DETERMINATION OF PROXIMATE AND MINERAL CONTENT OF SELECTED COMMERCIAL RICE IN MALAYSIA

by

ARIANI BT HUSAIN

Thesis submitted in partial fulfillment of the requirements for the degree of Bachelor of Health Sciences (Nutrition)

June 2013

ABSTRAK

Kajian telah dijalankan untuk menentukan dan membandingkan kandungan makronutrien dan mineral dalam tiga jenis beras putih komersial terpilih di Malaysia. Beras putih dipilih untuk kajian ini adalah daripada kategori panjang, sederhana dan pendek. Beras putih dimasak mengikut ukuran yang betul untuk air dan beras sebelum ia kering dan dianalisis. Makronutrien ditentukan dengan menggunakan kaedah analisis proksimat (AOAC), jumlah karbohidrat telah ditentukan oleh kaedah Anthrone, kandungan kalori telah ditentukan oleh Kalorimeter Bom dan kandungan mineral ditentukan menggunakan *Atomic Absorption Spectrophotometer (AAS).* Analisis proksimat menunjukkan semua sampel mengandungi 64.13-70.27% jumlah kelembapan, 0.22-0.38% jumlah abu, 0.09-0.46% lemak mentah, 11.11-26.61% protein mentah, dan 6.53-24.22% jumlah karbohidrat. Kandungan kalori adalah 3.753-3.999 kcal/g untuk semua sampel.

Berdasarkan analisis mineral, potassium adalah mineral yang paling tinggi (0.41-1.03 mg/L) manakala kandungan magnesium (0.11-0.18 mg/L) adalah mineral yang paling rendah dalam semua sampel beras putih yang dimasak. Sementara itu, kandungan natrium dan kalsium dalam sampel beras tersebut adalah (0.41-0.70 mg/L) dan (0.19-0.54 mg/L) masing-masing. Hasil kajian menunjukkan analisis mineral mempunyai perbezaan yang signifikan ($p < 0.05$) antara semua sampel. Keputusan keseluruhan menunjukkan bahawa beras putih yang panjang mempunyai kandungan kelembapan, pengabuan, protein dan kalori yang paling rendah berbanding dengan sampel lain. Beras putih sederhana panjang mempunyai kandungan lemak dan karbohidrat yang paling rendah. Kandungan magnesium dan natrium adalah tertinggi dalam beras putih yang panjang, manakala kandungan

kalsium yang tinggi dalam beras putih pendek dan kandungan kalium paling tinggi dalam beras putih sederhana panjang.

ABSTRACT

The study was conducted to determine and compare the contents of macronutrients and minerals in three types of selected commercial cooked white rice in Malaysia. The selected white rice for this study were long, medium and short white rice. The white rice was cooked according to the proper measurement of water to rice before it was dried and analysed. The macronutrients were determined by using proximate analysis (AOAC) method, total carbohydrate was determined by Anthrone method, calorie contents was determined by Bomb-Calorimetry and mineral contents were determined using Atomic Adsorption Spectrophotometer (AAS). The proximate analysis showed all samples contained 64.13 – 70.27 % of total moisture, 0.22 – 0.38 % of total ash, 0.09 – 0.46 % of crude fat, 11.11 – 26.61 % of crude protein, and 6.53 – 24.22 % of total carbohydrates. The calorie content were 3.753 – 3.999 kcal/g in all of the samples.

Based on the mineral analysis, potassium was the most abundant mineral (0.41 - 1.03 mg/L) whereas magnesium content (0.11 - 0.18 mg/L) was the lowest mineral in all cooked white rice samples. Sodium and calcium contents in the samples were (0.41 – 0.70 mg/L) and (0.19 – 0.54 mg/L) respectively. The result shows that the mineral contents were significant different ($p < 0.05$) between all of the samples. The overall results showed that the long white rice has the lowest content of moisture, ashing, protein and calorie compare to other samples. The medium white rice has the lowest fat and carbohydrate content. Magnesium and sodium content were the highest in the long white rice, while calcium content was the highest in the short white rice and potassium content was highest in the medium white rice.

DECLARATION

I hereby declare that the thesis is my original work except for the quotations and citations which have been duly acknowledged. I also declare that it has not been previously, and is not concurrently submitted for any other degree or purposes in Universiti Sains Malaysia or at any other institutions.

Name : ARIANI BT HUSAIN

Date : 7/7/2013

I certify that Mrs Ariani Bt Husain has carried out her study entitled "Determination of Proximate and Mineral Content of Selected Commercial Rice" as a final year research project in nutrition under my supervision. She has complied with the ethical standard and regulations in conducting her study and has completed writing her thesis. I am satisfied with her work and have no objection for the thesis to be examined by the appointed examiners by the School of Health Sciences, Universiti Sains Malaysia.

Thank you.

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Name of Supervisor : Dr. Marina Bt Abdul Manaf

Date: 7/7/2013

ACKNOWLEDGEMENTS

I would like to express my thanks and deepest gratitute to my supervisor, Dr. Marina Abdul Manaf, whose gives me with a lot of guidance, support and encouragement from the initial until the final level of my final year project in University Sains Malaysia (USM). She always gives her opinions, comments and advises to solve my problems about my final year project and help me a lot in completing this project.

Special thanks go to Unit Pengurusan Makmal Sains (UPMS), School of Health Sciences, USM for their helps and supply of materials throughout my project study. I also would like to thanks the Nutrition Lab assistant such as Ms. Nor Fazdlina Hamid, Mdm. Roziyanie Hashim, Mdm. Amiera and Ms. Aziela for their guidance in using the lab equipments and give permission for me to use lab and kitchen to run my project in more smoothly way. Big thanks to En. Sahnusi that teach me a lot in doing mineral analysis by using AAS in the Analitical Lab. Next, I am too, grateful towards my lab mates, Ms. Nurulazizah Shaharuddin and Ms. Suzyelawati Shukri in responding to my request for helps and various discussions I had with them to solve the difficulty that I faced during analysis.

Last but not least, I would like to offer my best regards and blessings to my family and friends that giving me so much encouragements, supports and opinions in pursuing my studies in this field spiritually during the completion of this final year project.

Ariani Husain

June 2013

LIST OF FIGURES

LIST OF ABBREVIATIONS

Symbol	Abbreviation
AOAC	Association of Official Analytical Chemist
AI	Adequate Intake
ANOVA	Analysis of Variance
FAOSTAT	Food and Agriculture Organization of United Nations
HCL	Hydrochloric acid
RDA	Recommended Dietary Allowances
SPSS	Statistical analysis software
USA	*United States of America*
USDA	United States Department of Agriculture
Ca	Calcium
Mg	Magnesium
Na	Sodium
K	Potassium
P	Phosphorus
Fe	Iron
mg	Milligram
g	Gram
%	Percentage
ppm	*Part per million*
° C	Degree of celcius
mins	Minutes

ml	Milliliter
Kcal/g	Kilocalorie per gram
mg/L	Milligram per litre

CHAPTER 1

INTRODUCTION

1.1 Background

Rice is the staple food of over half of the world's population. In Asia, 94 percent of the world's rice is produced. It is so important and said as a symbol of life and fertility. This is why rice is sometimes thrown at the bride and groom at a wedding (Brown, 2008). According to Food and Agriculture Organization of United Nations (FAOSTAT), rice is the grain with the second-highest worldwide production whereas it is the predominant dietary energy source for human all around the world and can provides 20 % of the world's dietary energy supply (FAO, 2004). Rice is one of the example of cereal grain and it has been considered the best staple food among all cereals. Most rice is common consumed by people in the producing country and unlike wheat, only a small proportion enters the world trade (Houstan *et al.*, 1970).

Rice also is a staple food for Malaysians. Despite the introduction of other food item, rice has remained as the main source of food energy for the majority of the Malaysian population. Malaysia's domestic rice production for the last 10 years accounted for about 77% of total domestic consumption while the remaining 23% were imported from international market. This makes Malaysia the world's ninth biggest rice buyer and consumes about 2.2 million tons of rice annually. Total rice demand for the domestic market is projected to increase from 2.1 million tons in 2008 to 2.4 million tons in 2011 due to population growth (Abdullahi *et al.*, 2011)

Rice comes from in various forms depending on its type and the way it is processed. There are white, converted, instant, brown, wild, glutinous and specialty rice bran. Although there are more than 40,000 different varieties of rice worldwide, white rice is the most common consumed by the people (Brown, 2008). Compared with Asian countries, rice consumption is much lower in the United States but it is increasing rapidly. According to the US Deparment of Agriculture 2009 food supply and disappearance data, rice consumption has increased more than 3 fold since the 1930s to reach 20.5 lbs (9.3kg) per capita and more than 70 percent of rice consumed is white rice (Sun *et al.,* 2010).

Most of us prefer white rice compare to the other type of rice. White rice is the rice that has been milled and polished to remove the husk, bran, and germ. All of the fiber and most of the B vitamins and iron are eliminated by removing the bran layer and germ although some of these are replaced in enriched grains (Brown, 2008). In line with Lamberts *et al.,* (2007), white rice can be obtained by milling brown rice to remove the germ (2–3% of brown rice weight) and the bran layers (5–8% of brown rice weight) from the underlying starchy endosperm. Rice is classified according to its mode of cultivation, grain length and texture. Over 90 percent of all rice is grown with its roots submerged in water and is known as lowland, wet or irrigated rice (Brown, 2008).

Preferences for grain size and shape are different from one ethnic group to another in the world. Some ethnics group like Chinese and Japanese prefer short bold grains due to the medium and short-grain rices have less amylose content which makes them stickier when cooked. So, it is easier to handle with chopsticks and preparation of sushi by this ethnic group (Brown, 2008). Dry and long-grain rice is very difficult to eat with chopsticks. Most long-grain rices have their own

characteristics which are about four times longer than they are wide, cook to a drier and fluffier consistency. Due to these characteristics, it allows the grains to separate and that's why it is difficult to consumed with chopsticks. However, it is the most preferred staple food in the Indian subcontinent. But, in the Southeast Asia including Malaysia, most of them demand for medium to long-grain rices (Khush *et al.,* 1979).

Based on the previous study, researchers had to measure the grains size and shape. Due to their study, they come out with average length of the grains with categories such as extra long grains have length more than 7.50mm, long grains with their length 6.61 to 7.50mm, medium grains with 5.51 to 6.60mm of length and for the short grains have less than 5.50mm. For the grain shape, it is classified into slender grains shape with length/width ratio are over 3.0, medium grains shape have ratio 2.1 to 3.0, bold grains shape with ratio 1.1 to 2.0 and for the round grains shape have ratio 1.0 or less (Khush *et al.,* 1979).

Nowadays, many researchers reported the brown rice has better nutritional quality compared to the white rice. On the other hand, the white rice is highly preferred over brown rice in the United States, even though the brown rice has significantly higher levels of protein, vitamins, and minerals. The stronger, branny flavor of brown rice is usually not well accepted, compared to the fairly bland flavor of white rice. In addition, a major factor in the restricted use of brown rice is the comparatively long cooking time required, which is about twice that of white rice (Roberts *et al.,* 1980). Other than that, important socioeconomic and demographic factors that affect grain and rice consumption include income, education, sex, region, urbanization, family size and composition, and ethnicity (Batres-Marquez *et al.,* 2009).

Williams (2007) reported that there are seven essential macrominerals (major minerals) which are calcium, phosphorus, magnesium, potassium, sodium, chloride and sulfur. Minerals are classified as macrominerals if the Recommended Dietary Allowances (RDA) or Adequate Intake (AI) is greater than 100mg per day or the body contain more than 5 grams. So, based on this study, only four of the macrominerals were analysed in the three types of structured of white rices which are calcium, magnesium, sodium and potassium. The major minerals are so named because they are present and needed in large amount in the body (Whitney *et al.*, 2011). However, deficiency and excessive intake of minerals also can negatively affect health problem. For example, high intake of sodium and lower intake of potassium can cause increase in blood pressure. All minerals are essential nutrients, but all those nutrients must be consumed in moderate amount (McGuire *et al.*, 2007).

Based on this study, three types of size or structure of white rice like long, medium and short white rice were examined due to high consumption of white rice by people and most of us likely to choose medium or long white rice as our staple food daily. Thus, it is important to determine the nutritional content of different types of rice to compare their nutritional quality. At the same time, macromineral content of three types of white rice also were determined and this study just focused on four macromineral such as calcium, magnesium, sodium and potassium.

1.2 Justification of study

This research was conducted due to the rice has been a staple food in Asian countries for centuries (Sun *et al.,* 2010). Different ethnics group prefer different types (size and shape) of rice (Khush *et al.,* 1979). In a recent study carried out in China by Hsu *et al.*, (2001) found that Chinese consumers differentiate rice according to quality and other attributes such as stickiness, fragrance, gluten and protein content with widely varying prices, reflecting high income elasticity for these type of rice. In Japan, japonica' varieties, characterized by adhesive and softer texture, are the most valued. Similar patterns have been observed in Malaysia as consumers go for quality rice. This is more apparent in the rice markets for presence of different types and quality of rice. Thus, this study is important to determine the nutritional quality of different types of rice.

Other than part, high intake of white rice can contributes to many health problems' risks includes type 2 diabetes. One of the study found that higher white rice consumption was associated with a significantly elevated risk of type 2 diabetes (Hu *et al.,* 2012). This association seems to be stronger for Asians than for Western populations. A dose-response analysis showed that each serving per day of white rice consumption was associated with an 11% increase in risk of diabetes in the overall population. So, this study need to be focused because of white rice is our staple food and their nutritional quality should be identified.

1.3 Research Objectives

i. To determine the proximate compositions of long, medium and short white rice.

ii. To determine the mineral content (Ca, Mg, Na & K) in long, medium and short white rice.

1.4 Research Questions

i. Are there any proximate compositions differences between long, medium and short white rice?

ii. Are there any mineral content (Ca, Mg, Na & K) differences in long, medium and short white rice?

1.5 Research Hypothesis

Null Hypothesis, H_0

There are no differences in the proximate compositions and mineral content of long, medium and short white rice.

Alternative Hypothesis, H_A

There are differences in the proximate composition and mineral content of long, medium and short white rice.

CHAPTER 2

LITERATURE REVIEW

Rice is the seed of the monocot plant of the genus Oryza and of the grass family Poaceae which includes twenty wild species and two cultivated ones which are *Oryza sativa* for Asian rice and *Oryza glaberrima* for African rice. *Oryza sativa* is the most commonly grown species throughout the world today (Oko *et al.*, 2011). Rice also is a key food for human nutrition because it supplies starch, protein and the majority of micronutrients to humans, particularly in Asia. In recent decades, genetic improvement of rice grain quality is important for rice breeding and considerable progress has been made in quality breeding (Jiang *et al.*, 2007).

Rice is the most important grain with regard to human nutrition and caloric intake whereas it can provide more than one fifth of the calories consumed worldwide by the human species (Smith *et al.*, 1998). Based on the Atlas of Food Exchanges and Portion Sizes (2009), one scoop or weight in 50g of cooked white rice can contribute 65kcal of energy to human body and it contain 15g of carbohydrate, 1.2g of protein, and 0.1g of fat. It is also contain some mineral like calcium in 1.6mg, and 3.1mg of sodium and potassium each (Suzana *et al.*, 2009). Different weight of cooked white rice consumed gives different nutrient composition. Based on the Nutrient Composition of Malaysian Foods (1997), through edible portion of 158.8g of cooked white rice can contribute 207kcal of energy and it is contain 107.1g of water, 3.7g of protein, 0.2g of fat, 47.6g of carbohydrate, 0g of fibre, 0.3g of ash, 5mg of calcium and 10mg of sodium and potassium each (Tee *et al.*, 1997). Edible portion means food in its raw state, minus that which is discarded like bones, fat, skins, and/or seeds (Brown, 2008).

United States Deparment of Agriculture (USDA) stated that 100g of different types of white rice contributes different content of Ca, Mg, K and Na. 100g of long white rice gives 10mg of Ca, 12mg of Mg, 35mg of K and 1g of Na. While, the medium white rice contributes 3mg of Ca, 13mg of Mg, 29mg of K and 0mg of Na. For the short white rice, it's contributes 1mg of Ca, 8mg of Mg, 26mg of K and 0mg of Na.

However, high intake of white rice in our diet will be face with a lot of chronic diseases such as arteriosclerotic vascular disease, heart enlargement and heart failure, acute and chronic nephritis, diabetes mellitus associated with vascular disease, and allergics (Houstan *et al.,* 1970). White rice is associated with an increased risk for diabetes in Japanese (Nanri *et al.,* 2010) and U.S. individuals (Sun *et al.,* 2010), and ischemic stroke in the Chinese (Liang W *et al.,* 2010). Imam *et al.,* (2012) study showed that white rice has high insulin and glycemic indices and it may increase the risk of cardiovascular diseases and other metabolic disorders including type 2 diabetes.

In Asian populations in which rice is a staple food and higher white rice consumption has been associated with elevated risk of diabetes or metabolic syndrome. For example, white rice consumption was prospectively associated with developing type 2 diabetes in Chinese women living in Shanghai. In addition, in Asian Indians and Japanese, higher intake of refined grains including white rice was associated with metabolic risks in cross-sectional analyses. Through the previous study on US men and women, the researcher found that regular consumption of white rice was associated with higher risk of type 2 diabetes whereas brown rice intake was associated with lower risk (Sun *et al.,* 2010).

Besides that, through the study in Japanese adult, rice consumption was shown to be associated with increased risk of type 2 diabetes in women whereas a significant increase in risk was observed in women with rice intakes 420g of weight per day. This study showed that association between rice intake and type 2 diabetes risk in physically inactive women, nonobese women, women who worked in jobs other than primary industries and women who did not add minor cereals to rice. However, the overall association in men was not clear although there was a suggestion of increased risk type 2 diabetes with rice intake in physically inactive men and smoking men (Nanri *et al.,* 2010). The explanation through this problem is that white rice has a high glycemic index (Barakatun *et al.,* 2005) which is a measure of the effect of food intake on blood gulocose concentrations and its tend to predict type 2 diabetes risk. But all these health problem can be prevented due to the healthy life style.

Many researchers suggest in their study to limit the intake of white rice in our diet to prevent a lot of health problem related with. One of the study suggest to Koreans who eat a rice-based by recommending the use of smaller rice bowls in order to consume decrease rice that can influence total energy intake (Ahn *et al.,* 2010). On other hand, nowadays people are suggested to consume brown rice instead of white rice. In fact, Sun *et al.* (2010) reported that the risk of developing type 2 diabetes was increased in people who consume white rice, and those who replaced at least 50 g/day with brown rice had a reduced risk of developing the disease by 16%. However, one study before found that substituting brown rice with white rice for 16 weeks was not associated with a substantial improvement in metabolic risk factors among people with diabetes or at high risk for diabetes (Zhang *et al.,* 2011).

Brown rice has a nutty flavor, stronger than milled rice and is favored to some extent by people who have become nutrition-conscious. The marked flavor is said by

heavy eaters of rice to become undesirable for a steady diet. Unfortunately, brown rice also has some disadvantages such as slower absorption of liquid into the kernel because the bran in brown rice contains fiber, which leads to prolonged cooking time (Parnsakhorn *et al.,* 2008). In addition, the percentage of brown rice consumed is very small due to the high price on marketing (Houstan *et al.,* 1970).

Rice is one of the major cereal grains and many consumers are unaware of the health benefits of whole grains or of the recommendations regarding increased intake. Also, there is much confusion about which products are truly whole grain. The bran portion of a whole grain may be highly coloured and contain stringent, intensely flavoured compounds that are not always appealing in taste. Other barriers to whole-grain consumption include price, softness, texture, and moisture content.

The component in the whole grains showed that the bran and germ fractions derived from conventional milling provide a majority of the biologically active compounds found in a grain. Specific nutrients include high concentrations of B vitamins (thiamin, niacin, riboflavin, and pantothenic acid) and minerals (Ca, Mg, K, P, Na, and Fe), elevated levels of basic amino acids (for example, arginine and lysine), and elevated tocol levels in the lipids. Numerous phytochemicals, some common in many plant foods (phytates and phenolic compounds) and some unique to grain products (avenanthramides, avenalumic acid), are responsible for the high antioxidant activity of wholegrain foods (Slavin *et al.,* 2004).

Whole grains contain nutrients and other food components that are generally present in higher concentrations in the outer part of the grain and are lost in the refining process. Thus, whole grains may impact health differently than do refined grains. Whole grains are of particular interest with regard to endometrial cancer

because of its hormonal etiology. Otherwise, one of the study found no significant association between whole grain intake and incident endometrial cancer overall (Kasum *et al.*, 2001).

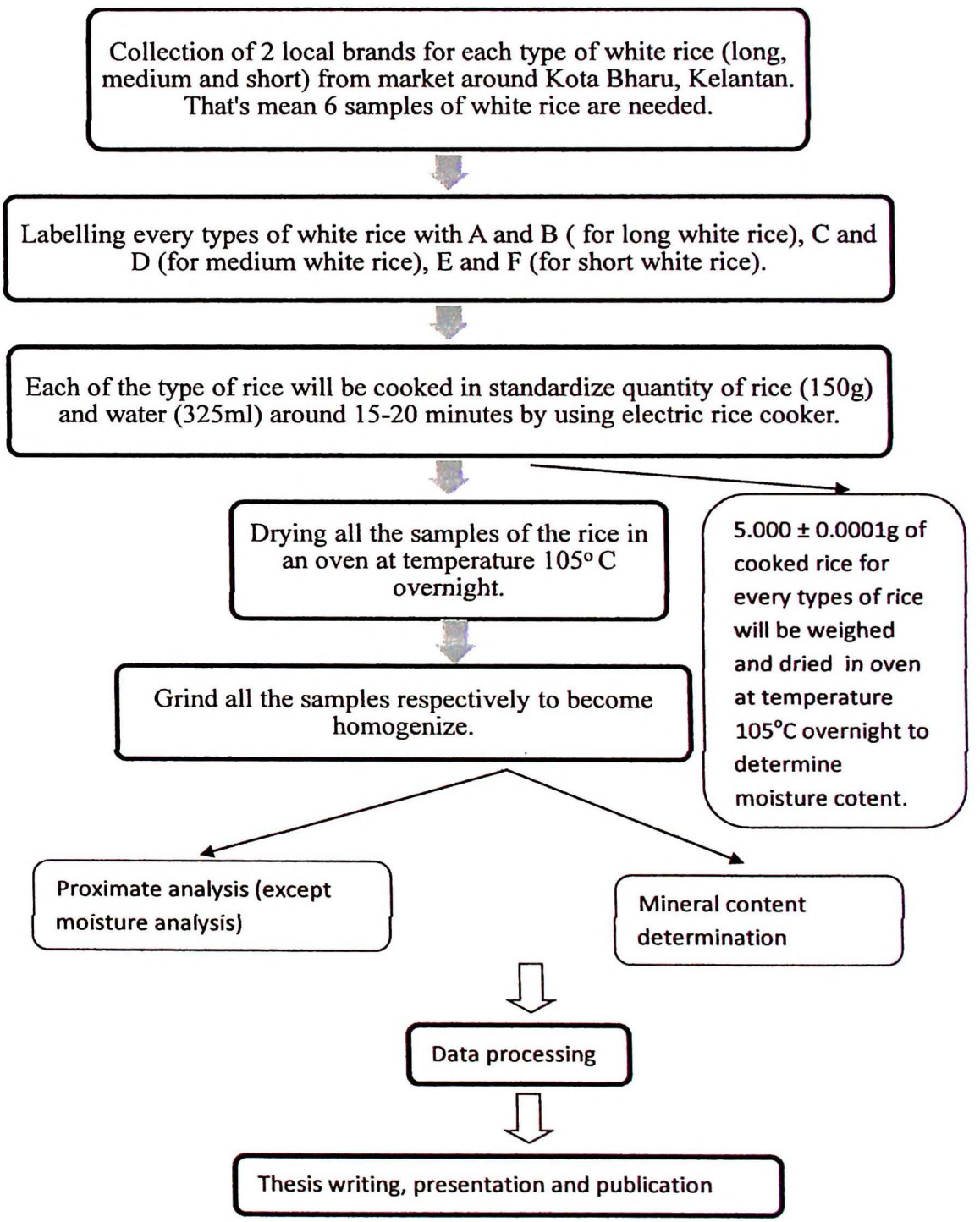
The whole grains that contain the major cereal grains like rice, wheat and corn, and the minor cereal grains like oats, rye, and barley have beneficial effect to our health. The whole grains are rich in many nutritious components, have been linked to reduced risk for coronary artery disease, cancer, diabetes, obesity, and other chronic diseases. Most of these components are found in the germ and bran, which are reduced in the grain-refining process (Slavin *et al.*, 1999). Matthias *et al.*, (2007) reported that high intake of magnesium content from nutritious food has beneficial effect which was can decreased of diabetes risk independent of age, sex and lifestyle risk factor (Schulze *et al.*, 2007).

Furthermore, the relationships between the mineral element contents and quality traits of rice might reflect the physiological function of the mineral elements. For example, K is essential for photosynthesis and has a role in carbohydrate metabolism. It also facilitates cell division and growth by helping to move starches and sugars between plant organs. Mg is a constituent of chlorophyll, which is the driving force of photosynthesis. Mg also is essential for carbohydrate metabolism and serves as a carrier of phosphate compounds during plant growth. On the other hand, Ca aids in carbohydrate transport and nitrogen uptake (Jiang *et al.*, 2007).

CHAPTER 3

MATERIAL AND METHODS

3.1 Experimental Flow Chart



3.2 Study design

This study is based on comparison between different types of white rice such as long, medium and short rice. Each of the type of structure of rice was conducted with two local brands. It is means that six samples of white rice were conducted in this study. This experimental design was compared the nutritional composition and mineral content respectively in the three types of structure of the white rice that were cooked according to standardize the water and quantity of the rice.

3.3 Preparation of Sample (Cooked Rice) and Development of Cooked Rice

Two local brands for long rice (brand A and B), two local brands for medium rice (brand C and D) and two local brands for short rice (brand E and F) used in this study were purchased from the mini market around Kota Bharu, Kelantan, Malaysia. Rice samples were washed and rinsed for 3 to 4 times. For cooking purpose, 325ml of water was used to cook 150g of rice. The rice was cooked in an electric rice cooker for 15 to 20 minutes. The cooked rice was left to cool and then dried in an oven at temperature of 105°C overnight for the next step of proximate analysis.

3.4 Proximate Composition Analysis of Cooked Rice

Proximate composition were conducted using AOAC (1996) for moisture (Air-oven method), total ash, crude protein by nitrogen conversion factor of 5.95 (Kjeldahl method) and crude fat content using the semi-continuous extraction (Soxhlet method). The analysis of caloric value was conducted by using Bomb-Calorimetry method (Caloric System, 2000). All measurements were carried out in triplicate (n = 3). Total carbohydrates were calculated by the difference: total carbohydrates = 100 – (% moisture + % protein + % fat + % ash).

3.4.1 Determination of Moisture

Air-Oven method was used to determine moisture content in different types of structure of white rice. In this method, also called the direct heating or drying method (AOAC, 1996) whereas a well ground sample was dried in an oven which is usually at 105°C - 110°C until constant weight. Then, the difference between initial weight and constant weight after drying was taken to be due to moisture lost and hence moisture content of the food sample.

Procedure:

i. An aluminium dish was dried for 3 hours with cover in an oven at 105°C. Then, the dish was cooled in a dessicator and was weighed soon after it has attained room temperature (W_1).
ii. The homogenized samples were weighed 5.000 ± 0.001g into the aluminium dish separately (W_2).
iii. The dish with sample was placed uncovered in a 105° C oven overnight.
iv. The dish from the oven was removed and cooled in desiccators. After that, it was weighed soon after attaining room temperature (W_3).

Calculation:

$$\text{Moisture, per cent by weight} = \frac{\text{Loss of weight in g of the sample}}{\text{Weight in g of the sample taken}} \times 100$$

$$(W_2 - W_3)$$

$$= \ldots\ldots\ldots\ldots \times 100$$

$$(W_2 - W_1)$$

3.4.2 Determination of Total Ash

Procedure:

i. A shallow crucible was dried in an oven at 105°c for 3 hours.

ii. It was cooled in a desiccator and weighed after attained room temperature (W1).

iii. 0.500±0.001g homogenize sample was weighed into the crucible (W2).

iv. Then, the dried sample was charred on hot plate until creased smoking.

v. After that, the crucible was placed in cold muffle furnace and temperature was brought to 550°C.

vi. The sample was ashed until whitish or grayish ash attained.

vii. The crucible was removed from the cold muffle furnace and cooled in desiccator and weighed after attaining room temperature (W3).

viii. Total ash content was calculated.

Calculation:

$$\text{Ash per cent by weight} = \frac{\text{Weight of ash (g)}}{\text{Weight of sample (g)}} \times 100$$

$$= \frac{(W3 - W1)}{(W2 - W1)} \times 100$$

3.4.3 Determination of Crude Fat

Procedure:

i. The sample ground made certain it was homogenized.

ii. The sample was weighed, 3.000 ± 0.0001g in a dry thimble.

iii. The thimble was introduced into the extraction equipment.

iv. The extract collecting vessel (W_1) was weighed, beforehand it was dried to constant weight and introduced it into the extraction equipment.

v. 80ml of petroleum ether was added to the extraction unit.

vi. The extraction unit was closed and the cooling water was started to flow and heating. When the solvent starts boiling immerse the thimble by placing the slider into 'immersion' position.

vii. After 30 minutes, the thimble was extracted from solvent placing the slider into 'washing' position.

viii. After 25 minutes of reflux washing close the stopcock located under the water cooled condenser and was evaporated completely the solvent from the extraction vessel.

ix. The extract collecting vessel was dried in an oven during 30 minutes at a temperature high enough to evaporate completely the solvent residues.

x. The extract collecting vessel was cooled in a dessicator and was weighed it (W_2).

Calculation:

$$\% \text{ fat in sample} = \frac{\text{Weight of fat (g)}}{\text{Weight of sample (g)}} \times 100$$

$$= \frac{(W2 - W1)}{\text{Weight of sample (g)}} \times 100$$

3.4.4 Determination of Protein

Digestion

i. First, the sample was digested in strong sulphuric acid in the presence of a catalyst, which helps in the conversion of the amine nitrogen to ammonium ions. The catalyst that usually used is copper sulphate, mercury or selenium.

Distillation

ii. Then, the ammonium ions were converted into ammonia gas, heated and distilled. The ammonia gas was led into a trapping solution where it dissolves and becomes an ammonium ion once again.

Titration

iii. Finally the amount of the ammonia that has been trapped was determined by titration with a standard solution, and a calculation was made.

Procedure:

1. Digestion

i. The homogenized sample was weighed 1.000 ± 0.001 g into digestion flask.

ii. 2 tablets of catalyst were added and followed by 20 ml sulphuric acid.

iii. The mixture was heated about 60 mins at 400°c on an electric coil heating rack in a fume cupboard.

iv. After the liquid has become clear and colourless, the digestion unit was stopped.

v. It was cold when it attained room temperature.

2. Distillation

vi. The digestion flask was transferred into distillation unit together with receiver flask (consists of few drop of indicator).

vii. It was passed steam through the distillation unit and was ceased after 3-4 mins.

3. Titration

viii. The contents of the receivers flask was titrated with 0.1N HCL (back to the original purplish colour).

Calculation:

$$\text{Protein, per cent} = \frac{(\text{ml HCL- ml HCL blank}) \times 14.008 \times 0.1\text{N HCL} \times \text{protein}}{\text{Weight in mg of the sample}} \times 100$$

3.4.5 Determination of Calorific Value

Procedure:

A. Preparing the measurement

I. The homogenized sample was pelleted by using pelleting press (weighed 1.000± 0.001 g of the tablet into crucible).

II. Preparing the decomposition vessel.

a) The union nut was unscrewed (used handle to pull the cover).

b) A cotton thread was fasten onto the middle of the ignition wire.

c) The crucible was placed onto crucible holder.

d) The cover was then placed onto the lower section and was pushed down until it presses against the stop piece in the lower section.

e) The union nut was placed and tighten by hand.

B. Performing the measurement

I. The decomposition vessel was guided into the fillet head until it catches in place.

II. Then, START button was pushed.

III. The measuring cell cover was opened when measurement is complete (removed the decomposition vessel).

IV. The pressure was released with venting button.

V. The decomposition vessel was opened and checked the crucible for sign of incomplete combustion.

3.5 Mineral Analysis of Cooked Rice

Reagents

a) Deionized water. Use for preparing standard and solutions.

b) Calcium standard solutions.

   i. Stock solution – 1000 ppm (calcium nitrate standard solution for atomic absorption spectrophotometry).

   ii. Working standard – 5 ppm.

c) Magnesium standard solutions.

   i. Stock solution – 1000 ppm (magnesium standard solution for atomic absorption spectrophotometry).

   ii. Working standard – 0.5 ppm.

d) Potassium standard solutions.

   i. Stock solution – 1000 ppm (potassium standard solution for atomic absorption spectrophotometry).

   ii. Working standard – 2 ppm.

e) Sodium standard solutions.

   i. Stock solution – 1000 ppm (sodium standard solution for atomic absorption spectrophotometry).

   ii. Working standard – 1 ppm.

Procedure :

A. Digestion sample

i. The ash was dissolved in 2 ml concentrated nitric acid 65%.

ii. It was diluted with 25 ml deionized water and was heated until boiling temperature.

iii. The solution was filtered and make up to 100 ml in a volumetric flask.

B. Determination

i. The instrument was set up and prepared and computer software was used as given in the operating manual.

ii. Calibration curve was prepared for each of the minerals to be determined by using the standard solution prepared.

iii. 3 reading were obtained for each sample solution prepared.

iv. The burner was flushed with water between samples.

Calculation:

Solid samples: Element (µg/g) = (C) (V) (d.f)

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3.6 Data Analysis

All of data obtained were analysed according to ANOVA procedure by using SPSS 18.0 (USA). Results were expressed as mean ± standard deviation. All measurements were carried out in triplicate (n = 3). Significant level established at $P \leq 0.05$.

CHAPTER 4

RESULTS AND DISCUSSION

4.1 Proximate and Mineral Analysis

The study shows the analysis and results according to ANOVA procedure by using SPSS 18.0 (USA). This study identified the comparison of nutritional quality between three types of white rice includes long, medium and short white rice, whereas each of them consists of two local brands that selected randomly from market around Kota Bharu, Kelantan. Thus, this study used six samples of white rice. For the long white rice, it was consists of rice brands A and B, the medium white rice was rice brands C and D, and for the short white rice was consists of rice brands E and F. Proximate analysis shown the results in percentage value except for calorie analysis that showed in the kcal/g value. While, for the mineral analysis, it was showed the results in the mg/L value.

4.1.1 Proximate Analysis

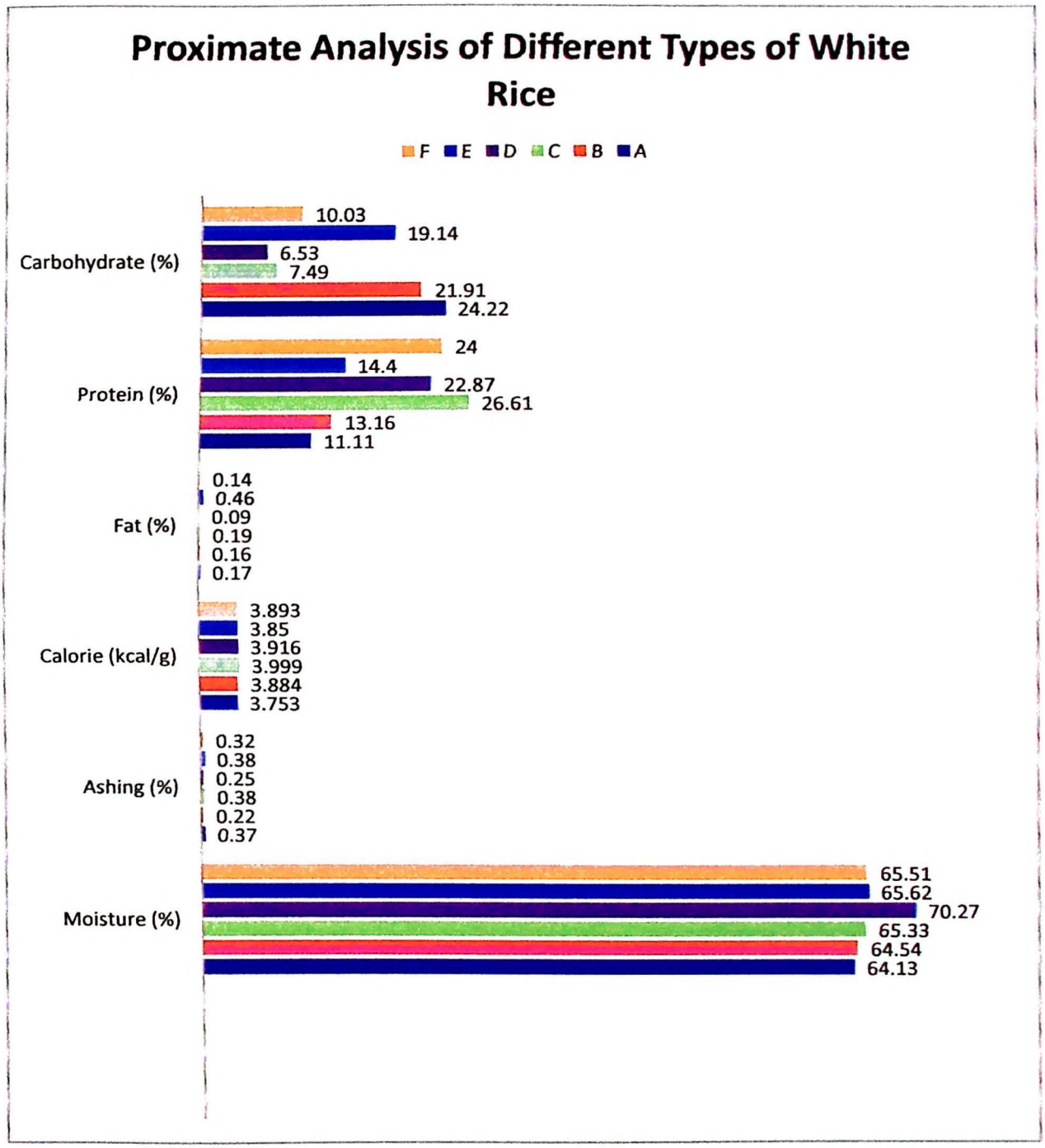

Figure 1: Overall results for proximate analysis of long, medium and short white rice.