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Full Length Research Paper

some nutrients and antinutrients contents of mango (*Magnifera indica*) seed

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Proximate composition, amino acid profile and antinutrients contents of mango seed were investigated. The results of proximate analysis show that mango seed contains (10.06 ± 0.12%) crude protein, (14.80 ± 0.13%) oil, (2.62 ± 0.02%) ash, (2.40 ± 0.01%) crude fibre, 70.12 ± 1.34%) carbohydrate and energy content (453.92 ± 4.32 KJ/100 g). The results also show that mango seed is very rich in glutamate (13.00 g/100 g of protein) while methionine has the lowest value (1.04 g/100 g of protein). Among the essential amino acids, leucine has the highest value (8.40 g/100 g of protein). This is followed by arginine which has the value of 5.17 g/100 g of protein. The results of antinutrient analysis show that mango contains alkaloid (0.01 ± 0.0 mg/100 g), tannins (1.03 ± 0.01 mg/100 g), phytate (1.44 ± 0.01 mg/100 g), cyanide (0 mg/100 g), saponin (0.04 ± 0 mg/100 g) and oxalate (1.49 ± 0.01 mg/100 g). Its trypsin inhibitor activity was found to be (18.42 ± 2.54 TIU/mg protein). The vitamin analysis showed that mango seed contained 15.27 (IU) vitamin A; (1.30 mg/100 g) vitamin E; (0.59 mg/100 g) Vitamin K; (0.08 mg/100 g) Vitamin B1; (0.03 mg/100 g) Vitamin B2; (0.19 mg/100 g) Vitamin B6; (0.12 mg/100 g) Vitamin B12 and (0.56 mg/100 g) Vitamin C. The result of mineral analysis showed that mango seed contained sodium (21.0 mg/100 g), potassium (22.3 mg/100 g), calcium (111.3 mg/100 g), magnesium (94.8 mg/100 g), iron (11.9 mg/100 g), zinc, (1.1 mg/100 g) and copper (0.1 mg/100 g). Therefore, mango seed is a nutritional promising seed.

Key words: Mango, amino acids, protein, antinutrients.

INTRODUCTION

The present uncertainty in the world food supply and the expected increase in demand, warrant the search for alternative sources of food which will be readily available for all and sundry by the government planners and scientists. Many workers such as Fetuga et al. (1973), Aletor and Aladetimi (1989) and Fowomola and Akindahunsi (2007) had studied nutritional potentials of lesser known plant seeds as alternative sources of food.

Mangoes belong to the genus *Angifera*, consisting of numerous species of tropical fruiting trees in the flowering plant family Anacardiaceae. The mango is indigenous to the Indian subcontinent and Southeast Asia (mango - botany-taxonomy, 2008). Cultivated in many tropical regions and distributed widely in the world. It is one of the most extensively exploited fruits for food, juice, flavor, fragrance and color and a common ingredient in new functional foods often called superfruits. Its leaves are ritually used as floral decorations at weddings and religious ceremonies.

Mango trees (*Mangifera indica*) reach 35 - 40 m in height, with a crown radius of 10 m. The leaves are evergreen, alternate, simple, 15 - 35 cm long and 6 - 16 cm broad; when the leaves are young they are orange-pink, rapidly changing to a dark glossy red, then dark green as they mature. The fruit takes from 3 - 6 months to ripen.

The ripe fruit is variable in size and color, and may be yellow, orange, red or green when ripe, depending on the cultivar. When ripe, the unpeeled fruit gives off a distinctive resinous sweet smell. In its center is a single flat oblong seed that can be fibrous or hairy on the surface, depending on the cultivar. Inside the seed coat 1 - 2 mm thick is a thin lining covering a single embryo, 4 - 7 cm long, 3 - 4 cm wide, and 1 cm thick.

Mango is rich in a variety of phytochemicals and nutrients that qualify it as a model "superfruit", a term used to highlight potential health value of certain edible fruits. The fruit is high in prebiotic dietary fiber, vitamin C, polyphenols and carotenoids (Nutritiondata.com, 2008).

Table 1. Proximate composition of mango seeds.

Composition	% (Dry weight)
Crude protein	10.06 ± 0.12
Crude oil	14.80 ± 0.13
Ash	2.62 ± 0.025
Crude fibre	2.40 ± 0.01
Carbohydrate	70.12 ±1.34
Energy content	453.92 ± 4.32 KJ/100 g

Each value is a mean of three determinations ± SEM.

Table 2. Amino acid profile (g/100 g of protein) of mango seeds.

Amino acid	Quantity
Lysine	3.13
Alanine	6.40
Histidine	2.31
Cysteine	2.30
Arginine	5.17
Valine	3.80
Aspartate	6.33
Methionine	1.04
Threonine	2.04
Isoleucine	3.23
Serine	2.93
Leucine	8.40
Glutamate	13.00
Tyrosine	3.17
Proline	3.00
Glycine	3.50
Phenylalanine	4.46

Mango fruit contains essential vitamins and dietary minerals. The antioxidant vitamins A, C and E comprise 25, 76 and 9% of the Dietary Reference Intake (DRI) in a 165 g serving. Vitamin B6 (pyridoxine, 11% DRI), vitamin K (9% DRI), other B vitamins and essential nutrients such as potassium, copper and 17 amino acids are at good levels. Mango peel and pulp contain other phytonutrients, such as the pigment antioxidants - carotenoids and polyphenols - and omega-3 and -6 polyunsaturated fatty acids.

The edible mango peel has considerable value as a source of dietary fiber and antioxidant pigments (Rocha et al*.,* 2007; Ajila and Prasada, 2008). Contained within the peel and pulp are rich contents of polysaccharides as fiber sources, especially starch and pectins (Iagher et al., 2002; Berardini, 2005).

Antioxidants of the peel and pulp include carotenoids, such as the provitamin A compound, beta-carotene, lutein and alpha-carotene (Gouado et al., 2007). Mahattanatawee et al. (2006) and Singh et al. (2004) reported that Polyphenols such as quercetin, kaempferol, gallic acid, caffeic acid, catechins, tannins, and the unique mango xanthone, mangiferin. Any of which may counteract free radicals in various disease mechanisms as revealed in preliminary research (Percival et al., 2006). According to Percival et al. (2006) and Rodríguez et al. (2006), contents of these phytochemicals and nutrients appear to vary across different mango species (Rocha et al., 2007). Up to 25 different carotenoids have been isolated from mango pulp, the densest content for which was beta-carotene accounting for the yellow-orange pigmentation of most mango species (Chen et al., 2004). .According to Barreto et al. (2008), peel and leaves also have significant content of polyphenols, including xanthones, mangiferin and gallic acid.

The mango triterpene, lupeol is an effective inhibitor in laboratory models of prostate and skin cancers (Saleem et al., 2004; Nigam et al., 2007; Chaturvedi et al., 2008 and Prasad et al., 2008). An extract of mango branch bark called Vimang, isolated by Cuban scientists, contains numerous polyphenols with antioxidant properties *in vitro* (Rodeiro et al., 2006) and on blood parameters of elderly humans (Pardo et al., 2006).

In Nigeria, people ignorantly throw away the mango seeds after eating the fruity part of mango fruit as a result of scarcity of the information on its nutritional and antinutritional potentials. The present study is aimed at providing this information.

RESULTS AND DISCUSSION

Table 1 shows the results of proximate analysis of mango seed. The results showed that mango seed contains (10.06 ± 0.12%) crude protein, (14.80 ± 0.13%) oil, (2.62 ± 0.02%) ash, (2.40 ± 0.01%) crude fibre, 70.12 ± 1.34%) carbohydrate and energy content (453.92 ± 4.32 KJ/100 g). The results of proximate analysis show that mango seed is a good source of carbohydrate with protein of about thirteen times that of cassava. Table 2 depicts the amino acid profile of mango seed. The results also showed that mango seed is very rich in glutamate (13.00 g/100 g of protein) while methionine has the lowest value (1.04 g/100 g of protein). Among the essential amino acids, leucine has the highest value (8.40 g/100 g of protein). This is followed by arginine which has the value of 5.17 g/100 g of protein. Table 3 depicts the amino acid scores of mango seed. Phenylalanine/Tyrosine had the highest amino acid value while lysine has the lowest value and it is the limiting amino acid in mango seed.

Table 4 shows the antinutrients content of mango seed. Table 5 showed that mango seed contained 15.27 (IU) vitamin A; (1.30 mg/100 g) vitamin E; (0.59 mg/100 g) Vitamin K; (0.08 mg/100 g) Vitamin B1; (0.03 mg/100 g) Vitamin B2; (0.19 mg/100 g) Vitamin B6; (0.12 mg/100 g) Vitamin B12 and (0.56 mg/100 g) Vitamin C. These results also showed that mango seed is richer in vitamins

Table 3. Amino acid scores of mango seed (%).

Lysine	47.42
Histidine	88.84
Threonine	47.44
Cysteine/methionine	79.52
Valine	69.10
Isoleucine	70.23
Leucine	93.33
Phenylalanine/Tyrosine	105.97

Table 4. Antinutrients content (mg/100 g) of mango seed.

Alkaloid	Tannins	Phytate	Cyanide	Saponin	Oxalate	Trypsin inhibition (TIU/mg)
0.01 ± 0.0	1.03 ± 0.01	1.44 ± 0.01	0	0.04 ± 0	1.49 ± 0.01	18.42 ± 2.54

Each value is a mean of three determinations. ±SEM. Column values with different superscript letters are significantly different ($P < 0.05$).

Table 5. Vitamins contents (mg\100g) of mango seeds.

Vitamins	Amount (mg\100 g)
A	15.27 (IU)
E	1.30
K	0.59
B_1	0.08
B_2	0.03
B_6	0.19
B_{12}	0.12
C	0.56

Table 6. Some mineral contents of mango seeds

Mineral	Composition (mg/100 g)
Na	21.0
K	22.3
Ca	111.3
Mg	94.8
Fe	11.9
Zn	1.10
Mn	0.04

than cassava (Bede, 2010). Table 6 showed that mango seed contained sodium (21.0 mg/100 g), potassium (22.3 mg/100 g), calcium (111.3 mg/100 g), magnesium (94.8 mg/100 g), iron (11.9 mg/100 g), zinc, (1.1 mg/100 g) and copper (0.1 mg/100 g). These results showed that mango seed is a good source of calcium when compared with that of cassava (Bede 2010). which is almost half of that of mango seed.

The results show that mango contains alkaloid (0.01 ± 0.0 mg/100g), tannins (1.03 ± 0.01 mg/100 g), phytate (1.44 ± 0.01 mg/100 g), cyanide (0 mg/100 g), saponin (0.04 ± 0 mg/100 g) and oxalate (1.49 ± 0.01 mg/100 g). Its trypsin inhibitor activity was found to be (18.42 ± 2.54 TIU/mg protein). The absence of cyanide in sherry mango seed shows that it is less toxic when compared with cassava(Bede,2010). Tannins are aromatic compounds containing phenolic groups. They interact with salivary proteins and glycoproteins in the mouth and render the tissues astringent to taste (Howes, 1953). Astringency gives tannin the medicinal value in preventing diarrhoea and dysentery and for controlling haemorrhage (Sollman, 1957; Jones, 1965). Furthermore, tannins protect plant against dehydration, rotting, damage by animals and pathogens. When they are polymerized, insoluble protective barrier is formed which prevents microbial attack (Stumpf and Conn, 1981). Therefore they can be applied to wounds as protective coating. Bichel and Bach (1968) had earlier reported that the symptoms of continued intake of tannin include gastritis as well as irritation and edema of the intestine. Glick and Joslyn (1970) have also reported that feeding 0.5% of tannic acid decreased nitrogen retention and caused 5% mortality in rats. It has been reported by Bressani et al. (1983) that tannins exhibit their toxicity effects by forming protein tannin complexes through multiple hydrogen binding between their hydroxyl groups and carboxyl groups of protein peptide bonds of proteolytic enzymes in the gastrointestinal tract. Savage et al. (1964) reported that phytate depressed the growth of chicks fed with phytate-casein diet by forming complex with zinc thereby making the later unavailable.

Omosaiye and Cheryan (1979) also reported that, phytate formed complex with protein by the actions of cations, usually calcium, zinc or magnesium which act as

a bridge between the negatively charged protein carboxyl groups and former. The report of Chen et al. (1934), shown that the minimum lethal dose of hydrogen cyanide taken by mouth to be between 0.5 and 3.5 mg/kg body weight.

The symptoms of hydrogen cyanide include peripheral numbness, light-headedness, mental confusion, stupor, cyanosis and convulsion were reported by survivors (Halstrom and Moller, 1945). Oxalate forms complex with calcium thereby making it unavailable when fed into animals and more so high oxalate diets can increase the risk of renal calcium absorption (Osagie and Eka, 1988). In addition, dietary oxalate has been known to complex with calcium,magnesium and iron leading to the formation of insoluble oxalate salts and resulting in oxalate stone (Wardlaw and Kessel, 2002). Saponins have been shown to possess both beneficial (cholesterol lowering) and deleterious (cytotoxic; permeabilization of the intestine) properties (Price et al., 1987; Oakenful and Sidhu, 1989). Although some saponins have been shown to be highly toxic under experimental conditions, acute poisoning is relatively rare both in animals and man (Osagie and Eka, 1988).

Some alkaloids for example potato alkaloid (solanine) cause gastrointestinal upsets and neurological disorders, especially when taken in excess of 20 mg/100 g sample (Osagie and Eka, 1988). Trypsin inhibitors are low molecular weight proteins which form complexes with trypsin thereby reduced it`s proteolytic activity which in turn reduced the availability of amino acids, reduced growth and pancreatic enlargement (Liener, 1989). Low levels of antinutrients observed in mango seed suggested that it is less toxic and it will not adversely affects live stocks if incorporated in their feeds. The works of Ravindran and Sivakanesan (1996), Farag (2001) and Agunbiade and Olanlokun (2006) had earlier shown that soaking and boiling,autoclaving for 30 min plus irradiation up to 20 kGy and roasting and boiling drastically reduced the antinutrional factors present in mango seed kernels respectively, thereby improved their nutritional qualities.

The results of proximate analysis show that mango seed is a nutritional promising seed because of its high levels of carbohydrate and oil. The results of mineral assayed showed that mango seed is very rich in calcium and magnesium. The presence of antioxidant vitamins such as vitamin C, E and A suggests that mango seed could be used as an alternative source of these vitamins. Antioxidant vitamins have been reported to reduce oxidative processes which are known to be vital in the initiation of arthrosclerosis (Steinberg et al., 1989). The results of mineral assayed showed that mango seed is very rich in calcium and magnesium. Calcium is essential for regulating the heart-beat, conducting nerve impulses, stimulating hormone secretions, clotting of blood, building and maintaining healthy bones (Medindia 2008).

According to Michael (1996), Magnesium is a critical co-factor in more than 300 enzymatic reactions in the human body. In addition, injectable magnesium sulfate has been extensively used in the treatment of high blood pressure, acute heart attacks, chronic cardiovascular disease, heart arrhythmias, diabetes, asthma, chronic fatigue syndrome and pre-eclampsia and eclampsia of pregnancy.

Conclusion

The informations obtained from these analysis would serve as a guide for the possible utilization of mango seed by animal feed manufacturers as an alternative source of food ingredient.

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