Physicochemical and Sensory Properties of Cracker Made from Lemongrass *(Cymbopogon citratus)*

Izzati Syafiqa Binti Azizan

F18A0044

A thesis report submitted in fulfilment of the requirements for the degree of Bachelor of Applied Science (Food Security) with Honours

Faculty of Agro-Based Industry

Universiti Malaysia Kelantan

2022

DECLARATION

I Hereby declare that the work embodied in here is the outcomes of my own research except the references for my further information.

_____

Signature

Students Name : Izzati Syafiqa Binti Azizan

Matric No : F18A0044

Date: :

Verified by:

_____

Supervisor Signature

Supervisor's Name : Dr. Leony Tham Yew Seng

Stamp :

Date :

ACKNOWLEDGEMENT

I would like to express my thankful and grateful to some individuals and organizations in supporting me from nothing to something. Firstly, I would like to thank to Dr.Zuharlida Binti Tuan Harith, my coordinator for this Final Year Project for all the support and big common sense she had gave to all students. Next, a big thank you to my supervisor for this Final Year Project 2021-2022, Dr. Leony Tham Yew Seng for his endless support, endless understanding, guidelines, ideas, suggestions and his kindness in helping me to get through ups and downs in my final year project journey. Besides that, a humble thank you to Dr. Nurhanan Abdul Rahman as my evaluator for final year project for giving useful feedback for my proposal in the past before proceeding with the thesis writing.

I would also thank to my close friends that always give a hand and assist me during doing the experiments as well as keep giving motivational words to each other until the finishing of the deadline for this final year project. Furthermore, a thousand thank you to all of the laboratory assistants for the knowledges, lectures and useful tips in doing the experiments. I would also thank to myself that do not giving up to learn something new and the mental and physical strength in doing this project even though there are a lot of insecurities that I need to polish during finishing it. Lastly, a big appreciation to my mother for always pray for my successful journey in this world.

ABSTRACT

Lemongrass is one of the herbs that is important to human especially in cooking. The flavour and aroma give the food a good taste and scent to whose eating it. It is even widely used for cooking, oil diffusion and many more. However, people rarely use lemongrass as ingredient in baked product such as cracker. In rare cases, lemongrass can also lead to an allergic reaction. Thus, this study is aiming on conducting a food product which is incorporate lemongrass cracker by using the concentration of lemongrass powder of 0%,1%,2%,3% and 4%. The study had been observed on the determination of physical attributes, proximate analysis and analysis of sensory evaluation of the lemongrass cracker. Physical attributes like colour and texture were determined by using the equipment like colourimeter based on the CIELAB colour space and texture analyser that focused on the hardness and fracturability. Analysis of proximate that estimate the nutritional composition like protein, moisture, ash and fat had been done were determine by many machines like protein Kjedahl machine, conventional oven, muffle furnace, and fat Soxtec machine. 30 panelists were collected for sensory evaluation for testing the lemongrass cracker by online survey. ANOVA and SPSS were the software that had been used to analysed the answers from the panelist. For the result obtained, percentage of fat and ash of the lemongrass cracker were increased along with the increased amount of lemongrass powder in cracker followed by lightness value and texture attributes while value of yellowness, redness and percentage of protein and moisture were decreased. At the end of the study, 3% concentration of the lemongrass cracker was the favourable one by the panelist in the terms of its overall acceptance.

Keywords: Cracker, Lemongrass, Lemongrass Cracker, Proximate Analysis, Sensory Evaluation.

ABSTRAK

Serai adalah salah satu herba yang sangat penting lebih-lebih lagi dalam masakan. Rasa dan aroma daripada serai memjadikan makanan yang dimasak mempunyai rasa yang lazat dan berbau harum. Penggunaan serai telah digunakan secara meluas iaitu untuk kegunaan masakan, minyak terapi dan banyak lagi. Walau bagaimanapun, pengunaan serai sebagai bahan dalam produk makanan kering seperti kraker jarang ditemui dan dalam masa yang sama serai boleh memberi impak buruk seperti penyakit alergik. Oleh itu, kajian ini dilakukan untuk mencapai matlamat dalam pembuatan produk makanan daripada serai iaitu kraker dengan peratusan penggunaan serbuk serai iaitu 0% hingga 4%. Kajian ini untuk mengenal pasti ciri-ciri fizikal, analisis proksimat dan penilaian sensori kraker serai. Ciri-ciri fizikal seperti warna dan tekstur telah ditentukan menggunakan peralatan seperti kolorimeter bedasarkan ruangan warna CIELAB dan alat pengukur tekstur. Analisis proksimat seperti analisis protein, analisis kelembapan, analisis abu dan analisis lemak terhadap kraker telah dibuat menggunakan peralatan dan mesin seperti mesin Kjedahl analisis protein, ketuhar yang bersuhu tinggi, dan mesin Soxtec analisis lemak. Sebanyak 30 penilai telah dikumpulkan bagi menjayakan penilaian sensori melalui soal selidik dalam talian. Applikasi peirisian seperti ANOVA dan SPSS digunakan untuk menganalisis jawapan daripada penilai dalam penilaian sensori. Untuk hasil dapatan kajian, peritus lemak dan abu daripada kraker serai adalah meningkat seiring dengan bertambahnya peratus serbuk serai di dalam kraker dan diikuti dengan peningkatan di dalam nilai warna kecerahan dan ciri tekstur kraker. Walau bagaimanapun, peratus nilai warna kekuningan dan kemerahan diikuti dengan nilai protein dan kelembapan adalah berkurangan. Pada akhirnya, dari segi penerimaan kesuluruhan daripada penilai, kraker serai yang mempunyai 3% kandungan serai di dalam kraker telah dipilih menjadi kraker yang digemari ramai.

Kata kunci: Analisis Proksimat, Kraker, Kraker Serai, Serai, Penilaian Sensori.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

LIST OF SYMBOLS

		Page
H_2O	Water	23
CO_2	Carbon Dioxide	23
HCL	Hydrogen Chloride	22
NaOH	Natrium Hydroxide	23

LIST OF ABREVIATIONS

		Page
TPA	Texture Profile Analysis	12
AOAC	Association of Official Analytical Chemist	38
ANOVA	One-Way-Analysis of Variance	28
SPSS	Statistical Package of Social Sciences	28
SD	Standard Deviation	48
SE	Standard Error	30

CHAPTER 1

INTRODUCTION

1.1 Research Background

Eating is the most crucial and lovely human habit and even can be a hobby to many human beings. Nowadays, people do not stay with saying goes ‘’Eat for life’’ but more to ‘’Life for eat’’. This is because of the feeling to eat something into your mouth is really joyful and brings happiness to our tummy as well as give a good mood when we already full. The question is how far we are eating a healthy ingredient in our food consumption? Thus, good eating habit with the right ingredients need to be a practice to all people. Little did you know, herbs surrounding us are the plants that bring us the good scents and flavour that usually comes in many forms like leaves. Herbs give a lot of nutritional value for our consumption. One of the best examples is lemongrass which is one of the herbs that gives beautiful scent and flavour to us. This herb that known as Cymbopogon Citratus has a nutritional value. Moreover, cracker is the food that we always consume for the snack session. It is known as slim, crispy texture of wafers and biscuit (Gerlat, 2009).

1.2 Problems Statements

This project research is investigating new sensory evaluation of the lemongrass in cracker by the consumers as well as study the health benefits in the lemongrass composition. In this context, many of people do not know the health benefits of lemongrass as they just only know about the fragrance and flavour from it. Also, in a rare case, allergic reaction can occur in the terms of its oil that directly touched the skin. Therefore, references from the doctors need to be taken especially for pregnant women and women is breastfeeding their babies before using or consuming the lemongrass oil or lemongrass itself (Firdous & Marwah, 2020).

1.2 Objectives

1. To determine physical attributes of the cracker in the terms of its texture and colour with different concentration.
2. To determine the proximate analysis of the cracker to know the nutritional contents in the cracker.
3. To analyse the sensory evaluation of lemongrass cracker to improve the quality, taste and acceptance by consumer.

1.3 Hypothesis

Ho: Incorporation of sensory evaluation, the different concentration of lemongrass in cracker has no effect on the acceptance of consumers.

H1: Incorporation of sensory evaluation, different concentration of lemongrass in cracker has the effect on the acceptance of consumers.

1.4 Scope of Study

This research study is aiming on the physical properties and sensory acceptability of the lemongrass cracker. In this study, the source of lemongrass will be obtained at nearby supermarket Universiti Malaysia Kelantan, Jeli campus. The physical properties will be determined the colour and texture of the cracker will be done by adding different concentration of lemongrass powder into the cracker. Moreover, a sensory evaluation will be done by using five sample of lemongrass cracker with five different concentrations by 30 panelists from UMK Jeli campus. The 30 people that will test the sample will be commenting on the colour, texture and the overall acceptance of the lemongrass cracker.

1.5 Significant of study

From this research project, lemongrass is a type of herbs that can are so beneficial from the top of its top to its end. This blue-green like herbs usually can be found at the market or groceries and even always be planted in everyone's home so that it is easy to be gained and use. The existence of lemongrass as the ingredient in cracker will gives a good nutritional value such as being one the good prevention of cancer because of the content of antioxidant in the lemongrass (Wallace, 2019). Moreover, the herbs contain the food industry will bring up the name of herbs to the world food industry and its consumers.

1.6 Limitation of study

This research experiment did have its potential limitations. The limitation was based on the sensory evaluation. The panelists that have done the sensory evaluation were not from the large range of people. Those panelists were basically from the students in the Universiti Malaysia Kelantan (UMK) Jeli campus and may do not provide the perfect geographic scope of panelist as well as the panelist volunteered in this study was at the minimum range with 30 all of them. Next, due to covid-19 new era, sensory in the laboratory was not recommended at all to be proceed. Online sensory evaluation was made by spreading the crackers in the plastic bag with QR code provided on each plastic sample. All of the panellists have done the sensory evaluation at home while answering the survey in an online mode.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction to Lemongrass

Lemongrass or known as *Cymbopogon* which is a genus contain of more than fifty species. ''Kymbe'' defined as boat and ''pogon'' that defined as beard and these two separation names is pointing to the arrangement of flower spike. In the term of its taxonomical classification, lemongrass is from the kingdom of plantae, the division of Magnoliophyta, the class of Liliopsida, the order of Poales, the family of Poeceae, the genus of *Cymbopogon* and lastly the species of *citratus*. The common name in English is lemongrass, citronella and squinant while for other country like Egypt is lemon grass and the country of Brazil is calling by the name of *capim-cidrao*. On the other hand, for its leaves that based on the botanical description, it has (1.3-2.5 cm) wide, (0.9m) long and the tips of the leaves are falling-down. Besides, the colour of the leaves is a blue-green colour and it delivers a beautiful scent of citrus when we squeeze it. In the term of flowers, lemongrass is rarely producing flowers but they do have the (30-60cm) long and nodding inflorescence (Shah, 2011).

2.2 Nutritional Composition of Lemongrass

Lemongrass which is commonly found in Southeast Asia and now is growing quite well in the South and North of America, and the country of Africa and Australia. Lemongrass that acts as tropical plant is actually good in treating some disease and complications like digestive problems and neurons complication. Also, high blood pressure is having the good engagement with the use of lemongrass due to its effectiveness to help in the treatment. Next, lemongrass is having the health benefits due to the content of flavonoids and compound of phenolic. The two components will lead the anti-inflammatory properties. For example, the effect of anti-inflammatory in lemongrass can lead human to the prevention and slows down of the cell that growth in cancer as well as can help with the heart disease in human. Furthermore, lemongrass is one of the effective ways to help in cure the food poisoning. The study found that the extract of lemongrass can lower the toxicity content in E.coli or *Escherichia coli* bacteria in human digestive system. For its nutritional composition, lemongrass per ounce will be containing of 30g of calories, a gram of protein, 7g of carbohydrate, no content of fat, fibre and sugar (Dan Brennan, 2020).

According to Wocknick (2020) for the nutritional value, it contains a lot of nutrients such as Folate, Vitamin C, Vitamin A, Vitamins B, Magnesium, Selenium, Phosphorus, Iron, Zinc, and many more that each of them giving its own advantages to the consumer. For instance, based on the 100 grams of lemongrass, there is 101mg and 14% RDA contain of phosphorus which a very important mineral to build the bones, nucleic acid and cell membrane to human body. The high magnesium content which is 60mg can lead to the good structure of bones, synthesis of protein and energy production which is glycolysis.

Figure 2.1: Picture of lemongrass

Figure 2.2: Picture of lemongrass *(Cymbopogon citratus)*

Source: (Lemon Grass Pictures, Images and Stock Photos, n.d.)

Table 2.1: Nutrient analysis and value of fresh lemongrass per 100g

Principle	Nutrient Content	RDA %
Energy	99 Kcal	5%
Carbohydrate	25.31g	19%
Protein	1.82 g	3%
Total Fat	0.49 g	2%
Cholesterol	0 mg	0%
Vitamins		
Folates	75µ	19%
Niacin	1.101 mg	7%
Pyridoxine	0.080 mg	6%
Riboflavine	0.135 mg	5.5%
Thiamin	0.065 mg	5.5%
Vitamin A	6 mg	<1%
Vitamin C	2.6 mg	4%
Electrolytes		
Sodium	6 mg	<1%
Potassium	723 mg	15%
Minerals		
Calcium	65 mg	<1%
Copper	0.266 mg	29%
Iron	8.17 mg	102%
Magnesium	60 mg	15%
Manganese	5.244 mg	228%

Selenium	0.7 µ	1%
Zinc	2.23 mg	20%

(Source: USDA National Nutrient data base)

2.3 Biscuits and Cookies

Cookies or biscuit are known to the look of tiny, easy to eat product, flat surface and cereal based baking product. It consists of the ingredients like sugar, wheat, butter and so on. In term of its texture, some crackers are crispy, some are soft and some are chewy. Due to the excellent shortening, small quantity of water and a lot sugar content, it makes the cracker and biscuit to have only small risk of microbial spoilage. Also, it does not decay to be compared to bread or any baked product. Cracker and biscuit also can be categorized in the term of its dough properties such as hard dough and short dough.

Hard dough can be known as a dough that consist of big amount of moisture, little shortening, and small quantity of sugar to be compared to short dough. In the term of its way of mixing, it combines the full ingredients at once. One of the disadvantages of hard dough is the dough is quite easy to be teared while doing the sheeting only if the gluten content is too high. However, for short dough type, it is well known for the common dough of making the biscuit and cookies. This short dough is having the variety of ingredients with different in size, shaping and taste. The main ingredient is usually known as ‘’weak soft wheat flour.’’ Moreover, in the term of its mixture, it is not mixed at once like the hard dough did as short dough have a lot of stages that usually being initiated with the sugar creaming. One of the

disadvantages of short dough is short dough is highly depending on the cream used as it does affect the dough and final product (Miller, 2016).

2.4 Crackers and its Types

Crackers are known as crisp, salty and not sweet kind of biscuit. It is eaten by the consumer as snack. Wheat flour are the main ingredient of making the cracker that having the big amount of protein content as well as excellent flour to be compared with the flour used in biscuit and cookies. In this context, cracker can be differed in the type of making it which is by the use of yeast fermentation and chemical leavened. Crackers have three types of which are the saltine crackers, cream crackers and the snack one. Saltine cracker is a fermented process of crackers that usually being eaten by the people in United States. The purpose of the fermentation process in saltine cracker which by the using of yeast in the dough making is for aiming the actual flavour and texture to the crackers. Also, the protease enzyme that did appear and involved in the fermentation process has been the main factor to the saltine cracker to have the tendency of having the plain and bland flavour with the hard texture. This saltine cracker is having the high temperature if 250˚C-300˚C, time consuming of only two to three minutes and the moisture content is 2-2.5% (Miller, 2016).

Next, the cream crackers. It is also known as the fermented type of crackers. It is consumed well by the people in the United Kingdom usually. Cream crackers always having the characteristic of different varieties in shape, size, texture and flavour. Besides, this kind of cracker is using process of sponge and dough. It also used the low content of flour and half

yeast composition to be compared to saltine crackers. This cream cracker is single-mixing of dough, having the usual high temperature which is from 210˚C to 250˚C, time consuming of 4.5-5 minutes of baking and contain of really high moisture content.

Last but not least, the snack type of crackers. It has varieties of name which are savoury crackers, cocktail cracker and cheese crackers. It also varies in the term of its size, shape and flavours. On the other hand, it usually can be topped with any suitable and tasty topping like herbs, seeds, salts and many more. The snack cracker is also containing the percentage of sugar, shortening to be compared with the saltine and cream ones. This type of crackers combined of two type of process which are yeast fermentation and chemical leavened by most of the process is mostly chemical leavened. Next, this snack crackers are a single-mixing of dough and at the last step of before baking, oil is commonly used on snack cracker in order to have a good appearance, flavour and increase position of the topping to maintain on the surface (Miller, 2016).

2.5 Texture Analysis

Texture analysis is an analysis that known as a combination of variety of method that incorporate with uncomplicated principle of force measurement as a time function or distance that related to the probe. Probe movement is depending on the speed while resisting force is estimated in the analysis. There is a lot of connection and probe for the texture analyser such

as compressing, biting, bending, tensile testing and many more. A graph will turn out after the attachment to the food was done, revealing the force (N), time or distance of probe as the plot.

Texture Profile Analysis (TPA) is an analysis to appraise physical attributes like chewiness, gumminess, adhesiveness, cohesiveness, hardness, fracturabilty and resilience that done by the attachment of probe to the sample and repeating the second cycle if we wanted too (Centre of Industrial Rheology, nd). Texture Profile Analysis (TPA) largely applied to examine food of solid and semisolid. It is also known as the two bites test procedure. This TPA was being generated as a mimic test stimulating what enters one's person mouth. It was been recommended that the TPA test shall work by using the similar speed of the jaw of human. A study shows human's speed in the terms of biting is around 33-66mm.s^{-1} (Macdougall, 2010).

In the terms of texture, it is defined as the process of physical properties of food being operated by the brain during chewing it (Lambert, nd). According to British Standard Institution, definition of texture is known as a substance of characteristic that obtained from physical attributes combination as well as the perceived of sight, touch and hearing senses (Meullenet, 2004).

2.6 Colour Analysis

Colour is the crucial property in the appearance of food particularly if related to the point of quality in food particularly if related to the point if quality in food such as the colour of fruit ripening process. Food product mostly will be having colour range acceptability that

determined by factor like consumer variability, ages and ethnics as well as the judgement of nature by the surrounding in time (Meullenet, 2004).

The appearance of object has come in two stages of characterisation which are the physical and psychological. In this context, physical characteristics are like shape, size, and consistency of the food incorporate with the types and changeability of the pigmentation. The physical one will be generated by the conversion of physical transmittance and reflectance with a value (Macdougall, 2010).

CIELAB that having the coordinates of L*, a* and b* is defined as the colour location in the colour space uniformity. This CIELAB are based in the conception of notable of the differences in colour in the coordination of cylindrical system. Coordination of cylindrical system include of L, a, b as L being the vertical line as the lightness and a as the red and green and b as the yellow and blue as the horizontal line (Identifying Color Differences Using L*a*b* or L*C*H* Coordinates, n.d.).

Consumer has a strong relationship with the colour of the food. For example, colour of meat will be the important characteristic for a consumer to purchase as it can imagine the taste of the meat when preparing and eating it. Consumer assumes the product of beef to look like ‘’Cherry-red’’ on the colour surface as the colour bring meaning of freshness and high quality (Berry, 2017).

2.7 Proximate Analysis

Proximate analysis is the determination of the basic food component by using the method that involving the logical and rational calculation of fraction. The calculation and determination are for moisture, ash, fat, protein, and fibre (Sawyer, 2012).

2.8 Sensory testing

According to Sharif (2017), Institute of Food Technologies (IFT) reported that sensory evaluation is known as a scientific technique to evoke, estimate, examine and explaining the reactions to food product with use of human senses like touch, smell, taste and hearing. In sensory analysis, all attributes quality involved such as appearance, aroma, flavour, texture, and sound. Appearance is the initial property that human goes into and has a crucial role to the finishing selection of food product. Flavour is to indicate the odour and taste sensation. Odour will help on the eating delight such as the aroma from food that freshly cooked while taste enhances in the terms of food acceptance, recognition and appreciation. In the mouthfeel, there are nerves exist in the mouth which is supported by the thermal and chemical such as the ice-cream that bring coldness or brain-freeze. Aroma is known as the compound of volatile that is

perceived by the receptor of odour of the nasal cavity olfactory tissue. Also, aroma is important in identification of fresh, rancid or poison food. Texture is perceived by combining the sight, touch, taste and hearing senses.

CHAPTER 3

METHODOLOGY

3.1 Material

3.1.1 Raw Material and Chemicals

The study was conducted in Universiti Malaysia Kelantan (UMK) Jeli campus specifically located at our Food Laboratory of Agro Based Industry and Husbandry Laboratory at University Malaysia Kelantan, Malaysia. In order to make the lemongrass cracker, the raw material that have been used or needed were lemongrass as the raw material and the dough making like sugar, salt, wheat flour, and butter. These ingredients were bought freshly from the supermarket that nearby Universiti Malaysia Kelantan (UMK) Jeli campus. In this context, chemicals that have been used were 0.1 M hydrochloric acid, sulphuric acid, 4% boric acid, Kjedal tablets, Natrium hydroxide, bromocresol and methyl red.

3.1.2 Equipment

The equipment used in this study were Texture Analyzer TA XT2 (Brookfield CT3, USA), colourimeter (Konica Minolta CR-400, Minolta model 3500, Minolta Camera., Ltd., Osaka, Japan), oven, hand mixer, lab digital electronic balance, beaker of 25 mL, steal bowl, hand roller, ruler, spoon, fork, knife, chopping board, oven tray, baking paper, plastic glove, which can be found in the Food Laboratory of Faculty of Agro-Based Industry. On the other hand, equipment for experiment in Husbandry Laboratory were conical flask, measuring cylinder, beaker, magnetic stirrer, dropper, burette, retort stand, Kjedahl auto distillation analyzer (Gerhard) crucible, muffle furnace, bunch funnel, filter paper and plastic bag with variety sizes. Most of them, the apparatus and equipment can be borrowed at the UPKEM in Universiti Malaysia Kelantan (UMK) Jeli.

3.2 Methodology

3.2.1 Preparation of Lemongrass Powder

The lemongrass obtained was prepared in the Food Laboratory of Agro-Based Industry. Firstly, the lemongrass was washed using a tap water to eliminate any contaminants, dirt, or any pesticides residue on it. Next, the lemongrass was cut into small pieces to increase the surface area of it by using knife. Those pieces of lemongrass were dried in the dehydrator for 8 hours at 60˚C. The lemongrass was dry and weighed repeated times until got a stable weight

and suitable weight to be compared to the initial weight of the lemongrass. Relating to the moisture of the dried lemongrass, the moisture content obtained was less than 3%. The dried lemongrass obtained then was grinding to obtain the powder form. The powder of lemongrass then will be packed into a dry container or airtight packaging with a good hygiene. A formula was used to calculate the moisture content of the lemongrass, as shown below:

$$\text{Moisture (\%)} = \frac{\text{Initial weight (g)} - \text{final weight (g)}}{\text{Initial weight (g)}} \times 100\% \quad (3.1)$$

3.2.2 Preparation of Lemongrass Crackers

The preparation of this lemongrass cracker was started with the preparation of the cracker dough. The recipe required of sugar (10g), salt (2g), butter (6g), all-purpose wheat flour (100g), and 45 ml of water. The electrical hand mixture was used to mix all of the ingredients effectively. Then, the dough was rolled thin by using the hand roller. The desired thickness of the dough was 0.02 cm. The cracker itself then was shaped and measured with the measurement of 3 cm x 3 cm by using a ruler. The dough then cut using knife and cutter into those required size and put into the baking tray. The temperature used was 180^{o}C by using the available oven in the laboratory. The cracker was baked in an oven at 180^{o}C for about 10-12 minutes. The baked crackers were taken out from the oven and being cooled in a room temperature for a

while. In this baking, the main ingredient which is the amount by weight of lemongrass powder as the dependent variable and the all-purpose wheat flour was the independent variable. The formulation of 0%, 1%, 2%, 3% and 4% were known as the concentration used in the crackers while 0% is the controlled one. Table 3.1 shows the flour substitution with lemongrass powder, respectively.

Table 3.1: Flour substitution with lemongrass powder

Ingredients	Flour substitution				
	0%	1%	2%	3%	4%
Wheat flour (g)	100	98.37	96.74	95.11	93.48
Lemongrass powder (g)	0	1.63	3.26	4.89	6.52
Sugar (g)	10	10	10	10	10
Salt (g)	2	2	2	2	2
Butter (g)	6	6	6	6	6
Water (mL)	45	45	45	45	45
Total (g)	163	163	163	163	163

3.2.3 Determination of Physical Properties (Colour) of Lemongrass Crackers

The colour of lemongrass cracker was determined by using colourimeter (Konica Minolta CR-400). All crackers were tested by using the colourimeter with different concentration of lemongrass with triplicate each sample of concentration. The results of the physical properties of colour were displayed in CIE *L* a* b** known as colour space in order to get the lightness *(L*)*, redness *(a*)* and yellowness *(b*).*

3.2.4 Determination of physical properties (Texture) of Lemongrass Crackers

The texture of the lemongrass cracker was determined using the equipment of Textture Analyzer (Brookfiled, CT3, USA) that can determine the hardness, crunchiness and fracturability and many more. In this study, the focus of my cracker was only the hardness and fracturability. The setting was set up with TPA test type, 5000g target value, 5g trigger load, test speed of 10.00 mm/s, TA7 probe, TA-RT-KIT fixture, cycle count of two. Each sample of concentration was done and recorded in triplicate.

3.2.5 Proximate Analysis

Proximate analysis was done during this study that required the analysis of protein, fat, carbohydrate, ash, and moisture content of the lemongrass cracker. Protein content was determined by using the Kjedahl analysis that consist of three stages of doing it which are the digestion, distillation and titration. Besides, fat content was determined by using the Soxtec laboratory extractor. The ash was determined by using muffle furnace at 600˚C for 6 hours while moisture content was determined by using the moisture conventional oven with 100˚C for 24 hours.

3.2.5.1 Moisture Content

Crackers was dry blend to get powder form. Then all samples were weighed for 1 g for each concentration and triplicated. Crucibles were used as equipment for this moisture analysis. It was weighed using the electronic scale before inserted in the samples of each concentration. Then, the sample and crucibles were weighed again before entering the conventional oven at 100˚C for 24 hours. After 24 hours, the crucible with the all samples were taken out from the oven and cooled using the desiccator to cool it down. Final weight was weighed and recorded. The moisture content the was gained using the formula as shown below:

$$\text{Moisture (\%)} = \frac{\text{initial weight (g)- final weight (g)}}{\text{initial weight}} \times 100\% \quad (3.2)$$

3.2.5.2 Protein Content

Protein analysis was done by using the Kjedahl Nitrogen Method in the Husbandry Laboratory. Kjedahl method required the of digestion, distillation and titration process to get the final result which is the HCL used. In this protein analysis, each sample was weighed 1g using the electronic scale and triplicated for all concentration used. The first stage which is digestion needed to use of 1g of sample, 2 Kjedahl tablet as the catalyst to speed up the reaction of the digestion, and 12 ml of sulphuric acid (1 mg/L). Those were inserted into a Kjedahl big test tube and directly being placed into the tube racked that consist of 8 tubes in one running. Heat side shield was used by attaching to the tube rack. Then, fume manifold was fit safely and tightly on the tubes as the lid. Temperature set at 420°C around 1-4 hours in a boiling condition. The speed of digestion depending on the sample, amount of catalyst used and the type of Kjedahl digestion machine named fume chamber was used.

At this point, the mirror or window in the digestion section which is the fume chamber was closed and air fan on the wall was turned on as the smells of the digestion process is really strong, irritating and can affect our breath if we are so close with it. This digestion process was converted the nitrogen in the samples in the form of nitrates into ammonium or organic matter to H_2O and CO_2. After few hours, the digestion tubes were taken out or can be separated from the machine rack and seat to be cooled down at the side of the machine as soon as the green light colour in the tubes was shown. The green light colour in each tubes bring the meaning of the digestion was completely done as the food was completely digested.

After a cooling session, each sample is a must to be inserted with 80 ml distilled water firstly before inserted in the solution of 40% Natrium hydroxide (NaOH) of 30 ml. The distilled water must come first in the finished digestion tube as the solution in the tubes and solution of (NaOH) cannot be directly contacted. A danger explode can be happened. Next, for the distillation, samples were distilled by using the Kjedahl (Gerhad) distillation analyser. The receiver was prepared to be seat into the distillation machine too. The receiver prepared was the combination solution of 30 ml of solution of 4% boric acid, 1.75 ml methyl red and 2.5 ml of bromocresol green in a conical flask. The colour of the receiver is pink.

The tube was inserted in the distillation machine one by one with the receiver at the side of it. The distillation was done at about 3 minutes for each run followed by a cleaning process which was the distillation of tape water inserted in the tube to clean the machine for next tube. The sample tube that had been distilled turned black and need to be pour down in trash chemical tong. The receiver in the conical flask was turned to a light green to gain the objective of distillation. The receiver was used to the next stage which was the titration by

using 0.1 M hydrochloric acid. The receiver was titrated until got the pink colour as the first receiver that had been prepared.

The protein content was determined by using the formula as shown below:

$$\text{Nitrogen (\%)} = \frac{[\text{sample (ml)} - \text{blank (ml)}] \times n \times 14.01}{\text{sample (mg)}} \times 100\% \quad (3.3)$$

In this formula, n is the molarity of Hydrogen chloride (HCL) solution for titration and 14.01 is the molecular weight for Nitrogen (Ni). After the nitrogen content was determined, a factor of 6.25 was used to convert the percentage of protein for each formulation of sample.

$$\text{Protein (\%)} = \text{N (\%)} \times 6.25 \quad (3.4)$$

3.2.5.3 Fat content

A total of 1.5g of each sample of concentration was weighed and triplicated. Firstly, the oven in the Husbandry Laboratory was turned for a heating for a moment. 6 metal cup was weighed with the electronic scale to get the initial value before inserted into the oven for 15 minutes with 103˚C of temperature. After that, the empty cups were taken out and being cooled for 20 minutes in the desiccator. The cups then being weighed to and used for fat analysis for hexane, the petroleum ether insertion. Those 6 aluminium cups were filled with 2 pumps of petroleum ether which same with 80 ml. Those 6 aluminium cups were put aside. Another 6 of thimble size of tube were then inserted in with stages of things. The first one to be inserted into the thimbles was small cotton as a layer, filter paper was shaped in a triangle shape as the second layer to be inserted in.

At this second stage, sample of 1.5 g crackers of inserted into the triangle hole and back to the small cotton as the third layer to cover the top of the triangle filter paper. Those 6 thimbles were put into the fat machine analysis (Soxtec) by clipping them into their complimentary magnetic clip in the machine to be hung. Then, the 6 aluminium cups filled with petroleum ether was seat at the bottom and also being clipped together.

The machine then was turned on, being process for about 40 minutes with stages of stop to raise up the handle on the machine with several buttons need to be pressed during the process. The aluminium cups with excess fat were gained, weighed and recorded. The fat content was determined by using the formula as shown below:

$$\text{Fat (\%)} = \frac{[(\text{weighing dish} + \text{fat})(g) - (\text{weighing dish})(g)]}{\text{initial sample weight (g)}} \times 100\% \quad (3.5)$$

3.2.5.4 Ash Content

1g of cracker sample with different concentration was weighed and triplicated. As each concentration was five 0% to 4% and in triplicate, 15 crucibles were taken and weighed for getting the initial weight of it. Then, crucibles with samples were weighed. After recorded the data, those 15 crucibles with sample were put into the drying oven named muffle furnace with 600˚C for 6 hours. After that, all samples were turned into black ash colour, being cooled down in about 20 minutes in the desiccator before weighing them to get the final value. The ash content was determined by using the formula as shown below:

$$\text{Ash (\%)} = \frac{[\text{weight of crucible} + \text{ash}](g) - \text{weight of crucible (g)}}{\text{weight of sample (g)}} \times 100\% \quad (3.6)$$

3.2.6.5 Carbohydrate Content

Carbohydrate content was gained by subtracting the total percentage of protein, fat, moisture and ash from 100%. The carbohydrate content was gained by using the formula as shown below:

$$\text{Carbohydrate (\%)} = 100\% - [\text{Moisture (\%)} + \text{Protein (\%)} + \text{Lipid (\%)} + \text{Ash (\%)}] \quad (3.7)$$

3.2.6 Sensory Evaluation

A sensory evaluation was conducted in order to observe the acceptance of people to this lemongrass cracker. The sensory evaluation also consists of the colour, texture, aroma, taste, and overall acceptance to be evaluated. Thus, 30 panelists from Universiti Malaysia Kelantan, Jeli Campus had been chosen to evaluate the sensory evaluation. In this study, the panelists were all from the students. They were given 5 samples of lemongrass cracker with 5-points of scale score for the acceptability. For each sample, they are going to be asked to drink a sip of water after each sample eaten to rinse back the taste so that they can eat the next sample with a bare taste in tongue. Due to covid-19 new era, sensory in the laboratory was not recommended to be proceed. Online sensory was made by spreading the crackers in the plastic

bag with QR code on it. All panellists can eat it at home while answering the survey. The sensory evaluation was evaluated by using the 7-points hedonic scale and the recorded data from the online survey of the 7-points hedonic scale was analysed by using the Statistical Package of Social Sciences and choosing the One-Way-Analysis of Variance (ANOVA) to screen out the result data.

3.2.8 Statistical Analysis

Microsoft Excel, 2010 was used as the platform or software to insert all the data from the proximate analysis with triplicate data for each sample of concentration followed by the mean values, standard deviation, percentages, and standard error for error bar to generate a graph of percentage of each analysis. The data from the online survey was captured and analyzed by using the Statistical Package of Social Sciences (SPSS) with One-Way-Analysis of Variance (ANOVA).

CHAPTER 4

RESULTS AND DISCUSSION

4.1 Colour Analysis

The physical attributes of the lemongrass cracker were determined by the colour testing and texture profiling analysis. For colour testing, the technology or equipment is by using the colourimeter. The parameter that was used for describing the colour of the food are the lightness *(L*)*, redness *(a*)*, and yellowness *(b*)* (refer Figure 4.1, Figure 4.2 and Figure 4.3).

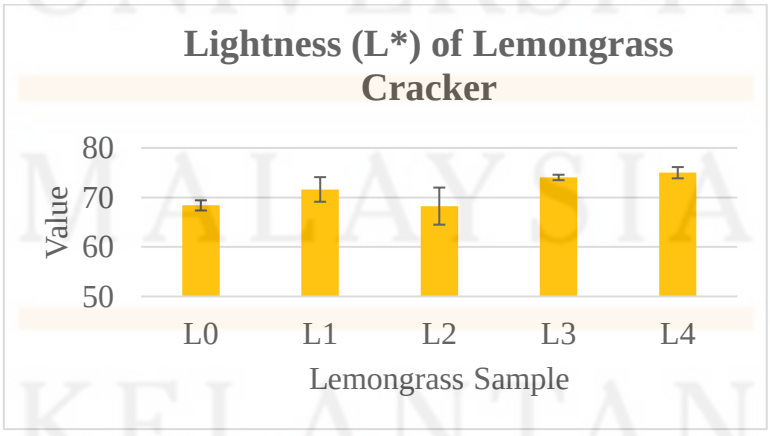

Figure 4.1: Lightness *(L*)* value (mean ± SE) of lemongrass cracker in different concentration of lemongrass powder

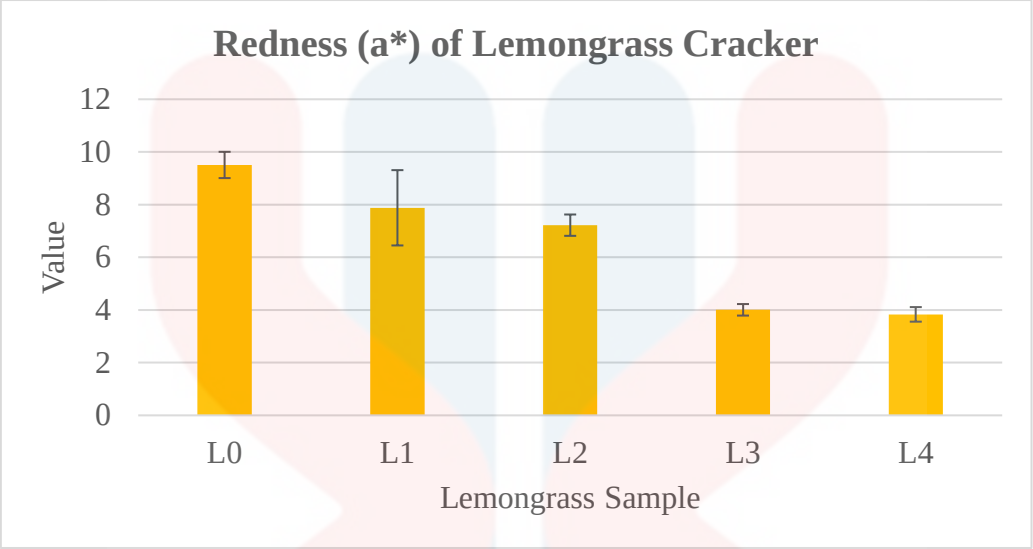

Figure 4.2: Redness *(a*)* value (mean ± SE) of lemongrass cracker in different concentration of lemongrass powder

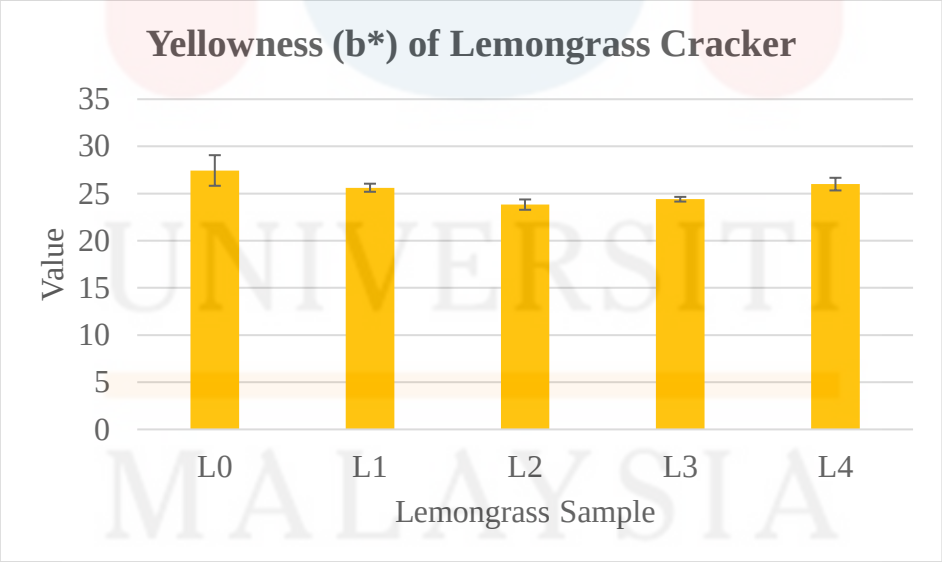

Figure 4.3: Yellowness *(b*)* value (mean ± SE) of lemongrass cracker in different concentration of lemongrass powder

The most crucial product-intrinsic sensory indication is colour. This is because of the expectation and assumption of people and consumer that related to the taste and flavour of food and beverages (Spence, 2015). Also, food that have colour will provide the direct impression of good quality, nice flavour and originality of the food. This will be a push factor for someone either to buy the food product or not (Narich, Creative innovation, 2019). Colourimeter or named as tristimulus colorimeter is created in order to replicate people eye's sight in the term of ''psycho-physical.'' It did sensors the human eye's sight how we look on the colour of something. (Giese, 2003). Colourimeter is equipment to access the initial radiation and non-primary radiation sources. The first radiation will release light and the second one will transfer the external light (Pathare et al., 2012). In this context of colour measurement, it can be identified by using the CIE *L* a* b** coordinations. *L** is known as the lightness and darkness differences, *a** can be known as red and green differences while *b** are known as the yellow and blue differences (Konica Minolta, nd).

In the terms of its value, yellowness *(b*)* value from 0 to 100 is approaching the yellow colour, as approaching the 0 value is dull colour while from 0 to -100, the colour is from dull to blue. Besides that, for redness *(a*)* value, value from 0 to 100 is dull to red colour while value from 0 to -100 is dull to green colour indication (Mouw, 2018)

Based on the result obtained, it showed slightly increasing trend for the lightness (L*) of lemongrass cracker (refer Figure 4.1). The *L** value for the control one which is the 0% is 68.40% averagely for triplicate sample. While for 2% of concentration is 71.62% of *L** value, 68.25% for 3% of concentration and 74.04% for 4% concentration of lemongrass powder. This differences or slightly increasing percentage of lightness *L** value was due to the high level of lemongrass powder content. The higher the level of the concentration, the higher the lightness value for the cracker. The supported element or the factor of the slightly increasing trend of the lightness may because of the increase of protein value in the crackers (Yadavand and Sunooj,

2013). However, in this 3% of concentration for lemongrass cracker tend to show a lower value from the previous concentration which was 2% with 3.37% differences. This might be due to the close concentration used in lemongrass powder content with only 1 range of concentration different.

In the terms of the redness *a** value, the results showed a decreasing trend for all of the concentration involved (refer Figure 4.2). All value were taken averagely by triplicate samples for each concentration. The *a** value for 0% concentration of lemongrass cracker was 9.51% followed by 1% for 7.88%, 7.22% for 2%, 4% for 3% and lastly 3.83% for the highest concentration which is 4%. According to the CIELAB colour space which is the *L**, *a** and *b** space of colour of the colour chart, value from 0 to -100 which is known as the -a* is approaching the colour from dull to green while the +a* that ranging from 0 to 100 is the dull colour approaching the red colour.

In this context, the decreasing trend of the redness value from the lemongrass cracker was leading to the colour of green due to the affection of lemongrass natural colour which is pale green. Also, this decreasing progression can be due to the content of lemongrass powder into the cracker. The higher the lemongrass powder content, the higher the colour of -a* of redness. In addition, redness value changes can be contributed from the process of baking the cracker as Maillard reaction can occur when it is subjected to the high temperature in the oven (Shantini et al., 2021).

From the result of yellowness *(b*)* value, it showed a slightly decreasing trend from 0% to 3%. The 0% concentration of lemongrass cracker showed 27.25% followed by 25.62% of 1% concentration lemongrass, 23.83% for 2% concentration of lemongrass, and 24.4% for the 3% concentration of lemongrass. In contrast with the 4% concentration of lemongrass which was 26% of yellowness value showed a slightly higher value from yellowness (b) value from

1%, 2% and 3% concentration of lemongrass cracker. This can be due to the lemongrass content of the 4% lemongrass powder used in the dough making was not evenly mixed while mixing all the ingredients such as wheat flour, sugar, salt, butter, water including the lemongrass powder. The uneven mixing may lead to the varieties of concentration depends on the where the powder seat or located in each of the cracker.

Other factors that are relevant related to the colour characteristic of crackers can be due to the composition in the ingredient, the velocity of air contained in the oven, and the Maillard reaction or known as the non-enzymatic browning that can cause the red colouring on the crackers or food. Temperature of the baking and time also can affect the colour attributions on the crackers (Pereira et al., 2013)

4.2 Texture Profile Analysis

Texture of the lemongrass crackers was analyzed and determined by using the Texture Analyzer (Brookfield, CT3, USA) in the Food Laboratory of Agro-Based Industry in Universiti Malaysia Kelantan. The parameter or characteristic observed were the hardness and fracturability of the lemongrass crackers with those different concentration of lemongrass crackers sample from 0% to 4% and being triplicated to get the average value (refer Figure 4.4 and Figure 4.5).

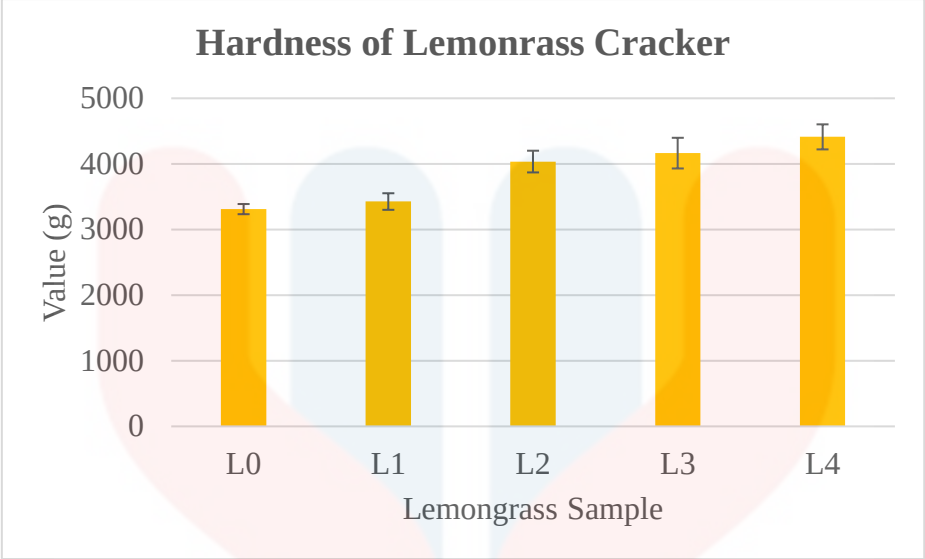

Figure 4.4: Hardness value (mean ± SE) of lemongrass cracker in different concentration of lemongrass powder

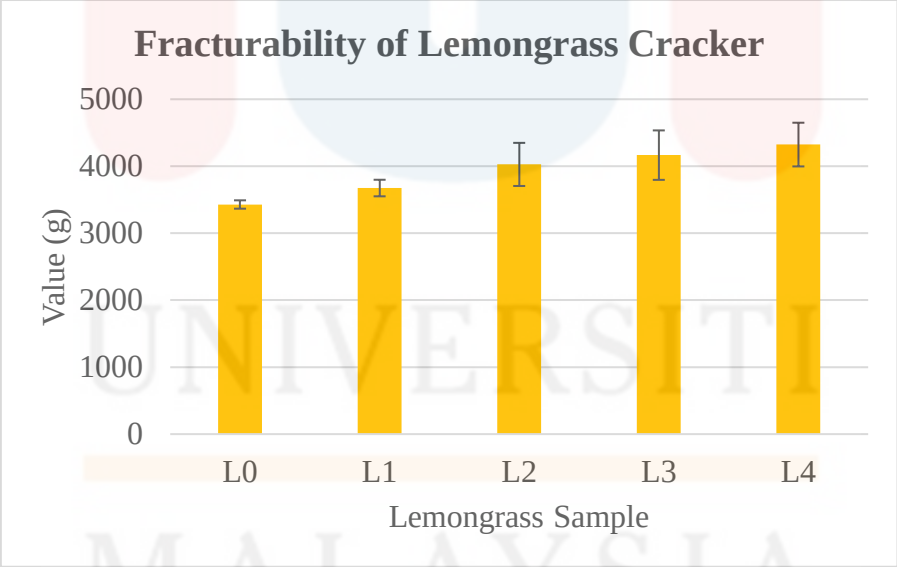

Figure 4.5: Fracturability value (mean ± SE) of lemongrass cracker in different concentration of lemongrass powder

In Texture Profile Analysis (TPA), varieties of parameter or physical properties like the chewiness, gumminess, adhesiveness, cohesiveness, springiness, including the hardness and fracturability. The TPA was tested using a basic format of movement which are the first compression, first withdrawal, waiting session, and repeated with the second compression and withdrawal. Compression meaning is the probe is approaching the sample with the speed, distance, time and force being already set while the withdrawal is the movement away of probe after touching the sample.

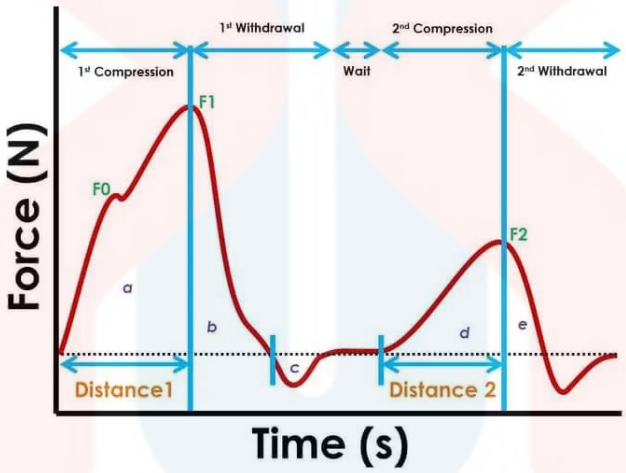

Figure 4.6: The example of graph of force-time curves of two times of compression of any general food.

Source: (Centre of Industrial Rheology, nd)

In this study, hardness being mainly observed. Based on figure 4.6, hardness (F1) is known as the tallest peak of force that the initial compression is capturing while the fracturability (F0) is known as the earliest peak that significant and done by the first compression. In the context of hardness, hardness was at first recognized by Friedman *et al.* (1963). Hardness will be different due to sample, probe and compression value that will have contact area sizes (Trinh, 2012).

Figure 4.4 showed the hardness attribute. The results showed increasing trend of hardness value for the lemongrass cracker with the different concentration of 0% to 4%. The 0% concentration of the lemongrass cracker obtained a 3311.33g of hardness value followed by 3426.67g for 1% of concentration, 4036 g for 1% concentration, 4164.67g for the 3% concentration and lastly the highest value with 4412.17g for 4% concentration of lemongrass. The increase of hardness value in the crackers can be due to the level of lemongrass powder content in the cracker. The higher the lemongrass powder being inserted in, the higher the hardness of the cracker's texture. Japanese rice crackers that named Koshihikari, Benisarasa, Akigumo and Natsugumo enhance a well eating quality because if the physical attributes of small value of hardness and big value of stickiness (Nakamura et al., 2014). Hardness and the final chemical composition of the biscuit baked with the addition of black currant and jostaberry powder is higher than the control sample (Molnar et al., 2015). It means that, cracker with concentration of added ingredient can lead to the higher value of hardiness compared to the control sample that have not inserted with any concentration.

Fracturability is defined as character of texture on the product that linked with the crunchiness and extruded like cereals. (Barrett & Kaletunc, 1998). Fracturability also is referring to the how easy the sample can be broken. Based on the result obtained on the fracturabilty value of lemongrass cracker on figure 4.5, an increasing trend can be seen starting from the control sample to the highest concentration of lemongrass cracker. 4% which is the highest concentration of lemongrass cracker showed a highest value for fracturability with 4323.33g. The high value of fracturabilty can be due to the increasing content of the lemongrass powder into the cracker. This can be supported by the biscuit that added with guar gum and sorghum flour. The higher the guar gum and sorghum flour content in the biscuit, the higher the fracturability of the biscuit. In addition, biscuits that enhanced with dietary fibre gained an

increased level of fracturabilty. This is due to the low resistance for the cracking in the analysing of texture profile analysis (Singh et al., 2015).

4.3 Proximate Analysis

Proximate analysis is a method estimates the macronutrients content in sample of food and those content obtained basically will be shown on the labelling content of nutrients on the food product. So, consumers can get the benefits from reading the nutritional labelling before choosing to buy or eat the food product as well taking care of their diet (BÜCHI Labortechnik AG, 2017). This proximate analysis was done to the lemongrass cracker in order to determine the content of protein, fat, ash, moisture and carbohydrate contained in it by the standard method (AOAC 1984).

4.3.1 Moisture Content

Moisture content of lemongrass crackers was obtained with the preparation of 1g sample for each concentration and being dried into the conventional oven with 100˚C for 24 hours. Based on the results obtained (refer Figure 4.7), lemongrass cracker with 0%

concentration of lemongrass had the highest moisture value with (10.0967 ± 0.9529) followed by the 4% concentration with (6.5548 ± 1.7492) that had the lowest content of moisture content. The trend in the moisture value tend to show a decreasing trend incorporate with the concentration in the crackers. This result is in agreement with Ferreira et al (2013) when the moisture percentage in the biscuit was lower with higher addition of Fruit and Vegetable Flour (FVR) flour compared to not added one. Also, according to Adeyeye et al (2010), the moisture value in the maize flour cookies was decreasing incorporated with the increase addition of soy protein in it. Moisture value was turned down when the amounts of vegetables in the chinchin is increased. This statement can be supported with the finding in research on spinach cracker when the moisture percentage was decreasing with the increase of spinach concentration (Nurhanan et al., 2021).

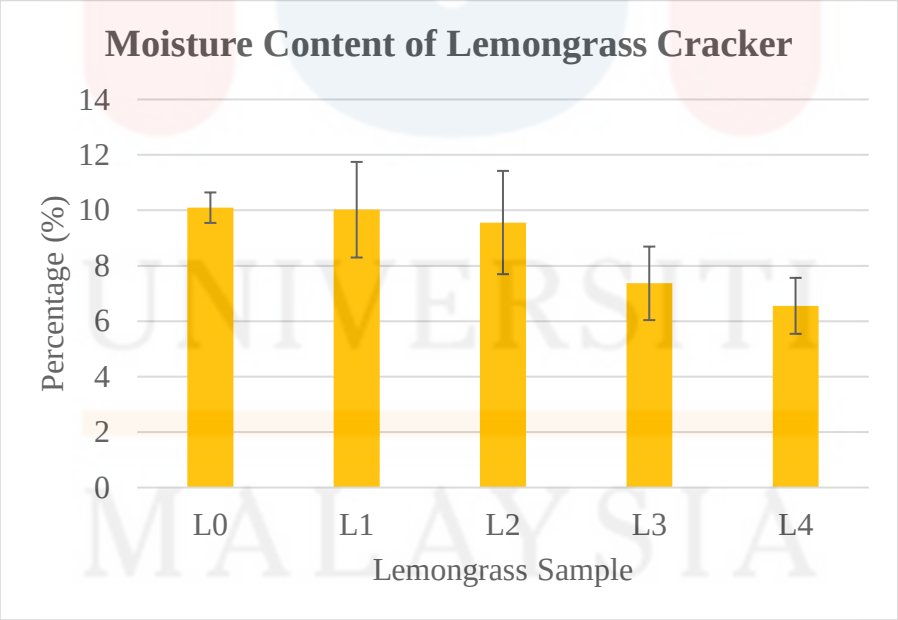

Figure 4.7: Moisture value (mean ± SE) of lemongrass cracker in different concentration of lemongrass powder

4.3.2 Fat Content

Fat analysis had showed an increasing trend of lemongrass cracker based on the results obtained (refer Figure 4.8). The highest concentration which is 4% of lemongrass cracker had the highest value of fat with (6.1915 ± 0.8368) while the control one with 0% concentration had the lowest value of fat with (3.9154 ± 0.7973).

The increased progression of fat content in crackers incorporate with lemongrass can be supported with the finding of chinchin with ugu and Indian spinach as it showed an increasing trend as well as the level of the vegetables increased (Olubukola, 2017). According to Altiner et al. (2021), it was reported that the fat percentage in crackers made from pumpkin flour is increasing as the level of pumpkin flour is increased. Also, the highest fat value can be seen in from the experiment of cracker from Dehydrated green curd of pea peel (DGCPp) with 15% concentration compared with 5% concentration as well as being compared with the use of wheat flour only (Mousa et al., 2021) The high fat content can be due to the content of oil which is high (Altiner, 2021). Large absorption oil volume leads to the increase of fat content (Olubukola, 2017). However, less fat value in the drying food did enhancing the shelf life, lower the rancidity occurs but lower in the energy gained while high fat value will lead to the higher energy content gained and encourage the oxidation of lipid (Olubukola, 2017).

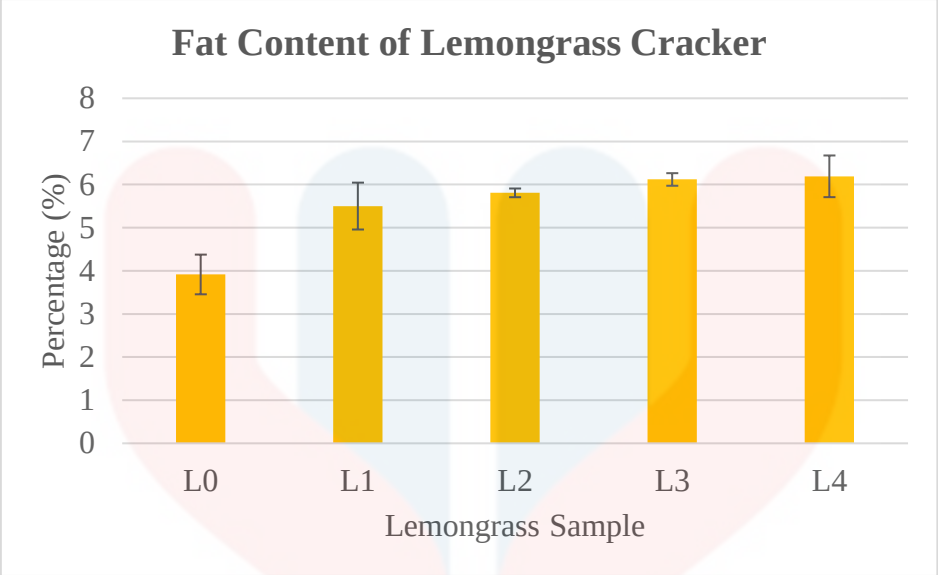

Figure 4.8: Fat value (mean ± SE) of lemongrass cracker in different concentration of lemongrass powder

4.3.3 Ash Content

From the result of ash content obtained (refer Figure 4.9), the ash content of the lemongrass cracker had shown an increasing trend. The final concentration of lemongrass cracker had highest ash content of (69.8810 ± 5.0132) while the controlled one had the lowest with (51.9995 ± 6.6843) followed by the 1% concentration with (57.4141 ± 1.6127), 2% concentration with (58.4971 ± 7.7733), and 3% concentration with (66.1181 ± 3.9288).

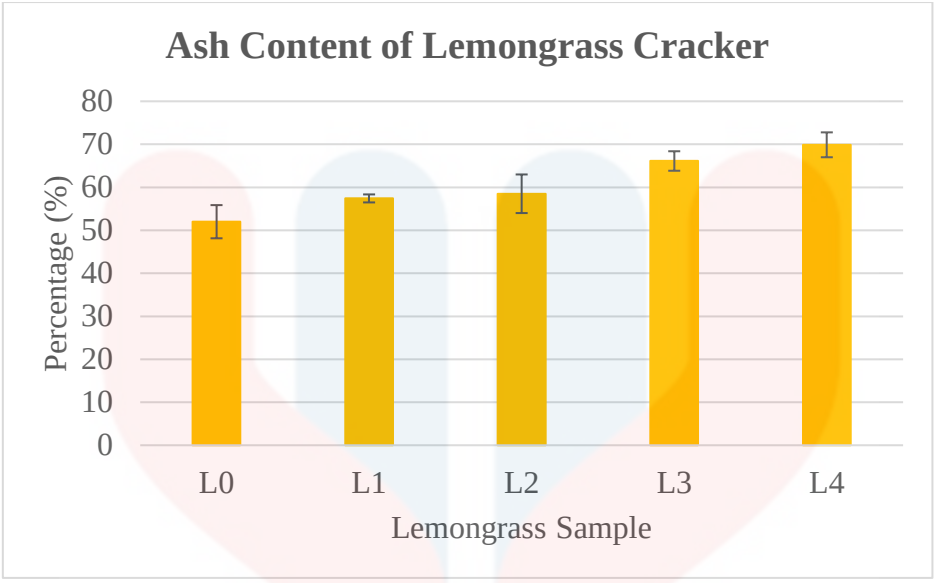

Figure 4.9: Ash value (mean ± SE) of lemongrass cracker in different concentration of lemongrass powder

The progression of the ash value can be supported with the finding in research of biscuits with the enrichment of herbs of tulshi and moringa tend to show an increasing ash value as well as the high concentration used in those herbs lead to higher ash content in biscuit (Alam, 2014). According to Shantini (2021), ash content in crackers was increased incorporated with the increase of spinach content. Similar results were obtained with the addition of pumpkin powder in cookies instead of using the wheat flour individually (Anitha S et al., 2020).

In the process of ash analysis, food usually is in powdered form and high temperature of 500°C will lead to the occur of water and another volatile component to be vapored and organic components are burning with the appearance of oxygen, nitrogen oxidation as well as eradicated the hydrogen. Percentage of ash is basically below and equals to 5%. Ash can be defined as the mineral value contained in any organic food that exist after a high temperature burning session. Ash also plays a crucial role in the terms of physicochemical, nutritional and

technological attributes (Food Science, 2012). Determining of ash content is related to the mineral content of the food as the quantity of mineral will soon determine the food physicochemical attributes and delaying the microorganism to grow (Dairy Food, 2010). The content of ash also did determine the mineral amount in the food. Thus, those mineral components will help on the carbohydrate and organic compound in the terms of the metabolism (Stamatovska et al., 2018).

4.3.4 Protein Content

Based on the results obtained (refer Figure 4.10), the protein percentage of lemongrass cracker showed a decreasing progression. The control sample without the addition of lemongrass was having the highest protein percentage with (11.5329 ± 0.1339) and keep decreasing into the highest concentration of lemongrass with the value of (11.479 ± 0.5739) for 1% of concentration, (11.2117 ± 0.3146) for 2% concentration, (10.9482 ± 0.4882) for 3% and the smallest value gone to 4% of concentration with (10.6274 ± 0.1331). This progression of protein content in lemongrass cracker has no supported research on the decreasing trend that can be led to some error in the data collection. For example, HCL solution value that was collected during the titration in Kjedahl should be increase as we increase the titration time incorporate with the increasing concentration of lemongrass sample. Those can lead to the high HCL solution collected. Thus, may lead to an increasing progression of protein content.

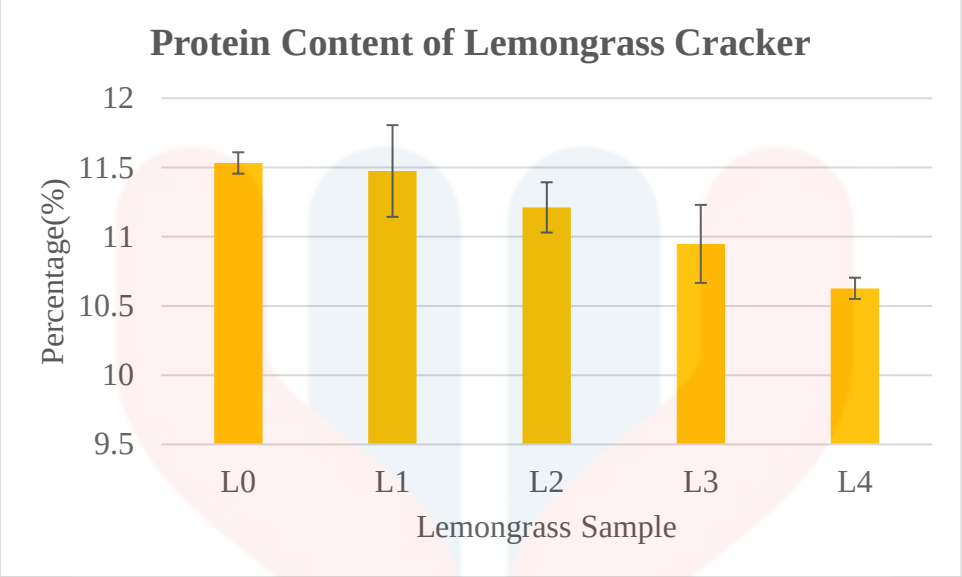

Figure 4.10: Protein value (mean ± SE) of lemongrass cracker in different concentration of lemongrass powder

4.3.5 Carbohydrate Content

The way to get the value of carbohydrate was by deducting the total percentage obtained by analysis on the proximate analysis such as protein, fat, moisture, and ash by 100%. Based on the result obtained below (refer Figure 4.11), a decreasing progression was observed incorporate with the concentration of lemongrass. This decreasing trend of lemongrass cracker can be seen in the research of soybean flour and cookies as the increasing of soybean flour added into the cookies make the fat and protein content increase but lowering the content of carbohydrate. On the other hand, cookies with the 100% of wheat flour addition has been reported is having the highest value of carbohydrate (Sanful, 2010). This can be supported with the finding research from the biscuits made from tulshi and moringa leaves herbs that is having

the decreasing in the terms of carbohydrate value as well as the concentration of those herbs increased (Alam, 2014). According to, carbohydrate is known as the exclusive macronutrient is easy to be digested in the body system to supply energy while doing extreme exercise. Experts also agreed that food that high in carbohydrate will enhance the physical performance and healing from exercise (Kanter, 2017).

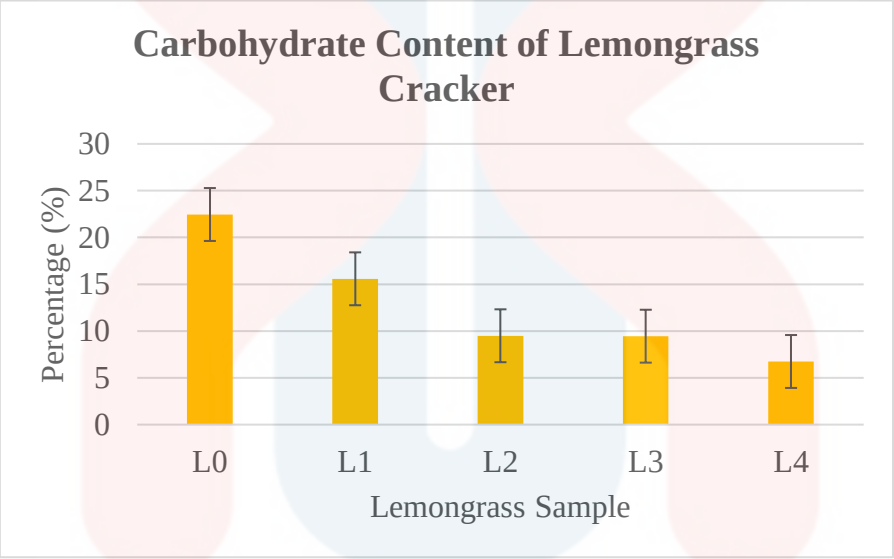

Figure 4.11: Carbohydrate value (mean ± SE) of lemongrass cracker in different concentration of lemongrass powder

4.3.6 Overall Chemical Composition of Lemongrass Cracker

Overall, all the chemical composition are the protein content, moisture content, ash content, fat content and carbohydrate content in the lemongrass cracker. All of the

compositions were lined up in a graph to be compared on what composition had the highest or lowest content in the lemongrass cracker. In this study, the concentration that had been used were the control one with 0% concentration of lemongrass cracker coded with (701), 1% concentration of lemongrass cracker coded with (153), 2% concentration of lemongrass cracker coded with (299), 3% concentration of lemongrass cracker with code (266) and lastly the highest concentrating being added with 4% with the code (107).

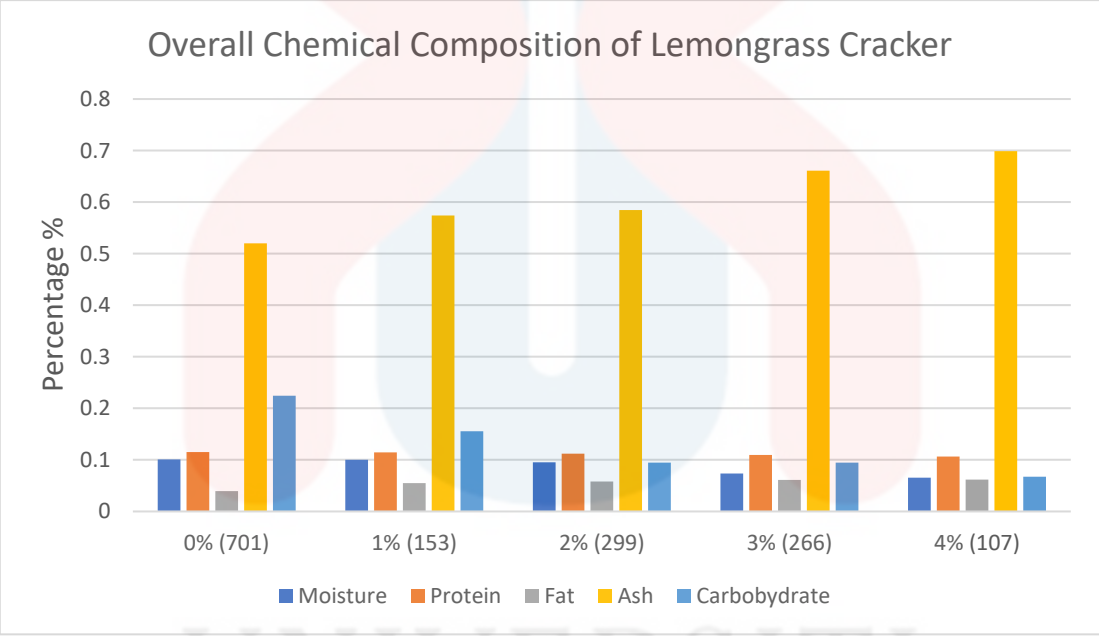

Figure 4.12: Overall chemical composition of lemongrass cracker in different concentration of lemongrass powder

From the result obtained (refer Figure 4.12), the highest content in the lemongrass cracker was ash content followed by the carbohydrate content, moisture content, protein content and fat content which was the lowest one. Carbohydrate content which was the second highest content is sign of good nutritional composition as it relates to energy.

4.4 Sensory Acceptability of Cracker Incorporated with Lemongrass Powder

Sensory analysis can be reviewed as a science of interdisciplinary when it is using the perceptions from human sensory to be a panellist to estimate the properties and the sensory used to determine the attributes in sensory as well as the food sample acceptance. The senses in sensory that can be used are the sight, touch, smell, taste and hearing. Sight is relating to the appearance of the food sample that include of the physical characteristics like colour, shape, and shape. Touch is connecting to the texture and mouth feel of the food sample while smell is relating to the aroma that comes from the aromatics and flavour of the food. On the other hand, taste is linked with the flavour of the food that combined of the odour, mouth feel and the variety of taste like the sweetness, saltiness, sourness and bitterness. Hearing is from the sound which encounter of the strength and quality (Ackbarali & Maharaj, 2013)

Basically, well-designed laboratory of sensory shall be act in accordance with the procedure of area recommended for the panellist to do the sensory such as the existence of area of waiting room followed by the area of briefing, area of preparation sample, area of evaluation and area of discussion. In sensory evaluation, 7-point hedonic scale and 9-point hedonic scale are regularly being used which is using the level of liking for the food sample is captured. The sensory expression is ranging from the ‘’dislike extremely’’ to the ‘’like extremely’’ (Sharif, 2017).

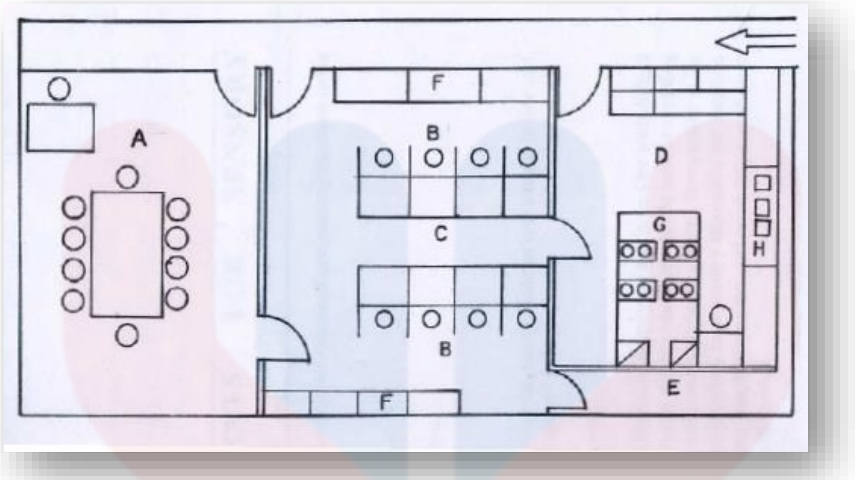

Figure 4.13: Laboratory design for sensory (A: Area of briefing; B: Area of evaluation; C: Area of distribution and serving; D: Area of preparation; E: Store room; F: Cub-boards; G: Cooking area; H: Refrigerator or deep freezer

Source: (Sharif, 2017)

In this study, the parameter of sensory evaluation that has been used are colour, texture, taste and aroma. The lemongrass cracker with 0% concentration of lemongrass was coded (701) and known as the control one. The 1% concentration of lemongrass is coded (153), followed by the 2% concentration of lemongrass with code (299), 3% concentration of lemongrass with code (266) and lastly the highest concentration of lemongrass with 4% was coded as (701).

Table 4.1: Score values from sensory evaluation in mean and standard deviation for ±Lemongrass crackers

Attributes					
Lemongrass Formulation (%) and code	Colour	Texture	Taste	Aroma	Overall Acceptance
0% (701)	5.20 ± 1.349	4.73 ± 1.660	5.47 ± 1.358	5.20 ± 1.584	4.73 ± 1.660
1% (153)	5.33 ± 1.516	4.10 ± 1.954	4.80 ± 1.808	5.20 ± 1.448	4.73 ± 1.639
2% (299)	5.57 ± 1.223	4.93 ± 1.893	5.00 ± 1.702	4.87 ± 1.737	4.90 ± 1.768
3% (266)	**5.50 ± 1.480**	**4.70 ± 1.685**	**5.10 ± 1.605**	**5.23 ± 1.382**	**5.07 ± 1.596**
4% (107)	5.33 ± 1.516	4.20 ± 2.024	4.97 ± 1.771	5.17 ± 1.416	4.90 ± 1.605

Based on the result of sensory evaluation obtained, the online survey that was done by 7-point hedonic scale that started the value of 7 with ‘’extremely like’’ to 1 with extremely dislike’’, the 2% (299) concentration of lemongrass cracker was most preferable one in the terms of colour with (5.57 ± 1.223) which was the highest (mean ± SD). Next, in the terms of the texture, taste, and aroma, lemongrass cracker with 2% (299) concentration had the best level of texture to become the most favourable one among others for texture attribute with value (4.93 ±1.893) of (mean ± SD). In the terms of the lemongrass cracker’s taste, the control one with 0% concentration of lemongrass had the highest value with (5.47 ± 1.358). For the aroma, the most preferable one was the cracker with 3% concentration of lemongrass with the value of (5.23 ± 1.382). Overall, the overall acceptance of lemongrass crackers showed the 3% concentration of lemongrass cracker that coded with (266) had been the most acceptable one

compared to the 0% control, 1%, 2% and the highest 4%. This may be concluded that crackers with the added of lemongrass powder was unpredictable more accepted than the control one with 0% concentration of lemongrass powder. This can be supported with the finding of research in chicory fibre in biscuit that concluded that the addition of 1% and 3% of chicory fibre in biscuit had the best acceptance in overall compared to the control one (Ivanisova et al., 2019). According to Jose et al. (2018), results of artichoke fibre incorporate with cookies was showed a penetrating taste to all the biscuits with the artichoke fibre enriched compared to biscuit without the fibre added.

Table 4.2: results for overall acceptance of lemongrass crackers

ANOVA

Source of Variation	SS	df	MS	F	P-value
Between Groups	11.10666667	4	2.776666667	1.02273497	0.397685924
Within Groups	393.6666667	145	2.714942529		
Total	404.7733333	149			

Based on the results of overall acceptance in p-value, the p-value obtained was 0.397685924 which is higher than (0.05) or ($p \geq 0.05$) and this was leading to the accepted null

hypothesis and no significance difference exist. Thus, no post hoc test will be proceeded as the test can determine the significance difference at the first place.

CHAPTER 5

CONCLUSIONS AND RECOMMENDATION

In conclusion, this overall study of lemongrass cracker with increasing concentrations which are 0%, 1%, 2%, 3% and 4% did shows differences in the terms of colour attributes, texture attributes, and in the proximate analysis of protein, fat, moisture, ash and the carbohydrate determination content. In the terms of colour attributes, lightness (L*) of the lemongrass cracker shows the value from around 65 to 75. Besides, the redness (a*) of the lemongrass cracker was tend to have the higher value on the cracker that content of 4% concentration which also known as the highest concentration. For the yellowness (b*) of lemongrass cracker, the 0% concentration of lemongrass cracker has the highest value. For the results of texture analysis, the graph of the hardness on the lemongrass cracker shows an increasing trend. The 4% concentration of lemongrass cracker shows the highest value of hardness. On the other hand, for fracturability result also shows an increasing trend for the lemongrass cracker as the lemongrass in cracker increased. For the results of proximate analysis, the percentage of the moisture, fat, ash, protein as well as carbohydrate gave different percentages with high and low amount of them. Moisture and fat showed the lower percentage to be compared with protein, ash and carbohydrate. Moisture showing a decreasing progression as well as carbohydrate and protein while ash and fat had showed an increasing progression.

In the terms of sensory evaluation, there was no significant difference among the concentrations of lemongrass crackers as the p-value is higher than (0.05). Thus, the null hypothesis is accepted and no post hoc test will be generated. For the overall acceptance of lemongrass cracker, cracker that coded with (266) had been the most preferable one with the concentration of 3% of lemongrass. Thus, it can be considered to commercialized as a food product.

One of the recommendations throughout this study were in the terms of baking the cracker, it is recommended to have a better and complete facility while doing the final year project in order to obtain a better result. This is due to the oven in the laboratory of UMK that just have one oven available for all students and the others were broken. Besides, the oven also not very specific at all in the terms of its temperature meaning that the temperature is not very sensitive and accurate. Thus, continuously observation was done such as to keep the eyes on the cracker while it is baking in the oven to prevent burning. Furthermore, it is highly suggested to have better equipment to grind the food. This is due to the texture of the main material in this study which is lemongrass is fibrous and difficult to have a fully powdery form for powder extracting. Also, it would be better if the electricity and water supply are in a good condition consistently. This is because while doing the proximate analysis, there were always no electricity and water supply in the laboratory to run the machines like Kjedahl protein machine, fat machine or fibre machine that highly need water and electricity to run it perfectly. It had made most of the students cannot perform the experiment and keep delaying to the it. This is actually affecting the time given for the students to complete the project.

REFERENCES

Adeola and Ohizua. (2018). Physical, chemical, and sensory properties of biscuits prepared from flour blends of unripe cooking banana, pigeon pea, and sweet potato. *Wiley Online Library*.

Aftab K, A. M. (2011). Determination of different trace and essential element in lemon grass samples by X-ray fluorescence spectroscopy technique. *ResearchGate*.

Akingbala, S. A. (2014). Evaluation of Nutritional and Sensory Properties of Cookies Produced from Sweet Potato- Maize Flour Blends. *ResearchGate*.

Ash content in food. (2012, November 6). Retrieved from Food Science: https://www.foodscience-avenue.com/2012/11/ash-content-in-food.html?m=0

Beryy, D. (2017, June 13). *Consumers look at meat color to communicate freshness*. Retrieved from supermarket perimeter: https://www.supermarketperimeter.com/articles/1488-consumers-look-at-meat-color-to-communicate-freshness

Dan Brennan, M. (2020, October 6). Retrieved from Lemongrass: Are There Health Benefits?: https://www.webmd.com/diet/lemongrass-health-benefits#2

Dilek Dulger Altiner, M. S. (2021). Chemical and nutritional characteristics of crackers substituted with Cucurbita pepo L. seed flour. *Emirates Journal of Food and Agriculture*.

Dr. Md. Ariful Alam, M. J. (2014). Development of Fiber Enriched Herbal Biscuits: A Preliminary Study on Sensory Evaluation and chemical Composition. *ResearchGate*.

Firdous, D., & Marwah, D. S. (2020, September 2). *Health Benefits Of Lemongrass, Uses And Its Side Effects*. Retrieved from lybrate: https://www.lybrate.com/topic/benefits-of-lemongrass-and-its-side-effects

Giese, J. (2003, December 1). *Color Measurement in Foods*. Retrieved from IFT: https://www.ift.org/news-and-publications/food-technology-magazine/issues/2003/december/columns/laboratory

*Identifying Color Differences Using L*a*b* or L*C*H* Coordinates*. (n.d.). Retrieved from Konica Minolta: https://sensing.konicaminolta.us/us/blog/identifying-color-differences-using-l-a-b-or-l-c-h-coordinates/

Jose, F. J., Fernandez, M. C., & Lopez, R. (2018). Sensory evaluation of biscuits enriched with artichoke fiber-rich powders (Cynara scolymus L.). *Food Science & Nutrition*.

Kaewmanee, Karrila, Benjakul. (2015). Effects of fish species on the characteristics of fish cracke. *ResearchGate*.

Kaletunc, B. a. (1998). Quantitative Description of Fracturability Changes in Puffed Corn Extrudates Affected by Sorption of Low Levels of Moisture. *Wiley Online Library*.

Kanter, M. (2018). High-Quality Carbohydrates and Physical Performance. *Lippincott Williams & Wilkins Open Access*.

Lemon Grass Pictures, Images and Stock Photos. (n.d.). Retrieved from iStock: https://www.istockphoto.com/photos/lemon-grass

Macdougall, D. (2010). Colour measurement of food: principles and practice. *ResearchGate*.

Maria Eliza Assis dos Passos, M. L.-M. (2013). Proximate and mineral composition of industrialized biscuits. *ResearchGate*.

Meullenet, J.-F. (2004). Consumers and texture: understanding their perceptions and preferences. *ResearchGate*.

Molnar, Suzana Rimac, Lovorka Vujic, and Erno Gyimes. (2015). Characterization of biscuits enriched with black currant and jostaberry powder. *ResearchGate*.

Mona M.H. Mousa, M. A.-M.-W. (2021). Pea peels as a value-added food ingredient for snack crackers and dry soup. *scientific report*.

Mouw, T. (2018, October 8). *LAB Color Values / Color Spaces*. Retrieved from x-rite pantone: https://www.xrite.com/blog/lab-color-space

Nakov, G., Stanmatovska, V., Vasileva, N., & Damyanova, S. T. (2018). Physicochemical characteristics of functional biscuits and In vivo determination of glucose in blood after consumption of functional biscuits. *ResearchGate*.

Nicole, N. E. (2021). Formulation of functional crackers enriched with fermented soybean (tempeh) paste: rheological and microstructural properties. *ScienceDirect*.

Pankaj B Patahre, U. L.-J.-S. (2013). Colour Measurement and Analysis in Fresh and Processed Foods: A Review. *ResearchGate*.

Park, K.-B., Kim, J.-E., & Park, J.-Y. (2015). Quality Characteristics of Cookies Containing Beetroot Powder. *ResearchGate*.

Parul Singh, Rakhi Singh, Alok Jha, Prasad Rasane, and Anuj Kumar Gautam. (2015). Optimization of a process for high fibre and high protein biscuit. *J Food Sci Technol*.

Phumudzo Mabai, A. O. (2017). Effect of Drying on Quality and Sensory Attributes of Lemongrass. *Journal of Food Research*.

Proximate Analysis in Food Samples. (2017, September 29). Retrieved from BUCHI Labortechnik AG: https://www.researchgate.net/institution/BUeCHI-Labortechnik-AG/post/Proximate-Analysis-in-Food-Samples-59ccf1ee217e20073a45f3d2

R.Miller. (2016, Disember). Biscuits, Cookies and Crackers: Nature of the Products. doi:10.1016/B978-0-12-384947-2.00075-1

Rosenthal, A. J. (2010). Texture profile analysis – how important are the parameters? *Journal of Texture Studies*.

S.A.O. Adeyeye, A. A.-O. (2017). Quality and sensory properties of maize flour cookies enriched with soy protein isolate. *Taylor & Francis Group*.

Sawyer, D. (2012, April 16). *Introduction to food analysis*. Retrieved from SlideServe: https://www.slideserve.com/dalit/introduction-to-food-analysis

Sensory Testing. (2020). Retrieved from Erganal Member of Qacs: https://erganal.gr/en/services/rd-support/sensory-testing/

Shah, G. (2011, March). Scientific basis for the therapeutic use of Cymbopogon citratus, stapf (Lemon grass). *Journal of Advanced Pharmaceutical Technology & Research*. doi:10.4103/2231-4040.79796

Sharif, M. K., Butt, M. S., Sharif, H. R., & Nasir, M. (2017, October). Sensory Evaluation and Consumer Acceptability. *ResearchGate*. Retrieved from https://www.researchgate.net/publication/320466080_Sensory_Evaluation_and_Consumer_Acceptability

Singh-Ackbarali, D., & Maharaj, R. (2013). Sensory Evaluation as a Tool in Determining Acceptability of Innovative. *Sciedu Press*.

Sumiko NAKAMURA, D. S. (2014). Quality Evaluation of Rice Crackers Based on. *Taylor & Francis group*.

Texture Analysis And Texture Profile Analysis. (n.d.). Retrieved from Centre for Industrial Rheology: https://www.rheologylab.com/services/texture-analysis/

Trinh, T. (2012). On the texture profile analysis test. *ResearchGate*.

WALLACE, A. (2019, May 20). Retrieved from Everything You Need to Know about Lemongrass (Cymbopogon citratus): https://thepureway.com/blogs/the-pure-way/lemongrass-monograph

Why Colour is important in the Food and Beverages industry? (2019, August 19). Retrieved from NARICH creative innovation: https://www.narich.co.za/application-food/why-is-colour-so-important-to-the-food-and-beverages-industry/

Wilson, D. R. (2018, October 24). Retrieved from What are the health benefits of lemongrass tea?: https://www.medicalnewstoday.com/articles/321969

Yadav, T. S. (2013). Effect of Partially De-Oiled Peanut Meal Flour (DPMF) on the Nutritional, Textural, Organoleptic and Physico Chemical Properties of Biscuits. *ResearchGate*.

APPENDIX A

Figure A.1: Fresh lemongrass

Figure A.2: Dried lemongrass

Figure A.3: Lemongrass powder

Figure A.4: The equipment to make lemongrass cracker

Figure A.5: One of the recipe formulations to make the lemongrass cracker dough

Figure A.6: Rolling the dough in the process of baking the lemongrass cracker

Figure A.7: Shaping and cutting the dough with (3cmx3cm) size

Figure A.8: Lemongrass cracker after finish baking and cooled down

Figure A.9: Lemongrass cracker ready for sensory evaluation in a zipped-plastic bag

Figure A.10: Samples separated in different concentrations for proximate analysis

Figure A.11: One of Kjedahl steps (Preparing the receiver for distillation)

Figure A.12: One of Kjedahl steps (Distillation machine)

Figure A.13: The pink colour of receiver for distillation in a 250 ml of conical flask

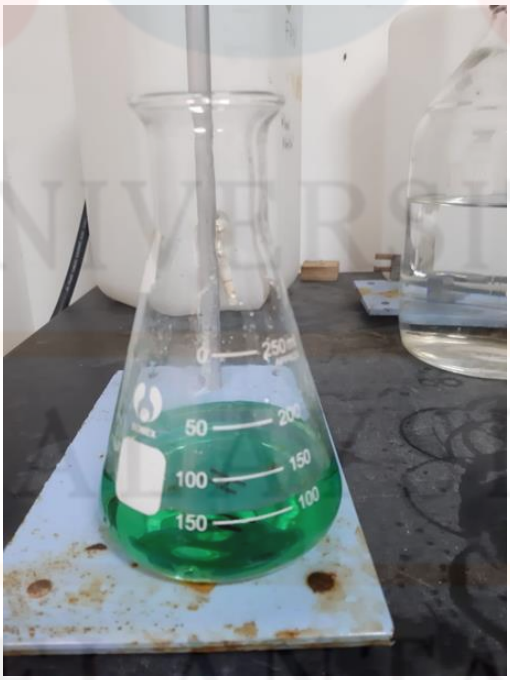

Figure A.14: The receiver from pink turns to green after a distillation process and ready for titration

Figure A.15: The fume chamber in the Husbandry Laboratory for digestion in Kjedahl Protein

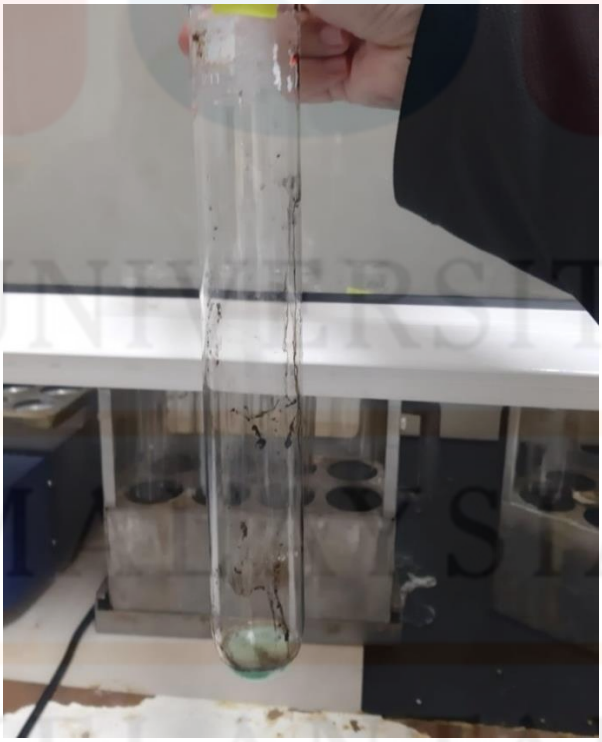

Figure A.16: The Kjedahl test tube after a complete digestion

Figure A.17: Analysis of ash by using the muffle furnace

Figure A.18: One of the processes in analysis of fat by using the Soxtec (FOSS) fat analysis machine (Removing the petrol ether used)

Figure A.19: One of the processes in analysis of fat by using the Soxtec (FOSS) fat analysis machine (Preparing the sample in the thimble)

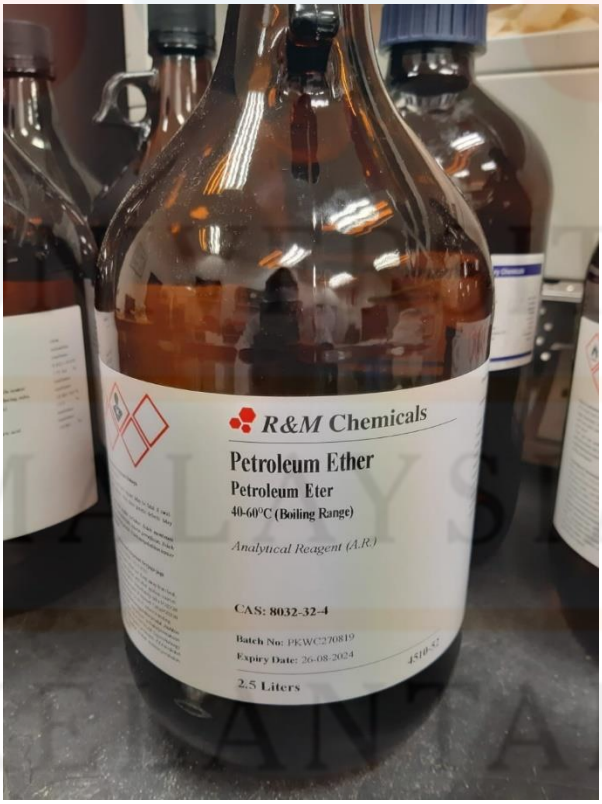

Figure A.20: The hexane or petroleum ether used in fat analysis

Figure A.21: The Soxtec (FOSS) fat analysis

Figure A.22: Analysis of moisture the conventional oven

Figure A.23: The texture analyser machine at the Food laboratory in (UMK) Jeli

APPENDIX B

Table B.1: Production cost for lemongrass cracker for 300 pcs crackers

Item	Quantity Required/300 pcs of crackers	Price (RM)
Fresh lemongrass	3	6.00/kg
Wheat flour	1	2.70
Sugar	1	2.20
Salt	1	1.50
Butter	1	4.50
Baking paper	1	3.00
Air-tight container	5	7.50
Cost Price per 300 pcs of Crackers	**13**	**27.40**

APPENDIX C

Table C.1: Mean score of the overall acceptance for formulation in lemongrass cracker

Descriptives

		N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
						Lower Bound	Upper Bound		
OVERALL	0%	30	4.73	1.660	.303	4.11	5.35	1	7
	1%	30	4.73	1.639	.299	4.12	5.35	1	7
	2%	30	4.90	1.768	.323	4.24	5.56	1	7
	3%	30	5.07	1.596	.291	4.47	5.66	1	7
	4%	30	4.90	1.605	.293	4.30	5.50	1	7
	Total	150	4.87	1.637	.134	4.60	5.13	1	7

Table C.2: ANOVA results for overall acceptance of lemongrass cracker

ANOVA

		Sum of Squares	df	Mean Square	F	Sig.
OVERALL	Between Groups	2.333	4	.583	.213	.931
	Within Groups	397.000	145	2.738		
	Total	399.333	149			