DETERMINATION OF NUTRITIONAL COMPOSITION OF LOCAL MANGOES OF SABAH

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PENENTUAN KANDUNGAN NUTRIEN MANGGA TEMPATAN SABAH

ABSTRAK

Kajian telah dijalankan ke atas dua jenis mangga tempatan di Sabah iaitu Mangga Air (*Mangifera aquaea sp. nov.* Kost.) dan mangga Wani (*Mangifera odorata* Griff.). Komposisi nutrien untuk buah-buah tersebut telah dianalisis pada dua tahap kematangan yang berlainan. Tujuan kajian ini adalah untuk menentukan komposisi Mangga Air dan Mangga Wani dari segi protein, karbohidrat, abu, serabut kasar, lemak kasar, kandungan air, vitamin C dan beberapa jenis mineral semasa masak dan kurang masak. Ujian t menunjukkan kebanyakan komposisi nutrien mempunyai nilai bererti yang signifikan antara dua tahap kemasakan. Kaedah Soxhlet digunakan untuk penentuan kandungan lemak kasar, kaedah Kjeldahl digunakan untuk penentuan kandungan protein, kandungan abu ditentukan melalui kaedah pengabuan kering, vitamin C ditentukan dengan menggunakan kaedah titratan 2,6-diklorofenol indofenol. Serapan Atomik Spektrofotometer digunakan untuk penentuan kandungan mineral seperti kalium, natrium, magnesium, kalsium, kuprum, besi dan zink. Keputusan menunjukkan bahawa Mangga Air yang masak mengandungi 82.6% kandungan air, 0.33% protein, 0.74% serabut kasar, 1.03% lemak kasar, 14.96% karbohidrat, 0.35% abu, 3.51mg/100g vitamin C, 114.24mg/100g kalium, 0.78mg/100g natrium, 8.1mg/100g kalsium, 0.49mg/100g magnesium, 0.11mg/100g zink dan 0.18mg/100g besi dan 0.57mg/100g of kuprum manakala bagi buah kurang masak terdiri daripada 84.08% kandungan air, 0.51% protein, 1.26% serabut kasar, 0.47% lemak kasar, 13.22% karbohidrat, 0.46% abu, 17.36mg/100g vitamin C, 67.69mg/100g kalium, 1.80mg/100g natrium, 12.03mg/100g kalsium, 0.59mg/100g magnesium, 0.11mg/100g zink dan 0.23mg/100g besi dan 0.07mg/g kuprum. Berbanding dengan Mangga Air, Mangga Wani yang masak terdiri daripada 77.79% kandungan air, 1.32% protein, 0.85% serabut kasar, 1.75% lemak kasar, 17.71% karbohidrat, 0.58% abu, 4.11mg/100g vitamin C, 195.19mg/100g kalium, 0.83mg/100g natrium, 6.65mg/100g kalsium, 0.03mg/100g magnesium, 0.22mg/100g zink and 0.27mg/100g besi dan 0.13mg/100g kuprum. Mangga Wani kurang masak mengandungi 80.16% kandungan air, 1.43% protein, 1.33% serabut kasar, 0.85% lemak kasar, 15.48% karbohidrat, 0.75% abu, 21.4mg/100g vitamin C, 89.3mg/100g kalium, 1.51mg/100g natrium, 9.91mg/100g kalsium, 0.01mg/100g magnesium, 0.15mg/100g of zink and 0.30mg/100g besi dan 0.11mg/100g kuprum. Keputusan menunjukkan Mangga Wani mempunyai nilai pemakanan yang lebih tinggi berbanding dengan Mangga Air. Semua nutrien dalam kajian ini mempunyai signifikan yang bererti antara buah masak dan kurang masak kecuali besi dan zink untuk Mangga Air dan besi dan kuprum untuk Mangga Wani.

DETERMINATION OF NUTRITIONAL COMPOSITION OF LOCAL MANGOES OF SABAH

ABSTRACT

Two types of local mangoes of Sabah, Mangga Air (Mangifera aquaea sp. nov. Kost.) and Mangga Wani (Mangifera odorata Griff.) were studied. The nutrient compositions of the fruits were analyzed at two ripening stages. The aim of the study is to determine nutrient composition of Mangga Air and Mangga Wani such as protein, carbohydrate, ash, crude fiber, crude lipid, moisture content, vitamin C and several minerals during ripe and unripe. The statistical studies of t-test showed that there were significant differences in most of the nutrient composition between the two stages of maturity. Soxhlet method was used to determine the crude lipid content, Kjeldahl method was used for protein determination, ash was determined by using dry ashing method, vitamin C was determined by using 2,6-Dichloroindophenol Titrimetric method. Atomic Absorption Spectrophotometry was used to determined mineral content such as sodium, potassium, calcium, magnesium, copper, iron and zinc. Result showed that ripe Mangga Air consists of 82.6% of moisture content, 0.33% of protein, 0.74% of crude fiber, 1.03% of crude lipid, 14.96% of carbohydrate, 0.35% of ash, 3.51mg/100g of vitamin C, 114.24mg/100g of potassium, 0.78mg/100g of sodium, 8.1mg/100g of calcium, 0.49mg/100g of magnesium, 0.11mg/100g of zinc and 0.18mg/100g of iron and 0.57mg/100g of copper while the unripe Mangga Air consist of 84.08% of moisture content, 0.51% of protein, 1.26% crude fiber, 0.47% of crude lipid 13.22% of carbohydrate 0.46% of ash, 17.36mg/100g of vitamin C, 67.69mg/100g of potassium, 1.80mg/100g of sodium 12.03mg/100g of calcium, 0.59mg/100g of magnesium, 0.11mg/100g of zinc and 0.23mg/100g of iron and 0.07mg/g of copper. Compare to Mangga Air, ripe Mangga Wani consists of 77.79% of moisture content, 1.32% of protein, 0.85% of crude fiber, 1.75% of crude lipid, 17.71% of carbohydrate, 0.58% of ash, 4.11mg/100g of vitamin C, 195.19mg/100g of potassium, 0.83mg/100g of sodium 6.65mg/100g of calcium, 0.03mg/100g of magnesium, 0.22mg/100g of zinc and 0.27mg/100g of iron and 0.13mg/100g of copper unripe Mangga Wani consists of 80.16% of moisture content, 1.43% of protein, 1.33% of crude fiber, 0.85% of crude lipid, 15.48% of carbohydrate, 0.75% of ash, 21.4mg/100g of vitamin C, 89.3mg/100g of potassium, 1.51mg/100g of sodium, 9.91mg/100g of calcium, 0.01mg/100g of magnesium, 0.15mg/100g of zinc and 0.30mg/100g of iron and o.11mg/100g of copper. Results showed that Mangga Wani has a higher nutritional value compare to Mangga Air. All nutrient composition studied have significant differences between ripe and unripe stages except iron and zinc in Mangga Air and iron and copper in Mangga Wani.

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LIST OF ABBREVIATION

RNI	Recommended Nutrition Intake
SPSS	*Statistical Package for Social Science*
AOAC	Association of Official Analytical Chemists
USDA	United States Department of Agriculture
AAS	Atomic Absorption Spectrophotometre
WHO	World Health Organization
H_2BO	boric acid
H_2SO_4	sulfuric acid
KOH	kalium hydroxide
NaCl	natrium chloride
NaOH	natrium hydroxide
$CuSO_4$	Cuprum sulfuric

LIST OF SYMBOLS

Symbols

*	Significant
>	More than
<	Less than
%	Percentage
&	and
µ	micro
mg	Milligram
cm	Centimeter
kg	Kilogram
g	Gram
ml	Milliliter
kcal	Kilocalorie
ppm	parts per million

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CHAPTER 1

INTRODUCTION

Mango (*Mangifera indica*) is the most important fruit of Asia. The mango industry has expanded rapidly in the last decade and its total production currently ranks fifth among the major fruit crops, world wide, because of their attractive strong aroma and excellent flavors, certain varieties of which have found increasing favor in temperate regions as dessert fruits (Hymavathi & Khader, 2005).

Many attempts have been made to study the nutrient composition of mangoes. Previous studies have given the nutritional value of common mango (*Mangifera indica*.). Although data from numerous sources are available, many other species of nutrient content in mangoes has not been reported, nor have analyses of the nutrient content in both the ripe and unripe stage. Information concerning the nutrient content of the edible portion of Sabah mangoes, at ripe stage and unripe stage, seemed desirable.

The mango is used as food in all stages of its development. The ripening process of mango fruit involves numerous biochemical changes including increased respiration, ethylene production, fruit softening, development of pigments, metabolic activities leading to nutrient compounds changes in carbohydrates, organic acids, lipids, mineral content, vitamin and softening of texture to acceptable quality (Lizada, 1993; Gomez-Lim,

1997). This ripening process takes place within 9-12 days postharvest at ambient temperature, depending on cultivar and stage of fruit maturity at harvest.

The aim of the present work is to study the nutrient composition of Sabah mangoes with specific reference to *Mangifera aquaea*. and *Mangifera odorata*., and the changes of nutrient compounds at two stages of ripening (ripe and unripe).

.1 Main nutrients of our diet

Nutrients are chemical substances in foods that provide energy, form body structures, and regulate body processes (Grosvenor & Smolin, 2002). Diet is the sum of the food consumed by an organism. Proper nutrition for a human requires vitamins, minerals, proteins, lipids and carbohydrates to maintain life and allow growth and reproduction.

In our foods, there are grouped into several categories. Macronutrients include carbohydrates, protein, and lipids while the micronutrients are the minerals and vitamins. Food also contains water and dietary fiber which plays an importance role in our health.

Fruits are valuable components of the daily diet. They are good sources of vitamin and minerals although their concentrations may be far less as compared with other components of diet that includes carbohydrate, lipids and proteins. However, their nutritive value partly depends on the soil and climate in which they are grown (Luke, 1984).

In general terms the food guide pyramid recommends 2-4 servings of fruits a day to maintain a healthy life. The food guide pyramid is shown in Figure 1.1 in the Appendix A.

1.1 Carbohydrates

Carbohydrates may be classified according to their degree of polymerisation and may be divided into three principal groups i.e. sugars (monosaccharides, disaccharides, polyols), oligosaccharides (malto-oligosaccharides, other oligosaccharides) and polysaccharides (starch, non-starch polysaccharides). Each of these three groups may be further subdivided on the basis of the monosaccharide composition of the individual carbohydrates (Greenfield, 1995).

The primary role of carbohydrate is to provide energy to our body (IOM, 2002). Carbohydrates provide about 4 kilo calories per g. The sugar galctose play an important role to form nerve tissue. Some sugar like deoxyribose and ribose are components of DNA and RNA which contain the genetic information needed for proteins synthesis.

Symptoms include abnormal fat metabolism, breakdown of body protein, increased sodium excretion, loss of energy and fatigue. It has been found that small amounts of carbohydrates, between 50 to 100 g, can prevent these symptoms (Murano, 2003).

Sources of carbohydrate include cereals, rice, wheat, barley, potatoes, sweet potatoes, vegetables, fruits and milk products. Sources of added sugars in diets are carbonated drinks, fruit juices drinks, desserts, cakes and biscuits.

In the population nutrient intake goals recommended by WHO (1990, 2003) for the prevention of diet-related chronic diseases, intake of total carbohydrate has been suggested to be from 55% to 75% of total energy. A daily minimum intake of 400 g of vegetables and fruits, including at least 30 g of pulses, nuts and seeds, should meet this recommendation.

1.1.2 Protein

Proteins are composed of subunits called amino acids. Typical amino acids consist of a nitrogen-containing amino (NH_2) group, an acid or carboxyl (COOH) group, and a side chain (R group) opposite a hydrogen atom. (Murano, 2003)

Next to water, protein is the major component of body tissues. Proteins are large molecules made up of amino acids bonded together by peptide linkages. They provide the essential amino acids, which are the initial materials for tissue synthesis and constituent of tissue protein.

Protein is a part of many enzymes, hormones, and antibodies in the body. Protein transports substances around the body, maintains fluid and is important for proper vision and blood clotting (Drummond & Brefere, 2004). In addition, proteins help maintain the balance between acids and bases within the body fluids by accepting and releasing hydrogen ions. Even though proteins are needed for growth, maintenance and repair, they will be used to provide glucose when the need arises (NCCFN, 2005).

Protein deficiency usually accompanies a deficiency of calories and other nutrients. The effects of protein loss during illness and injury are far-reaching. The most evident result is the wasting of muscle tissue and consequent loss of weight. Other symptoms include anemia and delayed healing of wounds, and fractures. A lowering of serum protein levels and hormonal changes may result in edema, and the reduced production of antibodies makes the affected person susceptible to infection severe protein deficiency, encountered only in times of famine, is fatal, due to the lack of material for the body to facilitate as energy (NCCFN, 2005).

According to NCCFN (2005), proteins in human diet are derived from two main sources, namely animal proteins (e.g. egg, milk, meat and fish.) and plant proteins (e.g. pulses, cereals, nuts, beans and soy products).

Based on the Recommended Nutrient Intakes for Malaysia 2005, RNI for children 1–3 years is 17g/day. RNI for adult men and women is 62g/day and 55g/day respectively. RNI for elderly men is 57g/day while for elderly women are 49 g/day.

1.1.3 Lipids

Lipids are commonly known as fats or oils, lipids are a class of compounds that are soluble in organic but insoluble or poorly soluble in water. They include fatty acid, glycerides, phospholipids, and sterols (Grosvenor & Smolin, 2002)

Fat are high concentrations of energy which providing 9.0 kcal/g of energy compared to carbohydrate and protein which provide only 4.0 kcal/g of energy. Vitamins A, D, E, and K can only be digested, absorbed, and transported in conjunction with fats. Fats are sources of essential fatty acids, an important dietary requirement. According to Murano (2003) dietary lipids supply the essential fatty acids needed by the body to maintain proper health and functioning.

Fats are important group of substances found in food where they often improve to taste, flavor perception and impart a pleasing texture to foods, and the energy content of the food (Greenfield, 1993).

Fat deficiency is rare and usually occurs in individuals with malabsorption problems. When this happens, the availability of the essential fatty acids (linoleic acid

and a-linolenic acid) and that of the fat-soluble vitamins (A, D, E and K) would be adversely affected. Symptoms include scaly, dry skin, liver abnormalities, poor healing of wounds, impaired vision and hearing, and growth failure in infants (Grosvenor & Smolin, 2002). Cooking oils, margarines, butter, shortenings, eggs, chicken, beef, other meats, fish.

Based on the Recommended Nutrient Intakes for Malaysia 2005, RNI for children below 3 years old ranges from 25g/day to 38g/day. RNI for adult men and women is 54 - 82 g/day and 46 - 70 g/day respectively. RNI for elderly men is 45 - 67 g/day while for elderly women are 40 - 59 g/day.

1.1.4 Crude fiber

Crude fiber is the residue of plant food left after extraction by dilute acid followed by dilute alkali. Dietary fiber, a new term, is the residue of plant food resistant to hydrolysis by human alimentary enzymes (Trowell, 1976). Human digestive enzymes cannot break down fiber; however, fiber does have important properties that affect the digestive tract and maintain healthy bowel function (Grosvenor & Smolin, 2002).

Fiber supplies mass of the feces, making elimination much easier. A high intake of soluble fiber also inhibits absorption of cholesterol and bile acid from the small intestine, thereby reducing blood cholesterol and possibly reducing the risk of cardiovascular disease and gallstones (Disilvestro, Hampl & Wardlaw, 2004). It may also help fight obesity. High-fiber foods help move waste through the digestive tract faster and easier, so possibly harmful substances do not have as much contact with the gastrointestinal tract and reduce straining. Epidemiological data have revealed negative

correlations between fiber intake and colon cancer, ischemic heart disease and diabetes mellitus (Suree, Komindir & Nichachotsalid, 2004).

Crude fiber supplies from starchy staples, wheat and potato. (Trowell, 1976). Other sources may include: whole grain foods, bran, nuts and seeds, vegetables such as green beans, cauliflower, zucchini, celery, the skins of some fruits, including tomatoes.

According to IOM, (2002), adequate intake of fiber ranging from 19-25 g/day of total fiber for young children whereas intakes for adolescents range from 26-38 g/day, the lower figures are being for girls. Adult intakes are recommended to be 25 g/day for women and 38 g/day for men.

1.1.5 Vitamin C

Vitamin C is the most important vitamin for human nutrition that is supplied by fruits and vegetables (Hernández, Lobo & González, 2005). Most vitamins are stored minimally in human cells, but some are stored in liver cells to a greater extent (Bsoul & Terezhalmy, 2004).

Vitamins are essential to maintain normal metabolic processes and homeostasis within the body. It is an important antioxidant that protects the body from reactive oxygen molecules, helps maintain the immune system, and aids in the absorption of iron. It also helps protect against cancers, heart disease, stress, it is part of the cellular chemistry that provides energy, it is essential for sperm production, and for making the collagen protein involved in the building and health of cartilage, joints, skin, and blood vessels (Bsoul & Terezhalmy, 2004).

Severe vitamin C (ascorbic acid) deficiency leads to scurvy (IOM, 2000) a disease characterized by weakness, small hemorrhages throughout the body that cause gums and skin to bleed, and loosening of the teeth.

Several symptoms of ascorbic acid deficiency have been recognized including follicular hyperkeratosis, swollen and inflamed gums, loosening of teeth, dryness of the mouth and eyes, loss of hair and dry itchy skin. These symptoms reflect the role of ascorbic acid in the maintenance of collagen and blood vessel integrity (NCCFN, 2005). A lack of vitamin C will manifest within weeks and may result in death in 5 to 6 months (Bsoul & Terezhalmy, 2004).

Citrus fruit, such as oranges, lemon, and limes, are an excellent source of vitamin C. other fruits that are high in vitamin C include strawberries and mangoes. Vegetables in the cabbage family, such is broccoli, cauliflower, as well as green leafy vegetables, green and red peppers, tomatoes are good sources. Fruit juices and drinks fortified with vitamin C (Grosvenor & Smolin, 2002).

The amount of a specific vitamin required by an individual varies considerably and it is influenced by such factors as body size, growth rate, physical activity, and pregnancy. The recommended intake for children is 30-35mg/day. The recommended intake for both adults and elderly are 70 mg/day. Pregnancy women need higher of vitamin C, RNI for pregnancy woman is 80mg/day (NCCFN, 2005).

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