PROXIMATE ANALYSIS OF LIPID, PROTEIN, TOTAL DIETARY FIBRE AND TOTAL CARBOHYDRATES IN CARROT (*Daucus carota*)

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DECLARATION

I hereby declare that this dissertation is based on my original work, except for quotations and summaries each of which have been fully acknowledged.

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ABSTRACT

The moisture, ash, lipid, protein, total dietary fibre and total carbohydrates content of three varieties of carrot which is 'Australia Sumich', Kundasang variety and China variety were studied. Moisture content, ash, lipid, protein, total dietary fibre and total carbohydrates content were determined by the method based on AOAC Method 952.10, AOAC: Method 900.02 A, AOAC method 934.01, AOAC Method 991.43, AOAC Method 960.52, James (1995) and Nielsen (1998). Based on the result, 'Australia Sumich' carrot contained moisture content of 90.97 g ± 0.04, ash content of 0.09 g ± 0.01, lipid content of 0.34 g ± 0.07, protein content of 1.08 g ± 0.06, total dietary fibre of 2.06 g ± 0.06 and total carbohydrates of 7.52 g ± 0.09 in 100 g of carrot Meanwhile, China carrot contained moisture content of 90.28 g ± 0.06, ash of 0.08 g ± 0.01, lipid content of 0.28 g ± 0.07, protein content of 0.93 ± 0.06, total dietary fibre of 2.74 g ± 0.06 and total carbohydrates of 8.43 g ± 0.10 in 100 g of carrot in 100 g of carrot. Kundasang carrot has moisture content of 89.82 g ± 0.10, ash of 0.07 g ± 0.01, lipid content of 0.21 g ± 0.08, protein content of 1.23 g ± 0.07, total dietary fibre of 3.52 g ± 0.04 and total carbohydrates of 8.67 g ± 0.10 in 100 g of carrot. As for conclusion, 'Australia Sumich' carrot contained the highest moisture, ash and lipid content meanwhile Kundasang variety carrot contained the highest protein content, total dietary fibre and total carbohydrate in 100 g of carrot.

ANALISIS PROKSIMAT KANDUNGAN LIPID, PROTEIN, JUMLAH PELAWAS DAN KARBOHIDRAT DALAM LOBAK MERAH (Daucus Corota)

ABSTRAK

Kajian analisis penentuan kandungan air, abu, lemak, protein, jumlah pelawas dan karbohidrat bagi tiga varieti lobak merah iaitu lobak 'Australia Sumich', lobak Kundasang dan lobak China telah dijalankan. Kandungan air, abu, lemak, protein, jumlah pelawas dan karbohidrat masing-masing telah ditentukan berdasarkan kaedah AOAC Method 952.10, AOAC: Method 900.02 A, AOAC method 934.01, AOAC Method 991.43, AOAC Method 960.52, James (1995) dan Nielsen (1998). Hasil kajian menunjukkan bahawa lobak 'Australia Sumich' mengandungi purata kandungan air sebanyak 90.97 g ± 0.04, kandungan abu sebanyak 0.09 g ± 0.01, kandungan lemak sebanyak 0.34 g ± 0.07, kandungan protein sebanyak 1.08 g ± 0.06, kandungan jumlah pelawas 2.06 g ± 0.06 and jumlah karbohidrat 7.52 g ± 0.09 dalam 100 g sampel. Bagi lobak China, purata kandungan air adalah sebanyak 90.28 g ± 0.06, kandungan abu sebanyak 0.08 g ± 0.01, kandungan lemak sebanyak 0.28 g ± 0.08, kandungan protein sebanyak 0.93 g ± 0.05, kandungan jumlah pelawas 2.74 g ± 0.06 and jumlah karbohidrat 8.43 g ± 0.10 dalam 100 g sampel. Selain itu, lobak Kundasang mengandungi purata kandungan air sebanyak 89.82 g ± 0.10, kandungan abu sebanyak 0.07 g ± 0.01, kandungan lemak sebanyak 0.21 g ± 0.08, kandungan protein sebanyak 1.23 g ± 0.07, kandungan jumlah pelawas 3.52 g ± 0.04 and jumlah karbohidrat 8.67 g ± 0.10 dalam 100 g sampel. Secara kesimpulannya, lobak 'Australia Sumich' mempunyai purata kandungan air, abu dan lemak paling tinggi dalam 100 g sampel manakala lobak Kundasang mempunyai purata kandungan protein, jumlah pelawas dan jumlah karbohidrat yang tertinggi dalam 100 g sampel.

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LIST OF SYMBOLS & ABBREVIATIONS

v/v	volume of solution per volume of water
ppm	parts per million
MES	morpholinoethane sulphonic acid
TRIS	*tris*-hydroxymethyl aminomethane
AOAC	association of analytical chemist
USDA	united states department of agriculture
α	alpha
°C	degree celsius
%	percentage
μ	mean value
N	total replicate
Co	dry matter coefficient, % solid

CHAPTER 1

INTRODUCTION

1.1 FOOD ANALYSIS

Food analysis involves the estimation of the main components of a food using procedures that allow a reasonably rapid and acceptable measurement of various food fractions without the need for chemical or sophisticated equipment (James, 1995). The development of foods analysis techniques are used to standardize and suitable for rapid control in factory. Furthermore, food analysis techniques are also made to replace the subjective methods of assessing some organoleptic qualities by more precise objective procedures (Pearson, 1976).

However, several problems in food analysis arise when the material or ingredients for the manufacture of food are biological origin vary both in composition and properties such as different properties due to country of origin. Furthermore, problem also occurs when deciding on a suitable mean figure for the selected components of the raw food (Pearson, 1976). Apart from this, proximate analysis still forms the basis feed analysis and analysis of foods for legislative purposes in many countries (Greenfield & Southgate, 2003). In the methods of proximate analysis, most foods are examined for at least four of the following components: moisture, fat,

protein, ash, carbohydrates and dietary fiber (Pearson, 1976). The most extensive development of rapid methods for vegetable has been those which provide the proximate (fat, water, protein) composition. Rapids methods used have the most obvious advantages. For example, time and labour savings achieved by using rapid methods can be used to increase the number of measurement collected, thereby gaining better control over more steps in a process (Tunick *et al.*, 1998). With the proximate analysis, there are instances where accuracy is more likely to be achieved due to a compensation of errors (Pearson, 1976).

1.2 CARROTS AND ITS NUTRIENTS

Carrot is under the family of Umbelliferae and it is known scientifically as *Daucus corota* (Williams *et al.*, 1991; Ong, 2003). Common name for carrot in Malay is Lobak Merah (Buku Panduan Tanaman, 1989). In Malaysia, 'Australia Sumich', China variety and Kundasang variety carrots are the most popular and easily found variety carrots in local market. Carrots are excellent sources of macronutrient in our daily diet where it contain high amount of carbohydrates and protein that is important in providing energy source for most of the body functions and mechanisms (Grosvenor & Smolin, 2002). Besides, it also contains a high amount of dietary fibre that plays a beneficial role in the prevention of constipation and diarrhea (Chau *et al.*, 2005). On the other hand, lipid content in carrots act as solvent for the fat soluble vitamin such as vitamin A, D, E and K (Timberlake, 2003; Prosky, 2000).

Carrots are rich in micronutrients such as vitamin A that helps improve eye sight and immune system in human body (Chia, 2006). In addition, carrots also

contain vitamin E that plays a vital role as antioxidant in protecting the skin and liver tissue. Vitamin C content is carrots can helps activates many enzymes in body to prevent from different kinds of diseases such as skin cancer (Cataldo *et al.*, 1999). Besides vitamin, carrots also contains many types of minerals such sodium, potassium, calcium, magnesium and phosphorus (Williams, 1999). Calcium helps increase the strength of bone and teeth in human body while magnesium involves in regulating calcium homeostasis and blood clotting. On the other hand, sodium helps generates the smoothness flow of body fluids while potassium is critical in keeping the heartbeat steady. Meanwhile, phosphorus helps to maintain acid-base balance in the blood and assists in energy metabolism (Dunne, 2002; Grosvenor & Smolin, 2002).

1.3 OBJECTIVE

Objectives of this research are:

i. to determine the total dietary fibers, protein, ash, moisture and lipid content in 'Australia Sumich' carrots, China variety carrots, and Kundasang variety carrots

ii. to determine the total carbohydrate in carrot, by calculation

1.4 SCOPE

In the proximate analysis of carrot for protein, total dietary fiber, ash, lipid content, moisture and total carbohydrate, three different varieties of carrots were used based on their country origin. Carrots from Australia, China and Malaysia (Sabah) were used in this study. Proximate analysis of protein, moisture, ash, lipid and total dietary

in carrots has been carried out. To determine protein content, AOAC Method 955.04 which is Kjeldahl method was used. AOAC Method 900.02A is used to obtain the ash content in carrot which the muffle furnace was used in ash determination. According to AOAC method 920.39, lipid content was determined by Soxhlet Extraction Method. On the other hand, AOAC Method 991.43 is used to determine the total dietary fiber. Determination of moisture content in the carrot sample was carried out using AOAC Method 952.10 - the oven drying method. As for the amount of total carbohydrate in the carrot sample, the calculation is performed by using a formula in which the amount of protein, ash, water and lipid that obtained from the proximate analysis were added together and is subtracted with 100 g of fresh carrot sample to obtain the amount of total carbohydrate in the carrots sample (James, 1995).

CHAPTER 2

LITERATURE REVIEW

2.1 CARROT

Carrot was originated some 5000 years ago in Middle Asia around Afghanistan, and later was slowly spread to the Mediterranean area (Saadiah, 1998). The yellow carrot and purple carrot are believed to be originated from Afghanistan. Red carrots are widely preferred if compare to yellow and purple carrot because it taste better and has a higher nutrition value (Ong, 2003).

There are two types of carrots, which are the cultivated carrots and the wild carrots (Raj, 1995). Besides that, carrot can also be divided according to regions; eastern carrot and western carrot. Eastern carrots are often called anthocyanin carrots because of their purple roots. Eastern carrots were domesticated in Central Asia, probably in modern-day Afghanistan in the 10th century or possibly earlier. Western carrots have orange, red or white roots. The Western carrot emerged in the Netherlands in the 15th or 16th century (Gross, 1991).

Carrots are roots of flowering plant which normally grown at higher latitudes in the tropics or at higher elevations above 500 m (Cochrane, 1990; Saadiah, 1998).

Carrots plantation requires a range of temperature from 15°C-25°C, rainfall of 150 to 200 mm per month and the pH range of the soil is at 6.0-6.6. Nowadays, there are some carrots that can be produced in a lowland tropic (Togˇrul, 2005). It is also believed that a small decrease in the night temperature greatly improves the crop. A sandy well-drained loam is required for carrots, particularly in the lowlands (Saadiah, 1998). Turkey is an important carrot producer in the world with a production of 240000 tons metric in 2003. Turkey produces nearly 1.02% of world's carrot production (Togˇrul, 2005). Table 2.1 shows the scientific classification of carrot and its binomial name.

Table 2.1 Scientific classification of carrot

Kingdom	Plantae
Division	Magnoliophyta
Class	Magnoliopsida
Order	Apiales
Family	Apiaceae
Genus	*Daucus*
Species	*D. carota*
Binomial name of Carrot	*Daucus carota*

(Source: Williams *et al.*, 1991)

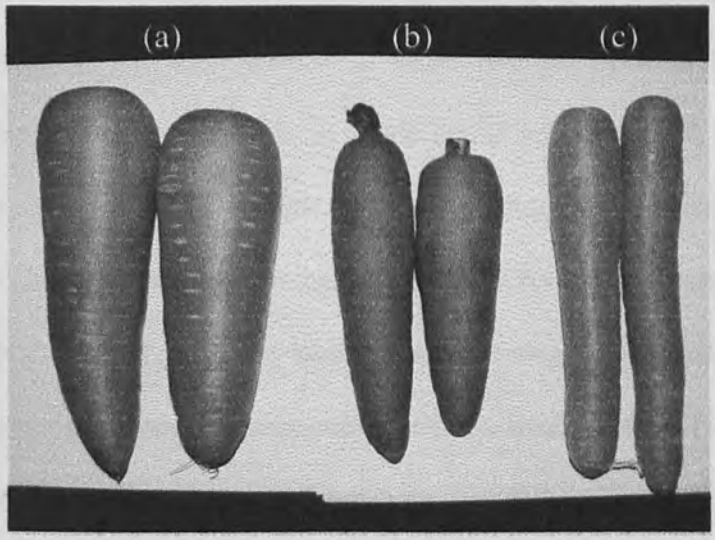


Photo 2.1 Sample of harvested carrots (*Daucus corota*).
(a) China variety carrot (b) Kundasang variety carrot (c) Australia Sumich carrot

2.2 NUTRIENTS

Vegetables contain a mixture of chemicals, some of which are essential for normal body function. These essential chemicals are called nutrients. A nutrient is a chemical whose absence from the diet for a long enough time results in a specific change in health (Cataldo *et al.*, 1999). There are six classes of nutrients in food: carbohydrates, lipids (fats and oils), proteins, vitamins, minerals and water. These six classes of nutrients serve three general functions which will provide energy, regulate body process and contribute to body structures (Insel *et al.*, 2004). Carbohydrate, protein and fat are called macronutrients due to the large quantities needs in human body. Meanwhile vitamins and minerals are micronutrients because the amounts needed in body are comparatively small (Insel *et al.*, 2004; Fennema, 1993).

2.2.1 Carbohydrates

The term carbohydrate refers to a range of compounds whose molecular formula approximate to $C_xH_yO_z$ where the ratio of x, y, and z is 1:2:1. (Arene & Kitwood, 1979). Carbohydrates are very soluble in water but are less soluble in alcohols (Southgate, 1991). The carbohydrate in foods could be considered into two broad categories. The available carbohydrates are those digested and absorbed by man and glucogenic to human body (Southgate, 1991). Available carbohydrates are characterized as those carbohydrates which produce energy in the human body. They include the monosaccharides (glucose and fructose), disaccharides (sucrose, lactose, and maltose) and reserve polysaccharides (starch and dextrins) (James, 1995). The unavailable carbohydrates often described as dietary fiber or non-starch

polysaccharides that are resistant to the endogenous enzymes of the human upper digestive system (Southgate, 1991; Pang *et al.*, 2006). Dietary fibre is a type of unavailable carbohydrates that contain cellulose, hemicellulose, pectic substances and lignin. Dietary fibre is a type of food components that resistant to digestion in the small intestine (James, 1995; Insel *et al.,* 2004). Furthermore dietary fibre is also beneficial to intestinal function as it help to increase facial bulk and to enhance intestinal peristalsis (Srikiatden & Roberts, 2005; Pang *et al.*, 2006).

Carbohydrates are a major source of fuel for the body and muscular exertion (Insel *et al.,* 2004; Dunne, 2002). They are human daily basic food and constitute large portion of total nutrient intake. Besides, non-digestible carbohydrates which are important in a balanced daily nutrition such as the dietary fibre acts as ballast material by maintaining normal gastrointestinal function and healthy cardiovascular system and lowering the postprandial serum glucose levels (Belitz & Grosch, 1999; Srikiatden & Roberts, 2005). Carbohydrates are the products of photosynthesis in green plants. They may serve as structural components as in the case of cellulose or they may be stored as reserved energy as in the case of plants starch (Dauthy, 1995; Potter & Hotchkiss, 1998).

The human body, especially the brain, needs a constant supply of glucose. Glucose levels that drop too low can result in weakness and fatigue. On the other hand, diabetic patients are advised to take more dietary fibre foods in their diet that can delayed the rise in blood sugar. Furthermore, minimizing sugar in the diet and eating small frequent meals focusing on whole grains, fresh fruits and vegetables can aid in stabilizing blood sugar level (Dunne, 2002; Chau *et al.*, 2005).

a. Monosaccharide

The most common monosaccharides in human diet are glucose, fructose and galactose. All these three monosaccharides have 6 carbons and all have the same chemical formula, $C_6H_{12}O_6$ but each has a different arrangement of atoms (Insel *et al.,* 2004). Glucose has the most abundant simple carbohydrates unit in nature. Glucose (also called dextrose) is found in varying amounts in honey, maple syrup, fruits, berries, and vegetables. Glucose ia an invert sugar in human body formed from the hydrolysis of sucrose such as in honey, maple sugar to supply energy to the cells (Insel *et al.,* 2004). Fructose is an example of a keto-sugar. Fructose is the primary source of the sweet taste. To compare the sweetness between fructose and sucrose, fructose is 140% sweeter than sucrose (Arene & Kitwood, 1979). Glucose and fructose are the main carbohydrates contain in vegetables or fruits (Fennema, 1993). Besides that, galactose which is a type of milk sugar can form lactose when combine with glucose. Lactose is an important enzyme that helps to break the disaccharides links into a monosaccharide for further metabolism in human body (Dunne, 2002).

b. Disaccharides

Disaccharides are formed by the union or reaction of two monosaccharide molecules with a loss of water molecules (Insel *et al.,* 2004). There are some important disaccharides in food chemistry such maltose, lactose and sucrose (Belitz & Grosch, 1999). Monosaccharides and disaccharides are grouped together as reducing sugars (Arene & Kitwood, 1979). Maltose is composed of two glucose molecules. Maltose seldom occurs naturally in food, but forms only when long molecules of starch break

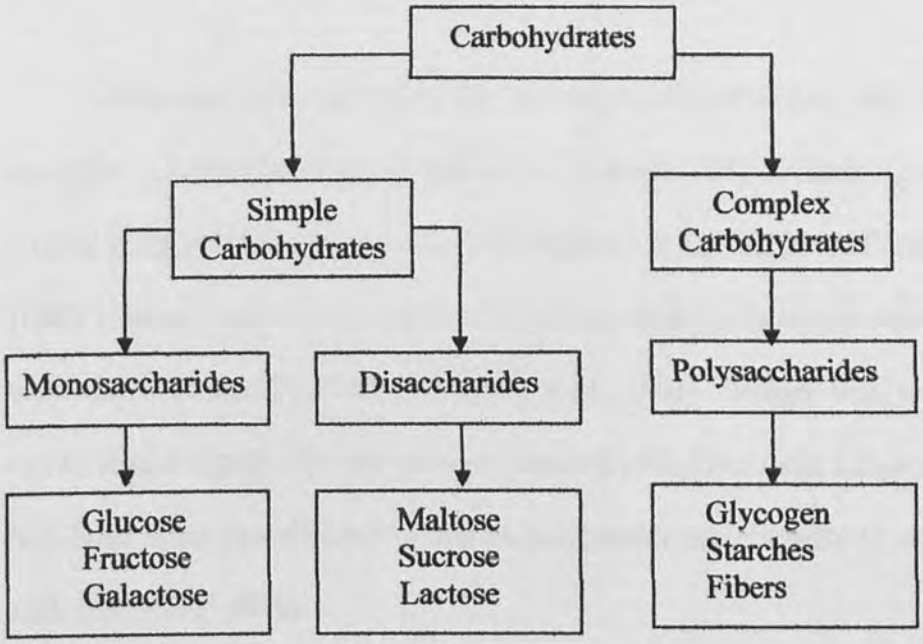
down. Maltose is mostly fermented in the production of beer (Insel *et al.*,2004). Besides that, lactose is a white crystalline solid type of disaccharides that mostly occurs in the milk of animals and is the combination of galactose and glucose unit. Lactose serves as an energy source for infants during the nursing period (Southgate, 1991). Sucrose is composed of a glucose molecule and a fructose molecule. Sucrose is found in all photosynthetic plants and is obtained commercially from sugarcane (Solomons & Fryhle, 2004). Sucrose can provide a number of desirable functional qualities to food products including sweetness, mouth-feel, and the ability to transform between amorphous and crystalline states (Williams, 1999; Dunne, 2002).

c. Polysaccharides

Polysaccharides are built up from a large number of connected monosaccharide units which may be alike or different (Insel *et al.,* 2004). Polysaccharides are generally insoluble in water and tasteless (Fox & Cameron, 1977). Homopolysaccharides possess only one repeating units while heteropolysaccharides contain more than one (Solomons & Fryhle, 2004).

For instant, dietary fibre is a very important type of polysaccharides that contains a mixture of many complex organic substances such as lignin, cellulose, pectins substances and hemicellulose (Inglett, 1979; Prosky, 2000). In general, dietary fibre produces various effects on food mix consumed and its fate in the body. Most of these effects are caused by its physiologic properties such as water absorption capacity, binding effect and colon bacteria effects (Al-Hasani *et al.*, 2005). Increase intake of dietary fibre by consuming more whole grain products, fruits and vegetables can help

reduce diabetes mellitus, obesity, coronary heart disease and other health problem (Goldberg, 1994; Chau *et al.*, 2005).



(Source: Southgate, 1991)

Figure 2.1 Different types of carbohydrates in food.

2.2.2 Protein

The term protein was coined by the Dutch chemist Gerardus Mulder in 1838 and comes from the Greek root word *protos* which means "to be first" (Meyer, 1986; Insel *et al.* ,2004). Protein consists of a group of complex compounds which combine the amino acids in peptide linkages that contain carbon, hydrogen, oxygen, nitrogen, and usually sulphur (Goldberg, 1994; Solomons & Fryhle, 2004). Furthermore, protein are polymers of amino acids, the majority are α-amino acids having the general formula R-CH(NH_2)-COOH and may thus be distinguished from fats and carbohydrates in being the only macronutrient in food to contain nitrogen. The presence of nitrogen in

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