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Comparative Proximate Composition of German Mango (*MangiferiaOdorata) and Sweet Mango* (*MangiferiaCarabao)*

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Abstract

Comparative proximate composition was carried out on the two local varieties of mango pulp German mango (Mangiferaododrata) and sweet mango (Mangiferacarabao) commonly consumed in Enugu town, Enugu state. The moisture content of the pulp ranges from 74.49% for German mango (M. ododrata) to 81.2% for sweet mango (M. odorata). Ash ranges from 0.41% for sweet mangoto 0.63%for German mango. Dietary fiberranges from 0.89% for sweet mango to 1.05% for German mango. The carbohydrate content was found to range from 14.98% for German mango to 18.91% for sweet mango while protein range from 1.21% to 1.71% for sweet mango and German mango respectively. The fat content for the pulp ranges from 0.05% for German mango to 0.06% for sweet mango. The pH value of the pulp was observed to range from 5.50 for German mango to 5.61 for sweet mango. The sugar content was found to be high in sweet mango 6.36% than German mango6.16%. The German mango variety was found to have higher nutritional value quality and most acceptable from sensory evaluation. The dietary parameters of the mango fruitpulps in this study were compared with benchmark for fruit groups and found to meet local and internationalrequirements recommended by EU/WHO and National Agency for Food and Drug Administration and Control(NAFDAC, Nigeria). The results showed that these mango fruit varieties are of high nutritional quality and will compete favorably in the international market.

Keywords: *Proximate composition, mangniferaodorato and mangiferacarabao, nutritional values, carbohydrate content.*

Introduction

Nowadays, the use of medicinal plants and bioactive phytocompounds has seen more growing interest. The importance of a diet rich in polyphenols has long sponsored and underlined because of their radical scavenging action, as well as anti-carcinogenetic properties (Lauricella et al., 2017; Pandey & Rizvi, 2009; Rathod et al., 2023).

Most food biological active components such as antioxidants are sourced from fruits and vegetables, which exhibit good free radical quencher and are therefore, regarded as an essential component that should be present in everyone's diet.Epidemiologic studies have consistently shown that consumption of fruits and vegetables

reduces the incidence of chronic diseases, such as cancer, diabetes and cardiovascular disease (Micha,2017; Poljsak et al., 2021; Lobo et al., 2010).

Fruits of tropical and subtropical regions are known for their nutraceutical value, which provide nutrient and pharmaceuticals. The major nutritional antioxidants, vitamin E, Vitamin C and B-carotene, may be beneficial to prevent several chronic disorders. Reactive oxygen species (ROS) possess a strong oxidizing effect and induce damage to biological molecules, including proteins, lipids and DNA with concomitant changes in their structure and function. Most of the antioxidant showed a powerful scavenging activity of hydroxy radicals,a significant inhibitory effect on the peroxidation, phospholipid oxidation and prevented DNA damage caused by bleomycin or copper-phenanthroline systemand acted as a chelator of iron. (Shah et al., 2010; Arias et al., 2022; Gemede et al., 2015; Rasmus&Kozłowska, 2023).

Some plants are used for theirantidiabetic properties because they produce a significant hypoglycemic effect. This action may be due to an intestinal reduction of the absorption of glucose (Patel et al., 2012; Shetty et al., 2010; Kooti et al., 2016; Zanzabil et al., 2023; Yen et al., 2021; Bindu Jacob&Narendhirakannan, 2019; Gondi &Prasada Rao, 2015).

The Analgesic and anti-inflammatory of the polyphenols found in the seed kernel of mangoextract were found to possess significant anti-inflammatory activity(Nwoke et al., 2016; Islam et al., 2011; Kim et al., 2021).

The gastro protective agent(anthracene) was found to provide protection against gastric injury in gastric lesion area or ulcer by stopping production; and neutralize the gastric acid (Escobedo-Hinojosa et al., 2018; Saranya et al., 2011; Mohamed et al., 2021).

The stem bark extract of mango was reported to demonstrate a significant activityin early malaria (P. *falciparum)*and increased activityduring very high fever (Tajbakhsh et al., 2021; Baah et al., 2020; Airaodion et al., 2021).

Earlier investigations reported that some mango extractshave activities against the breast cancer cells, as well as against a colon cancer cells and leukemia cells, suggesting that mangiferin has a potential as a naturally occurring chemopreventive agent (Shah et al., 2010; Abdullah et al., 2014; Akindele et al., 2015; Navarro et al., 2019; Bakar et al., 2010; Mary Helen, et al., 2013).

Various parts of mango (Roots, bark, leaves, flowers, fruits, seed kernel, and stem bark)have been reported to have potentialsfor many ethno-medicinal use such as astringent, acrid, refrigerant, styptic, anti-syphilitic, vulnerary, anti-emetic, anti-inflammatory and constipating. Good for vitiated conditions of pitta, metrorrhagia, calonorrhagia, pneumorrhagia, lecorrhoea, syphilis, uteritis, wounds, ulcers, menorrhoea, leucorrhoca, bleeding piles and diarrhoea, management of emaciation, and anemia, and vomiting (MasudParvez, 2016; Ibrahim et al., 2023: Ali et al., 2020; Mehmood et al., 2024; Gorakh&Shalagaonkar, 2022; Agrawal, 2021; Jain et al., 2018; Ibrahim &Chindo, 2018; Kim et al., 2021;Patil et al., 2023; Shah et al., 2010; Samanta et al., 2019; Senthilkumar et al., 2020; Lima et al., 2006; Kumar et al., 2021; Nikhal& Mahajan, 2010; Stohs et al., 2018; Mustapha et al., 2014).

Materials and Method

Sample Collection

The two local varieties of mango fruits used in this research were purchased from a commissioned farmer in Emene, Enugu on April 14, 2023. The matured ripe mango fruits were labeled A for German mango *.M. odorata* and B for Sweet mango *.M. carabao*andtransported to a laboratory in a sterile polyethene bags, and stored in refrigerator prior to processing.

Sample Preparation

The samples were thoroughly washed in warm water, to remove gummy sap or other materials. With the aid of a clean sharp knife, the peels, pulp and seed (kernel) of the mango fruits were separated and weighed respectively. The pulps from each batch of the two fruits were homogenized with a blender (Sharp blender model; EM-11). The

pulp was blended for five (5) minutes. The resulting pulp here-in referred to as the juice was preserved in a refrigerator at 15ºC in a plastic bottle until required for analysis.

Determination of Proximate Composition

The proximate parameters viz; crude protein, crude fiber, moisture content, Ash content, pH, fat content, carbohydrate and sugar content of the mango variety samples were determined using the Standard Analytical Method of Association of Official Analytical Chemists, AOAC (2000). All measurements were in triplicate, and reagents used were Analar grade.

Determination of Moisture Content

Moisture was determined by oven drying method. One and half gram of the homogenized sample was accurately weighed in clean, dried crucible (W_1). The crucible was heated in an electric oven at 105 ºC for 6-12 hours until a constant weight was obtained. Then the crucible was placed in the desiccator for 30 min to cool and was weighed again (W_2).

The percent moisture was calculated by following formula:

$$\% \text{ Moisture content} = \frac{W1-W2}{Wt.\,of sample} \times 100$$

Where:

W_1 = Initial weight of crucible + Sample

W_2 = Final weight of crucible + Sample

Determination of Ash

Clean empty crucible were placed in a muffle furnace set at 500ºC for an hour, cooled in desiccator and weighed (W_1). One gram of each sample was taken in crucible and weighed (W_2). The sample was ignited in a furnace at 550ºC for 3 hours for complete oxidation of all organic matter in the sample. The crucible was cooled in a desiccator and re-weighed (W_3). Percent ash was calculated by following formula:

$$\%\text{Ash content} = \frac{W3-W1}{Wt.\,of sample} \times 100$$

Difference in wt. of Ash = W3 -W1

Determination of Crude Protein

Protein in the sample was determined by Kjeldahl method. One gram of dried samples was digestedwith15 ml of concentrated H_2SO_4 and 8g of digestion catalyst(K_2SO_4:CuSO4 (8:1)) until the mixture became clear (blue green in color). The digest was cooled and the volume made up to 100 ml with distilled water. Ten milliliters of the digest was distilled using Markham Still Distillation Apparatus. Ten milliliters of 0.5N sodium hydroxide were gradually added through funnel and sealed. Distillation was continued for at least 10min and ammonia produced was collected as ammonium hydroxide in a conical flask containing 20ml of 4% boric acid solution.With three drops of methyl red indicator, the mixture was titrated against standard 0.1N hydrochloric acid solutions till the appearance of pink color. A blank titration was carried out without the sample. Percent crude protein content of the sample was calculated by using the following formula:

$$\% \text{ N} = \frac{(S-B)\times 0.014 \times D}{Wt.\,of sample \times V} \times 100$$

$$\% \text{ Crude Protein} = 6.25 \times \%\text{N}$$

Where:

S = Sample titration reading

B = Blank titration reading

N = Normality of HCl

D = Dilution of sample after digestion

V = Volume taken for distillation
0.014 = Milli equivalent weight of Nitrogen

Determination of Crude Fat Content
Five grams of the sample in a thimble was extracted with 150 mL of an anhydrous diethyl ether (petroleum ether) of boiling point of 40-60^{o}C using Soxhlet extractor for 4 hours. The thimble was removed and the solvent was then collected, concentrated with rotary evaporator. The flask was dried in an electric oven at 65^{o}C for 4 hours, cooled in desiccators and weighed.

$$\% \text{ Crude fat content} = \frac{wt,of flask+extract-wt.of flask}{Wt.of sample \times V} \times 100$$

Determination of Crude Fiber
Five grams of sample was boiled with 200ml of 0.25M sulphuric acid for 30min and filtered with a Buchner funnel. The residue was washed with distilled water until it was acid-free and boiled with 200ml of 0.03M sodium hydroxide for 30 minutes and filtered. The residue was washed several times with distilled water until it was alkaline-free. It was then rinsed once with 10% hydrochloric acid and twice with ethanol. Finally, it was rinsed with petroleum ether three times. The residue was dried at 105^{O}C in an electric oven over-night. After cooling in a desiccator, it was ignited in a muffle furnace at 550^{O}C for 90 minutes to obtain ash which was then weighed. The percentage crude fiber was calculated using the formula below:

$$\% \text{ Crude Fiber} = \frac{lossinweightonignation}{Wt.of sample \times V} \times 100$$

Determination of Carbohydrate Percentage
Carbohydrate was calculated by difference using the expression below:

% Carbohydrate = (100 - % moisture + % crude protein + % crude fat + % crude fiber + % ash).

Determination of Sugar Content
The Luff – Schoorl's method was employed in determination of sugar. The sample was hydrolyzed by boiling with hydrochloric acid solution for 3 minutes. The sugar liquor is not oxidized by a cupro-alkaline solution and the excess cupric is titrated by iodometry. At the same time, the cupro alkaline liquor is titrated. The total sugar content, expressed in mg per 100ml of product, is given by the relationship:

$$\% \text{ sugars} = \frac{m \times V_0 \times d \times 100}{25\ v}$$

Where:
V = Test sample in milliliter (liquid sample).
V0 = volume of '0.1' N thiosulphate solution used to titrate the sample.
M = Mass of sugar, expressed in mg, corresponding to the difference in volume between the blank and the sample(v0-v1)

d = Dilution factor

Determination of pH value

Three portions of 15mm width and 15 deep mango pulps were taken, and illuminated by the NIR radiation to obtain NIR spectra. The mango pulps were homogenized for 3 minutes using a small blender and then, filtered with a piece of white cloth to eliminate any suspended solid in the juice. Then, a digital pH meter calibrated with pH 4.0 and 7.0 buffers was used to measure the actual value of the mango juice and the average values were noted.

4.0 Results and Discussions

4.1 Results

Two mango varieties German mango (*M. odorata)* and sweet mango (*M. carabao)* were investigated for their proximate composition. Results in Table 1, revealed that their moisture content ranges from 74.4%to 81.2% for German mango and Sweetmango; ash content ranges from 0.41% to 0.63% for Sweet mango and German mango;dietary fiber of the pulp was found to be from 1.05% for German mango to 0.89 for Sweet mango;fats from 0.05% to 0.069% for German mango and Sweet mango respectively. Carbohydrate content was found to be from 14.98% for German mango to 18.91% for sweet mango whileprotein content from1.21% to 1.71% for Sweet mango and German mango respectively. The pH value of the pulp was observed to range from 5.5% for German mango to5.6% for sweet mango and the sugar was found to be high in German mango at 6.36% while for sweet mango was 6.16%.

Table 1: Proximate Composition of the Mango Samples

Sample	Moisture content (%)	Ash content (%)	Dietary fiber (%)	Carbohydrate (%)	Protein content (%)	Fats content (%)	pH Value	Sugar content (%)
German Mango	74.4	0.63	1.05	14.98	1.71	0.05	5.5	6.16
sweet mango	81.2	0.41	0.89	18.91	1.21	0.069	5.6	6.36

4.2 Discussion

The proximate composition of German mango and Sweet mango pulps commonly found in Enugu state were determined. The percentage moisture, ash, fat, proteins, carbohydrate, dietary fiber, pH value and sugar contents were determined using AOAC.

Moisture content is one of the most important analyses performed on food product because it determines the quality of that product. The higher the moisture content of a product, the more it is susceptible to spoilage by microbial action. From the result of the work, German mango variety contain lesser moisture content of 74.4%,therefore, the fruit will have more shelf life and better stability than the counterpart sweetmango.

The carbohydrate content of any food product determines its energy producing substances. Carbohydrate content analysis in this study shows that sweet mango contains a higher amount of carbohydrate (18.91%) than theGerman mango (14.98 %). These total carbohydrates are likely composed of pectin, sugars and cellulose.

This work also revealed that German mango (*Mangiferaodorata)* variety was found to contain more crude protein (1.71 %) than sweet mango (*Mangiferacarabao)* (1.21 %). Meaning that German mango is more nutritive in terms of protein content than the sweet mango.

Further studies as reported by Arukwe et al 2019, communicated that Opioro mango and sucking mango had similar moisture contents (8.00 ± 0.06% and 8.00 ± 0.17%) respectively. Bush mango had slightly higher values of 8.05 ± 0.01%.

However, the values were quite higher than 2.40 ± 0.19% as reported by Arukwe et al. for avocado seeds. His results advised that the ash contents of sucking, bush and opioro mangos were 1.30 ± 1.10%, 1.80 ± 0.03% and 0.40 ± 0.08% respectively. This clearly specified that bush mango varieties contain more minerals, followed by the sucking mango variety; the least in mineral content being the opioro mango.

These results are also in line (1.31%) with the presentations by Gumte et al., [24] for mango kernel flour. Mango seeds from sucking mangoes had high fat content (27.14 ± 0.01%) than opioromango (25.29 ± 0.03%) whiles the bush mango was spotted to have the least value (14.28 ± 0.05%). These results were lower than 30.83 ± 0.01%, as commented by Justina et al., [25]. The crude fibre content had comparable values for the three varieties of the three mango species (49.50 ± 0.08%, 49.50 ± 0.03% and 49.00 ± 0.03%), which are quite higher than that reported by Kittiphoom, [5] (3.96%) for mango seed and Justina et al., [25] (13.76 ± 0.02%) for avocado seed. The difference in values may be due to nature of specie and geographical location of cultivation.

The protein content of the three varieties of mango seeds examined reported that bush mango had the highest value (15.75 ± 0.01%) compared to opioro and the sucking mango seeds (6.65 ± 0.36% and 1.14 ± 0.07%) respectively. These results being also similar to the 15.23 ± 0.18% and 15.55 ± 0.36% as presented by Justina et al, [25]. Carbohydrate content shows that sucking mangoes contain the highest amount of carbohydrate (14.27 ± 0.07) followed by bush mango (10.66 ± 0.11%) and the least from opioro mango being 9.26 ± 0.28%. These were lower than 48.11 ± 4.13% as reported by Arukwe et al., [23] for avocado seed and was also observed to be lesser than 17.32 ± 0.09 and 19.02 ± 0.30% as noted by Ayoola et al., [26] and Okolo et al., [27] for groundnut and soya beans. Being that a carbohydrate generates energy [23], its contents in these samples are indications that the samples can generate energies to power body cells when they are eaten.

The moisture contents of the mango fruit pulp was noted to be same with those presented by Mohammed &Yakubu, 2013; Abdualrahman, 2013; Arumugan&Manikandan, 2011; Gopalan et al., &Rathore, 2009 for mango fruit varieties in Kaduna, northern Nigeria, Dafur, southern Ethiopia and India but lower than the upper limits of 86.1% and 84.12% earlier reported by Othman &Mbago, Wenkam& Miller (1965) for mango fruit varieties. Values of crude fat obtained (table 1) are lower than the 0.5g/100g maximum limit recommended by EU/WHO for fruit groups. Nevertheless, the values of free fatty foods presented in this research are relatively lower than the values presented by Mohammed &Yakubu (2013) and Arumugan&Manikandan(2011). HM had its own crude fats higherthan the values presented by Othman &Mbago (2009); Wenkam& Miller (1965) for mango fruits in Tanzania and Hawaii.

Nwofia et al., (2012) have earlier reported that low lipid concentration in fruits is an indication that the lipid is mobilized and stored in the seeds thereby making the fruits a very good diet for obsessed persons.
Remarkably, from the table above, the carbohydrate content is higher than 15g/100g minimum requirement for fruit groups, as put forward by EU/WHO, and is also in line with the values stated for similar academic works on mango fruits in Kaduna, Nigeria.

4.3 Conclusion

From our observations, it was clear that the two mango pulp varieties analyzed were of high nutritional value and quality. However, German mango (*Mangiferaodorata*) exhibited the highest nutritional value with respect to higher protein content and lesser sugar contents. Furthermore, having the lowest moisture content, gave it a longer shelf life when processed. It will be suggested that the general public should consume Sweet mangoes (*Mangiferacarabao)*in moderation.

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