NUTRITIONAL VALUE OF MANGO (*Mangifera indica*) SEEDS AND PEELS

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ABSTRACT
The nutritional value of peels and seeds of Mango, *Mangifera indica* was studied by analyzing collected samples of these non conventional feedstuffs for their proximate composition. The result of the analysis shows that moisture ranged from 9.70 to 10.48% (peels) and 9.50 to 10.48% (seeds). Protein ranged from 4.08 to 4.49% (peels) and 5.38 to 8.10% (seeds). Carbohydrate was 49.35 to 62.45% (peels) and 53.64 to 70.58% (seeds). Fat ranged from 3.98 to 6.30% (peels) and 8.30 to 12.80% (seeds).Ash content ranged from 2.20 to 4.98% (peels) and 2.00 to 3.70% (seeds). The values for the proximate parameters of the peels and seeds were comparable to values reported for other non convectional feedstuffs. The seeds of mango had higher values than peels.

INTRODUCTION
The nutritional value of any food or food materials can be evaluated by biological, chemical and physical score (Eddy and Udo, 2004). The method of chemical score has proven to be very useful because it tend to assess the nutritional value of food based on the chemical composition (proximate composition) of the food. The proximate composition of any food will include its content of protein, carbohydrate fat and oil, moisture and dietary fibre. In recent times, much emphasis on nutritional value of food is placed on the protein content and energy value of the food because most food contained carbohydrate in sufficient quantity. It has been proven that the combustion of 1g of protein yields 4kcal (17 KJ), the combustion of 1g of carbohydrate yields 4kcal (17KJ) of energy while the combustion of 1g of fat yields 9kcal (37 KJ) of energy. These values are called the physiological fuel value of food and are calculated by multiplying the concentration of protein, carbohydrate and fat by their respective Atwater value (James, 1984; Eneobong, 2001 and Lewis, 1990). The nutritional role of carbohydrates, protein, fat and oil, dietary fibre, ash and water have been extensively studied and reviewed by many authors (Onimawo and Egbekun, 1998; James, 1984; Beryl, 1997; Paul and Southgate, 1978).

Mangoes belong to the genus Mangifera, consisting of numerous species of tropical fruiting trees in the flowering plant family Anacardiaceae. Mango is indigenous to the Indian subcontinent and Southeast Asia. It is cultivated in many tropical regions and distributed widely in the world. The mango tree is erect 10-30m high, with a broad rounded canopy which may with age attain 30-38m in width or a more upright, oval, relatively slender crown. In deep soil, the tap root descends to a depth of 6 inches, the profuse wide spreading feeder root system also sends down many anchor roots which penetrate for several meters. The tree is long-lived, some specimens being known to be 300years old and still fruiting (Henry, 1988).

Fish feeds are expensive and can account to over two-third (2/3) of the variable cost of a fish culture operation and this has forced nutritionists to consider alternative source of plant- based protein and energy sources such as Soyabean, groundnut cake, maize, guinea corn and others at low cost for fish. In view of the scarcity and escalating costs of most conventional animal feed ingredients, it has become necessary to search for cheaper alternative nutrient sources to enhance fish culture development. Efforts geared towards substituting maize with cheaper substitutes have yielded positive results. Some industrial by-products, wastes and some under-utilized crops used as maize substitute in fish and livestock feed production include wheat offals (Igbinosun and Talabi, 1982), cassava peel (Faturoti and Akibote, 1986), yam peel (Fagbenro and Arowosoge, 1990), cocoa pod husks (Fagbenro, 1988), coffee pulp (Fagbenro and Arowosoge, 1991) and tigernut (Bamgbose et al., 1997; 2003) among others. In other to enhance the utilization potential of the fruit in the utilization prompted the proximate evaluation of nutritional value of mango, *Mangifera indica*. Therefore, the objectives of this study were: to determine the proximate composition of the seeds and peels of mango, *Mangifera indica*; and to evaluate based on the nutritive value, its potentiality as fish feed.

MATERIALS AND METHODS
Mango fruits were obtained from New Bussa. Samples of the mango peels and seeds were collected from the fruit and sun dried and ground into powdered form. However, the samples were carried to the laboratories of Grand cereals and Oil Mills limited, Jos, University of Agriculture, Abeokuta,

University of Jos and Institute of Agricultural Research and Training (I.A.R. & T.) Mooi Plantation, Ibadan for proximate analysis. Proximate analysis was carried out on the samples mango peel and seed meals according to the official methods of analysis described by the Association of Official Analytical Chemist (A.O.A.C., 1990). Moisture content was determined by drying to constant weight in an oven at 80-85°C for ten hours. Crude protein content or total nitrogen was determined by kjeldahl method, the total nitrogen obtained was converted to crude protein by multiplying with a conversion factor of 6.25 (AOAC, 1990). Crude fibre content was determined as the materials that were left after acid / alkali digestion. Crude lipid was determined by the soxhlet method, ether extract was used as the refluxing solvent for 6 hours (AOAC, 1990). Nitrogen Free Extract (NFE) was determined by subtracting the sum of moisture, ash, crude protein, ether extract and crude fibre (all expressed as g/kg) from 1000. NFE = 1000 – (moisture + ash + crude protein+ ether extract+ crude fibre) (g/kg). Ash content was determined by burning weighted samples inside porcelain crucibles in muffle furnace at 450°C for 12 hours (overnight). The residue was weighted and determined as ash content.

RESULTS AND DISCUSSION

The proximate analysis of mango peel and seed meals is presented in Tables 1 and 2. The moisture content of the mango peel meals was observed to follow the trend, sample 3 (9.70%) < sample 1(9.80%) < sample 2 (8.96%) < sample 4 (10.48%) while the moisture content of the mango seed meals followed the trend, sample 1 (9.50%) < sample 4 (9.76%) < sample 2 (9.82%) < sample 3 (10.48%).Onimawo and Egbekun (1998) stated that the presence of water in food is essential because it serves as an ideal medium for the transportation of nutrient and is also actively involved in various metabolic reactions. Other functions of water in human system are in the maintenance of heat within the body and in control of body temperature. Moisture content of the mango peel and seed meals are the same when compared to the range of values reported for other conventional feedstuff (8.70-14.85) and non-conventional feedstuff (9.0-15.0). Gabriel *et. al.*(2007). The water requirement of the body is 2300ml/day or 400ml/kg body weight which implies that the moisture content of the mango samples are less than the required amount. The amount of water formed from the metabolism of carbohydrate, protein and fat are 0.6g/g, 0.41g/g and 1.07g/g, respectively (Eneobong, 2001).

Table 1: Proximate analysis of peels of Mango

Proximate parameters	Sample 1	Sample 2	Sample 3	Sample 4	Mean
Moisture content	9.80	9.86	9.70	10.48	9.96
Ash	4.66	4.98	3.68	2.20	3.88
Fat	4.38	4.54	3.98	6.30	4.80
Crude Protein	4.27	4.08	4.42	4.49	4.32
Crude fibre	16.85	16.69	15.77	16.70	16.50
Carbohydrate	60.04	59.85	62.45	49.35	57.92

Table 2: Proximate analysis of seeds of Mango

Proximate parameters	Sample 1	Sample 2	Sample 3	Sample 4	Mean
Moisture content	9.50	9.82	10.48	9.76	9.89
Ash	2.33	2.00	2.30	3.70	2.58
Fat	12.50	12.80	8.30	12.60	11.55
Crude Protein	5.38	7.11	6.33	8.10	6.73
Crude fibre	14.30	13.89	2.01	12.20	10.60
Carbohydrate	55.99	54.38	70.58	53.64	59.34

Protein content of the mango peel meals followed the trend, sample 2 (4.08%) < sample 1(4.27%) < sample 3(4.42%) < sample 4 (4.49%) while the protein content of the mango seed meals was observed to follow the trend, sample 1 (5.38%) < sample 3 (6.33%) < sample 2 (7.11%) < sample 4 (8.10%). This implies that the metabolic water for mango peel samples 1, 2, 3 and 4 with respect to protein are 1.75g, 1.67g, 1.81g and 1.84g, respectively while the metabolic water for mango seed samples 1, 2, 3 and 4 with respect to protein are 5.86, 2.92, 2.60 and 3.32g, respectively. The physiological fuel values (PFV) of the mango peel samples due to protein are 17.08, 16.32, 17.68 and 17.96kcal, respectively while the physiological fuel values (PFV) of the mango seed samples due to protein are

21.52, 28.44, 25.32 and 32.40kcal respectively. Protein is essential in human system because it functions in the growth, support and movement (Eddy, 2004). It also needed in the transportation of gas, organ components, water and in metabolic regulation. Protein also plays vital roles in the body defense of system, the production of energy and amino acid, Hopwood (1975) and Fox and Cameron, 1984.The Protein energy in these by-products are <20% therefore, they are better recommended as energy sources in formulation of fish feed.

The trend for the carbohydrate content of the mango peel meals 1, 2, 3 and 4 was 4 (49.35%) < 2 (59.85%) < 1 (60.04%) < 3 (62.45%) while the trend for the carbohydrate content of the mango seed meals 1, 2, 3 and 4 was 4 (53.64%) < 2 (54.38%) < 1 (55.99%) < 3 (70.58%). The metabolic water for mango peel samples 1, 2, 3 and 4 due to carbohydrate are 3.60, 3.59, 3.75 and 2.96g, respectively while the metabolic water for mango seed samples 1, 2, 3 and 4 due to carbohydrate are 3.36, 3.26, 4.23 and 3.22g, respectively. The PFV for mango peel due to carbohydrate are 240.18, 239.40, 249.80 and 197.40 kcal, respectively while the PFV for mango seed due to carbohydrate are 223.96, 217.52, 282.32 and 214.56.40 kcal, respectively. The values observed for the carbohydrate in the mango peel and seed meals are comparable to values reported by Ilesanmi (1988) for water hyacinth leave (52.45%), Olude *et. al.* (2008) for copra meal (45.75%), Fasakin *et. al.* (2001) for water fern, *Azolla Africana* (34.10%) duckweed, *Spirodela polyrrhiza* (41.20%) and *Cassia fistula* seed meal (50.53%)

The trend for the fat and oil content of the mango peel was 3 (3.98%) < 1 (4.38%) < 4 (4.54%) < 2 (6.30%) while the trend for the fat and oil content of the mango seed was 3 (8.30%) < 1 (12.50%) < 4 (12.60%) < 2 (12.80%). The metabolic water content of samples of the mango peel was 3 (4.26g) < 1 (4.69g) < 4 (4.74g) < 2 (4.86 g) while the metabolic water content of samples of the mango seed was 3 (8.88g) < 1 (13.38g) < 4 (13.48g) < 2 (13.70g). The PFV for mango peel due to fat and oil are 39.42, 40.86, 35.82 and 43.20 kcal, respectively while the PFV for mango seed due to fat and oil are 112.50, 115.20, 74.70 and 113.40 kcal, respectively. The concentration of fat reported for Water hyacinth leave, copra meal Water fern, *Azolla Africana*, Duckweed, *Spirodela polyrrhiza* and *Cassia fistula* seed meal are 1.56, 5.50, 4.60, 4.0 and 3.14%, respectively. Ilesanmi, (1988); Olude *et. al.*, 2008 and Fasakin *et. al.*, 2001.The values are comparable to those of the mango peels and seeds. The dietary fibre in the mango peel followed the trend, 3 (15.77%) < 2 (16.69%) < 4 (16.70%) < 1 (16.85%) while the percentage dietary fibre in the mango seed samples was observed to follow the trend, 3 (2.01%) < 4 (12.20%) < 2 (13.89%) < 1 (14.30%). Dietary fibre (DF) is the portion of plant food that cannot be digested by fish alimentary enzymes (Eneobong, 2001). However, DF helps to form softer bulky stools (Achinewhu, 1996).

Table 3: Mean proximate analysis of peels and seeds of Mango

Proximate parameters	Mango peel meals	Mango seed meals
Moisture	9.96	9.89
Ash	3.88	2.58
Fat	4.80	11.55
Protein	4.32	6.02
Crude fibre	16.50	10.60
Carbohydrate	57.92	59.34

* Mean of the determination

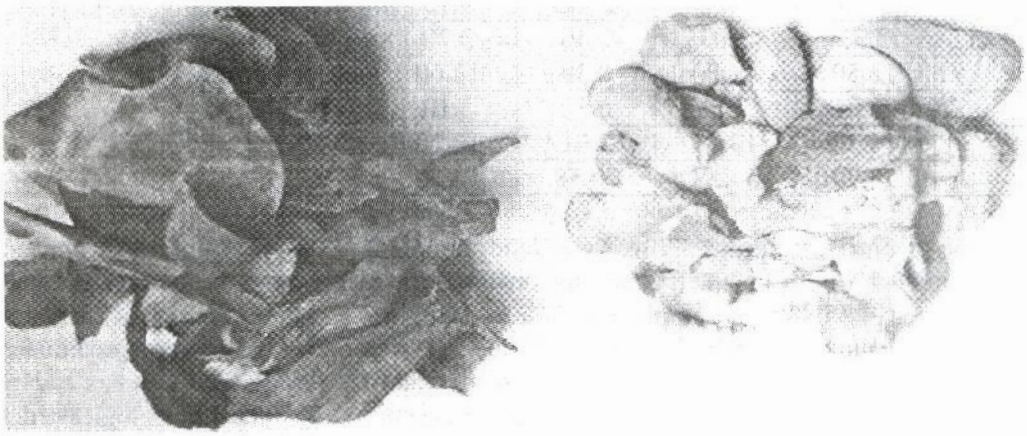

Plate 1: The peels and seeds of Mango, *Mangifera indica*

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