimeter
α	Alpha
β	Beta
mm	Millimeter

PEMAKANAN, PROFIL TEKSTUR DAN PENILAIAN DERIA KEK CAWAN MENGGUNAKAN PURI LABU SEBAGAI PENGGANTI LEMAK

ABSTRAK

Kek cawan terkenal dengan rasa yang lazat dan hiasan yang menarik secara visual, menjadikannya salah satu hidangan yang paling popular di dunia. Namun begitu, kek cawan ini selalunya mengandungi banyak kalori. Bagi menangani isu ini, kajian mencadangkan penggunaan puri labu sebagai pengganti lemak bagi mengurangkan kandungan lemak kek cawan. Labu dipuji kerana berkhasiat tinggi dan kelebihan kesihatan. Oleh kerana ia mengandungi banyak air, ia rendah kalori dan sumber serat makanan yang hebat. Banyak terdapat dalam labu terutamanya ialah beta-karotena, pendahulu kepada vitamin A yang menggalakkan imuniti, kesihatan kulit dan penglihatan. Oleh itu, kajian ini bertujuan untuk membandingkan analisis pemakanan, profil tekstur dan penerimaan deria kek cawan yang disediakan menggunakan puri labu sebagai pengganti lemak. Dalam kajian ini, empat jenis sampel telah disediakan iaitu kek awan kawalan dan kek cawan dengan 20%, 30% dan 40% puri labu. Analisis merangkumi penilaian kelembapan, abu, protein, lemak, karbohidrat, nilai kalori, analisis profil warna dan tekstur (TPA). Selain itu, penilaian deria oleh ahli panel dijalankan untuk menentukan rupa, warna, aroma, tekstur, rasa dan penerimaan keseluruhan. Hasil daripada sampel yang disediakan dengan menggunakan40% puri labu sebagai pengganti lemak mendapat keputusan tertinggi untuk kelembapan, abu dan protein dan paling rendah lemak, manakala sampel kawalan mendapat keputusan tertinggi lemak dan paling rendah

kelembapan, abu dan protein. Keputusan daripada TPA menunjukkan bahawa sampel yang disediakan menggunakan 40% puri labu sebagai pengganti lemak mendapat skor terendah untuk ketegasan tetapi paling tinggi dalam keanjalan. Keputusan sampel yang disediakan dengan 30% puri labu mendapat skor tertinggi untuk ketegasan. Kek cawan kawalan mendapat nilai tertinggi untuk L* (warna) manakala kek cawan dengan 40% puri labu mendapat nilai tertinggi untuk a* dan b*. Hasil daripada penilaian deria menunjukkan bahawa sampel yang disediakan dengan 40% puri labu mendapat skor tertinggi untuk rupa, aroma dan tekstur, manakala sampel kawalan mendapat nilai tertinggi untuk rasa dan penerimaan keseluruhan. Keputusan sampel yang disediakan dengan 30% puri labu mendapat skor tertinggi untuk warna oleh ahli panel. Akhirnya, daripada pelbagai sampel, 40% puri labu mengurangkan kandungan kalori produk bakeri dengan ketara.

THE NUTRITIONAL, TEXTURE PROFILE AND SENSORY EVALUATION OF CUPCAKE USING PUMPKIN PUREE AS A FAT REPLACER

ABSTRACT

Cupcakes are renowned for their delicious flavours and visually appealing embellishments, making them one of the most popular treats in the world. Nevertheless, these little cakes frequently contain a lot of calories. To address this issue, the study proposes the use of pumpkin puree as a fat replacer in order to reduce the fat content of the cupcake. Pumpkins are praised for their high nutritious content and health advantages. Since they contain a lot of water, they are low in calories and a great source of dietary fiber. Particularly abundant in pumpkins is beta-carotene, a precursor to vitamin A that promotes immunity, skin health and vision. Therefore, this study aims to compare the proximate analysis, texture profile and sensory acceptability of cupcake prepared using pumpkin puree as a fat replacer. In this study, four types of samples were prepared which are control cupcake and cupcake with 20%, 30% and 40% of pumpkin puree. The analysis encompasses evaluations of moisture, ash, protein, fat, carbohydrate, calorific value, colour and texture profile analysis (TPA). Additionally, sensory evaluation by panelists is conducted to determine appearance, colour, aroma, texture, taste and overall acceptability. The result from the sample prepared by using 40% pumpkin puree as a fat replacer had the highest result for moisture, ash and protein, while the control sample had the lowest in moisture, ash and protein. The fat content of sample with 40% of pumpkin puree has been reduced with a mean of 10.99 as compared to control sample with a mean of 18.25.

The results from TPA show that samples prepared using 40% pumpkin puree as a fat replacer had the lowest score for firmness but highest in springiness. The results of samples prepared with 30% of pumpkin puree had the highest score for firmness. Control cupcake had the highest value for L* (colour) while cupcake with 40% of pumpkin puree had the highest value for a* and b*. The result from sensory evaluation shows that samples prepared with 40% of pumpkin puree had the highest score for appearance, aroma and texture, while the control samples had the highest value for taste and overall acceptability. The result of samples prepared with 30% of pumpkin puree had the highest score for colour by panelists. Eventually, out of various samples, 40% of pumpkin puree substantially lower the calorie content of bakery products.

CHAPTER 1
INTRODUCTION

1.1 Study Background

Pumpkin is a nutrient-dense, orange vegetable that is plump and full of nutrients. Its seeds, leaves and liquid are also full of vitamins and minerals, making it low in calories yet high in nutrients. Pumpkin is a type of squash that is commonly associated with Thanksgiving pie filling or traditional Halloween decorations. Beyond the well-known holidays, the flesh of the pumpkin plant offers several health advantages. Pumpkin can be used in a variety of recipes, including salads, soups, desserts, preserves and even as a butter alternative. One of the most well-known sources of beta carotene is pumpkin, which offers many other wonderful health advantages. Fruits and vegetables that are orange in colour are coloured by the potent antioxidant beta carotene. Everything that is consumed turns into vitamin A by the body. Due to its many benefits, pumpkin is a promising ingredient for making cupcakes. Pumpkins are easily transportable, have a long shelf-life and are highly productive and nutritious. Depending on the species, pumpkins can be green, white, blue-gray, yellow, orange or red in colour. As a vegetable, pumpkin is used in both its full and technical maturity. The flesh tastes good baked, boiled, stewed or fried (Megan et al., 2023). Pumpkin contains water: 75.8-91.3%, carbohydrates: 3.1-13.0, protein: 0.2-2.7, fiber: 1.0-1.8, fat: 1.0-1.4, ash: 0.5-2.1%, carotene: 2.45.2mg/100g. Moreover, adding pumpkin to the cupcake will lower its sugar content (Liubych et al., 2022). Additionally, pumpkin offers a variety of vital vitamins and minerals, such as vitamin A, vitamin C, vitamin E and many more. One of the best sources of fiber is pumpkins. The recommended intake of fiber is between 25 g and 38 g per day for adults (Megan et al., 2023).

Fat is the main ingredient used in modern food preparation and is essential to the quality of the food. For instance, fat can help give food its smooth texture, glossy look and distinctive forms in addition to dissolving flavors to improve taste and aroma. This is demonstrated by the fact that fat gives ice cream a delightfully velvety mouthfeel, which makes people prefer foods high in fat. Reducing fat content during food processing will alter the physicochemical, physiological and sensory qualities of the food, which will greatly reduce consumer acceptance of fat-containing foods (Gao et al., 2024). Fat traps air during mixing to introduce air bubbles into the batter or dough, producing a porous crumb texture and leavening the finished goods in bakery goods like muffins, cakes and breads. Aside from fat's significance in the bakery sector, different dietary fats have varying health effects. Trans fatty acids (TFAs) and saturated fatty acids (SFAs) should be avoided for a healthier lifestyle. Consuming large amounts of SFAs and TFAs raises the risk of coronary heart disease by raising low-density lipoprotein (LDL). High intake of SFAs and TFAs causes hypercholesterolemia and coronary heart disease. Common ingredients in baked goods like butter and margarine are high in these kinds of fats.
Finding fat substitutes is therefore necessary to replace the use of these fats in baking. However, replacing fat in food presents a challenging issue because fat influences physiological and sensory qualities like flavour, mouthfeel, taste and texture. Many studies have been done to create acceptable low-fat food products with the use of natural ingredients as fat replacers because the public's demand for reduced-fat food products without sacrificing good taste is still high (Nurul et al., 2016).

Generally speaking, there are two types of fat replacers which are fat mimetics and fat substitutes. Ingredients that resemble lipids in physicochemical characteristics and chemical structure are known as fat replacements. In general, they are either indigestible or provide fewer calories per gram. Ingredients that differ significantly from fat in terms

of their chemical makeup are known as fat mimetics (Ognean et al., 2006). They are typically contained either protein or carbohydrates. Their varied functional properties, such as viscosity, mouthfeel and appearance, resemble some of the physicochemical characteristics of fat and make it an appealing food item. Fat substitutes are macromolecules that, in theory, can replace fat in meals on a gram-for-gram basis. They are similar to triglycerides, or typical fats and oils, both physically and chemically. Fat substitutes, also known as lipid- or fat-based fat replacers, are produced chemically or through enzymatic alteration of traditional fats and oils. At the temperatures used for cooking and frying, many fat alternatives remain stable (Ognean et al., 2006).

A cupcake is a type of cake that can be eaten as an appetizer or dessert. The three main elements used to make any kind of cake are flour, sugar and fat. Each of these components influences the finished product's overall look and organoleptic characteristics (Lydia et al., 2022). The batter is then topped with several types of toppings, such as frosting, whip cream, butter cream, cooking chocolate and edible images. This is what makes cupcakes products have their unique personality and draws customers in with mouthwatering flavors and product variations, which is why it's crucial to their growth (Oktriandi et al., 2021). Thus, this study aims to evaluate the proximate analysis, textural and sensorial analysis of the development of cupcake using pumpkin puree as fat replacer.

1.2 Problem Statement

Based on MDG 2020, regarding key message 9, it is stated thats reduce intake of foods high in fat and limit saturated fat intake. Cupcakes are food that should only be eaten in moderation, due to their high sugar and saturated fat content that is contained in the butter (Lainey Younkin, 2021). However, fats play a crucial role in determining the texture,

flavour and overall quality of the final bakery product. In order to produce low calories cupcakes, pumpkin is one of the natural sources that is suitable to replace butter in the ingredients. Pumpkin is, in fact, low in calories and incredibly healthy (Jennings, 2023). This study will compare the proximate analysis of nutritional composition, texture profile analysis and sensory acceptability of cupcake using pumpkin puree as fat replacer.

To achieve this, pumpkin puree will be used to make low calorie cupcakes.

1.3 Study Significance

This study will compare the result of proximate analysis of nutritional composition, texture and sensory evaluation of development of cupcake using pumpkin puree as fat replacer. Pumpkin is a staple item that has many uses in both medicine and diet. Because of its abundance in phenolics, flavonoids, vitamins, amino acids, carbohydrates and minerals, as well as its low energy content about 17 kcal/100g of pumpkin flesh and high fiber content, it is thought to be a healthful and useful vegetable (Tamer et al., 2010). The study will use pumpkin puree to produce low-calorie cupcake.

The research examines the physicochemical properties of cupcake, including ash, protein, fat and calorie content. These analyses shed light on the effect of the development of cupcake using pumpkin puree as fat replacer. Lastly, in this study, it will include sensorial evaluation, which incorporates sensory analysis by panelists. The purpose of this evaluation is to determine the appearance, colour, aroma, texture, taste and general acceptability of cupcake using pumpkin puree as fat replacer. The findings may reveal sensory preferences and consumer acceptability of the product.

1.4 Research Questions

1. Is there any significance difference in the proximate analysis between control cupcake and cupcake using pumpkin puree as a fat replacer?
2. Is there any significance difference in the texture profile analysis between control cupcake and cupcake using pumpkin puree as a fat replacer?
3. Is there any significance difference in the sensory acceptability between control cupcake and cupcake using pumpkin puree as a fat replacer?

1.5 Research Objective

1.5.1 General Objective

The objective of this study is to analyze cupcake developed by using pumpkin puree as a fat replacer.

1.5.2 Specific Objective

1. To determine the nutritional composition of cupcake using pumpkin puree as a fat replacer.
2. To identify the texture profile analysis of cupcake using pumpkin puree as a fat replacer.
3. To evaluate the sensory acceptability of cupcake using pumpkin puree as a fat replacer.

1.6 Research Hypothesis

1.6.1 Null Hypothesis

H_o = There is no significant mean difference in the nutritional, texture profile and sensory evaluation between control cupcake and cupcake using pumpkin puree as a fat replacer.

H_a = There is a significant mean difference in the nutritional, texture profile and sensory evaluation between control cupcake and cupcake using pumpkin puree as a fat replacer.

CHAPTER 2
LITERATURE REVIEW

2.1 Pumpkin

The pumpkin, or Cucurbita moschata, is a well-known plant that belongs to the Cucurbitaceae family and the other Violales. Pumpkins are grown from northern Mexico to Argentina and Chile, and they have also made their way to Western, Asia (Chine and India), and Europe (France and Portugal, for instance). Pumpkins may be grown from sea level to high elevations and are an annual vine or trailing plant. They are well-known for their culinary leaves, fruit and seeds (Yadav et al., 2010). It is distinguished by its unique climbing and creeping growth habits. It has a hardy, wedge-shaped root that can withstand cold conditions. The plant bears unisex flowers in bright yellow to orange hues, and its huge, heart-shaped leaves can grow up to 25 cm in length (Aldakhoul et al., 2024).

Although they are sometimes called vegetables, pumpkins are actually fruit according to science and have a lot of nutritious value. Essential elements including water, protein, carbohydrates, fiber, vitamins, potassium, copper, calcium and saturated fatty acids are all abundant in them. The pumpkin plant's seeds have garnered a lot of interest since they contain a wide variety of bioactive chemicals and ingredients that can be used to create functional and therapeutic foods. Because of their many health advantages, a great deal of study has been done to extract and isolate these bioactive chemicals. Food, cosmetics and pharmaceuticals are just a few of the businesses that have acknowledged the potential uses of these substances (Aldakhoul et al., 2024).

The pumpkin's low fat, high-protein seeds are its most valuable component. Its fruit is the second most crucial component. While the mature fruit is sweet and used to make confections and occasionally alcoholic beverages, the immature fruit is cooked as a

vegetable. The fruit contains a reasonable amount of carbohydrates, vitamins and minerals, along with a good amount of β-carotene. Throughout the American distribution area, different portions of the pumpkin plant have been used in different feeding regimens. Ripe fruit flesh is utilized to make soft, slightly alcoholic drinks and desserts, whereas unripe fruit is consumed as a boiled vegetable. Seeds are also highly prized, and in Chiapas, Mexico, they are combined with honey to make palanquetas, which are sweets. Additionally, the pumpkin seed, which is high in oleic acid, can be used to make edible oil (Yadav et al., 2010).

2.2 Health Benefits of Pumpkin

The need for novel, sustainably produced, and nutritionally sound foods has grown significantly in recent decades. Consequently, the use of by-products has received particular attention. Every aspect of the pumpkin's anatomy is utilized in human nutrition. Given the current state of waste reduction and sustainable development, this is crucial. Although people are well aware of the many health benefits of pumpkin, this fruit is still underappreciated. The pumpkin's flesh, seeds and husk are among the increasingly used botanical parts. The primary bioactive substances, including vitamins, carotenes and fibers are linked to health advantages. Due to their anti-inflammatory, antifungal, antibacterial and antioxidant properties, all of these substances offer some significant advantages.

The nutritional quality traits of pumpkin fruit at each stage of maturation — young, pre-mature, mature, pre-ripened, and ripened — are presented in the study by Sharma and Rao (2013). According to the findings, pumpkin fruit has higher levels of sugars, starches and total proteins in addition to being a rich source of carotenoids and

vitamin C. The study emphasises that when the fruit reaches the commercial maturation stage, it should be harvested. Consuming cucurbita aids in recuperation during or following colon and rectal cancer.

Pumpkin is a great food if you want to lose weight or protect your skin from the sun because its natural β-carotene and vitamin E (tocopherols) slow down ageing, limit tumour growth, lower the risk of cataracts and lessen skin damage. β-carotene, vitamin C and vitamin E have been demonstrated to promote eye health and stop degenerative damage. Pumpkin pulp powder demonstrated anti-diabetic effects in rats with alloxaninduced diabetes by lowering blood glucose levels while raising plasma insulin levels (Liliana Ceclu et. al., 2020).

Pumpkin seeds, which are typically thrown away during processing, are regarded as a by-product despite being a highly nutritious and exceptional source of oil and proteins. Additionally, the seeds are regarded as a significant source of monounsaturated fatty acids, dietary fibre, vital vitamin and minerals. Pumpkin seeds are eaten for their anti-diabetic, antifungal, antibacterial, anti-inflammatory and antioxidant properties in addition to their sensory appeal. Fresh or roasted pumpkin seeds have anthelmintic properties and lower the risk of bladder stones. Zinc, phosphorus, magnesium, potassium and selenium are among the elements found in pumpkin seeds that are known to help prevent conditions including arthritis, inflammation and prostate cancer (Liliana Ceclu et. al., 2020).

According to Akintade et al. ‘s 2019 study, seeds are a significant source of flour, which can be made from a variety of processed seeds (fermented, germinated or roasted). The processed pumpkin seeds flour’s essential amino acid concentration was excellent for every procedure. Increasing the bioavailability of the bioactive chemicals, which have

anti-inflammatory, antifungal, anti-diabetic and antioxidant properties and extending the shelf life of the pumpkin seeds were the goals of all the procedures.

Several amino acids, such as alanine, arginine, aspartic acid, glutamic acid, histidine, leucine, isoleucine, glycine, lysine, methionine, phenylalanine, serine, threonine, valine and tyrosine, are found in pumpkin peel. Consuming pumpkin peels can help with hepatic diseases, peptic ulcers, gastrointestinal bleeding, and various wounds, including burn wounds, because they are cool and moist (Liliana Ceclu et. al., 2020).

Pumpkin oil is used to cure diarrhoea in children. In Korea, there have been reports of further advantages of using pumpkin oil to treat depression. Pumpkin seed oil, which contains vitamin E (tocopherols), is widely consumed by Japanese people.

2.3 Food Application of Pumpkin

2.3.1 Application in The Meat Industry

Meat is the flesh of an animal that is consumed as sustenance. The Old English word “mete”, which refers to a common meal, is where the word “meat” comes from. The Danish, Swedish and Norwegian terms mat and mad, which both mean “to eat”, are the etymological roots of the phrase. Meatballs, burgers and other ground beef dishes are popular among people of all ages and cultural backgrounds. These meat products do, however also have some unfavourable traits. Reduced yields, increased cooking losses and unstable emulsions are just a few of the negative sensory and technical effects of removing fat from meat products. Changes in texture also result in the loss of juiciness and taste. According to a study that looked at the benefits of adding pumpkin seeds to chicken patties, these components may enhance the final product’s lipid oxidation and