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Effect of Cooking Methods (Boiling and Roasting) on Nutrients and Anti-nutrients Content of *Moringa oleifera* Seeds

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Abstract: This study evaluated the effect of different cooking methods (boiling and roasting) on the nutrients and anti-nutrients content of *Moringa oleifera* seeds. The *Moringa oleifera* seeds were collected from Enugu state, Nigeria. The grains were picked, washed, drained and divided into seven portions. The first portion was raw and it served as the control. The second, third and fourth portions were boiled at different time intervals. The remaining fifth, sixth and seventh portions were roasted at different time intervals. With the roasting and boiling temperatures kept constant, the different time set up was 10 min, 20 min and 30 min. The nutrient and the anti-nutrients determination were done using various standards. Mean and standard deviation of the duplicate determinations were calculated. The result showed that boiling and roasting increased the protein, fibre, vitamin A, iron and zinc content. The result also showed that cooking techniques (boiling and roasting) decreased the tannin level but increased the saponin, phytate and oxalate levels. Because of the nutritive values of this under-exploited food crops, nutrition education workshops should be conducted to enlighten mothers on how to improve infants and adult foods with appropriate cooking methods on *Moringa oleifera* seeds.

Key words: Cooking methods, nutrients, anti-nutrients, *Moringa oleifera* seeds

INTRODUCTION

Poor dietary consumption in developing countries is the cause of malnutrition prevalence. To get rid of this malnutrition, *Moringa* will be one of the alternatives to most, imported food supplies to treat malnutrition (Khawaja *et al.*, 2010). The diet of many rural and urban dwellers is deficient in protein and high in carbohydrate. The implication is high incidence of malnutrition and increase in dietary disease; a situation in which children and especially pregnant and lactating women are most vulnerable.

In various parts of the world, the numbers of people that depend on traditional herbal remedies for their health are on the increase. The use of plant and plant products in health-care is much higher in communities that have no access to it. The knowledge and use of plant as species medicine is as old as the history of mankind. Experts tell us that 30% of children in Sub-Saharan Africa are protein-deficient. *Moringa* could be an extremely valuable food source because of its high nutrient profile (Fuglie and Lowell, 2001). *Moringa* can be used in fortifying sauces, juices, spices, milk, bread and most importantly instant noodles.

Moringa oleifera is considered one of the world's most useful trees, as almost every part of the tree can be used for food or has some other beneficiary property. *Moringa* is a special food for the tropics, because the tree is in full leaf at the end of scarce (Iwu, 1993). It is available all

year round. Almost all parts are used as food and forage for livestock (Ram, 1994). The part (leaves, fruits, flowers and immature pods) are edible and form part of traditional diet in many countries of the tropics and sub-tropics (Odee, 1998). The seeds are eaten as peas or roasted and consumed like nuts. The seed cakes left over after oil extraction (for cooking) are used as fertilizer and are also used for water treatment. In 1996, the church world service office in Dakar began studying the potential of *Moringa Oleifera* to combat the problem of malnutrition. Church World Service (CWS) in collaboration with the Senegalese Organisation AGADA (Alternative Action for African Development) carried out projects on prevention and cure of malnutrition using the products made from moringa tree. Through the project collaboration with local health posts, successful treatment of malnourished children with moringa has been well documented (Fuglie, 2001).

Malnutrition could be reduced by increase consumption of foods based on *Moringa oleifera*. Poor consumption of traditional foods is on the verge of extinction. Many communities due to poor nutrition education in Nigeria and other developing countries do not properly select what they consume many indigenous foods (fruits and vegetables) to their micronutrient needs (Timothy and Pablo, 2000).

Food processing transforms raw foods to edible forms. It also increases shelf-life, digestibility, flavor, nutritive

value among other benefits. Various foods presuppose different processing techniques depend on the needs and end products required (Okokon, 2004). Cooking has been known to bring about high complex reaction without having direct effect on nutritional value of food (Umeh and Bassir, 1977). Boiling is the most common method of cooking and is also the simplest. During boiling, the action of then heated water makes the food to get cooked. The liquid is usually thrown away after the food is cooked. Roasting is a cooking method that uses dry heat, whether an open flame, oven or other heat source. Roasting usually cause caramelization or Millard browning of surface of the food, which is considered flavor enhancement (Blaisdell, 2002). Roasting uses more indirect, diffused heat (as in oven) and is suitable for slower cooking of meat in a larger, whole piece (Blaisdell, 2002).

The aims of this article are:

- To determine the level of nutrients present in *Moringa oleifera* seeds processed at different time intervals (control, boiled and roasted).
- To determine the effect of the cooking methods (boiling and roasting) on the nutrient contents of *Moringa oleifera* seeds.
- To determine the level of antinutrients (tannins, phytate, saponins, oxalates) present in *Moringa oleifera* seeds (control, boiled and roasted).

MATERIALS AND METHODS

Materials and sources: *Moringa oleifera* seeds used for this study were collected from Enugu State, South Eastern Nigeria. One kilogramme of the grain was collected.

Sample preparation: The grains were picked, washed, drained and divided into seven portions. The first portion was raw and it served as the control. The second, third and fourth portions were boiled at different time intervals (10, 20 and 30 min). The remaining fifth, sixth and seventh portions were roasted at three different time intervals (10, 20 and 30 min). However, the roasting temperature was kept constant for the different time set up.

The seed was boiled in a pot with tap water in a ratio of 1:3 (weights of the seeds to three parts of water) for varying periods of 10, 20 and 30 min. After boiling, the seed was oven dried at 100°C for 5 hrs and hammer milled into fine flours. The other three portions were roasted in 3 different sauce pans for the different time setup and then dehulled. The dehulled seeds were winnowed to remove the hulls. The clean dehulled seed was milled into fine flour (70 mm screen sieve). The control seed was milled raw without any treatment. The boiled, roasted and raw flours were stored in a labeled polythene bags in a cool dry place until used for various analysis.

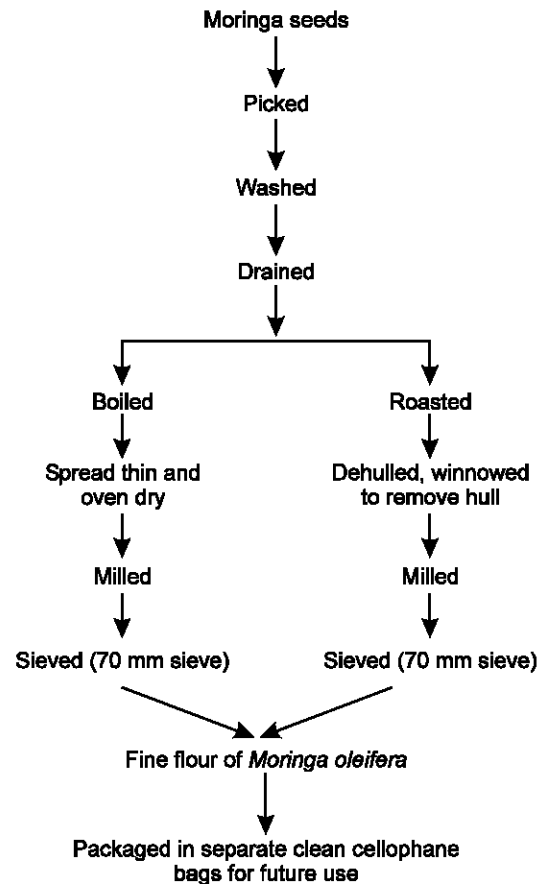


Fig. 1: The flow chart for preparation of boiled and roasted seeds of Moringa

Laboratory analysis

Proximate determination

Determination of moisture: The standard method of Association of Official Analytical Chemists, (AOAC, 2005) hot air oven method was used.

Ash determination: The ash content of the sample was individually determined by using (AOAC 2005) method.

Fat determination: The fat content of the sample was determined using Soxhlet extraction method described by AOAC (2005).

Protein determination: The protein content was determined using AOAC (2005) method.

Determination of fibre: The determination was done by using AOAC (2005) procedure.

Determination of carbohydrate: Carbohydrate content was obtained by difference. That is:

$$\% \text{ carbohydrate} = 100 - (\% \text{moisture} + \% \text{protein} + \% \text{fat} + \% \text{ash} + \% \text{fibre})$$

Mineral determination

Calcium composition: The standard method of AOAC (2005) was used to determine the level of calcium in the samples.

Iron composition: The phenanthroline method described by AOAC (1976) was used to determine the level of iron in the samples.

Zinc composition: The level of zinc in the samples was determined using Pearson (1976) method.

Vitamins determination

Vitamin A: Vitamin A content was determined using the method of chemical analysis of food described by Pearson (1976).

Vitamin B1: Vitamin B1 content was determined using the method of chemical analysis of food described by Pearson (1976).

Antinutrients determination

Tannins determination: Tannins was determined using Pearson (1976) method.

Phytate determination: Phytate was determined using Onwuka (2005) method.

Oxalate determination: Oxalate was determined using Pearson (1976) method.

Saponin determination: Saponin was determined using Harbone (1973) method.

Data analysis: The analysis was done in triplicates. The mean and standard deviation were calculated using SPSS (Statistical Packaged for Social Science) version 17.

RESULTS AND DISCUSSION

The result showed that the moisture content of Boiled *Moringa oleifera* seeds at 10, 20 min and 30 min interval

(14.87%, 19.02% and 19.43% respectively) were higher than the other samples. This implies that the boiled samples of *Moringa oleifera* seeds may not be kept for a longer time than the other samples because it will deteriorate faster than the others. The Roasted seeds at 30 min had the least moisture content (3.51%) when compared with the Control (6.78%) and the other processed seeds. This explains that roasting of the seeds at a longer time prolong its shelf life better than any other forms. The increase in proximate protein in the processed samples R2, B2 and B3 (32.04%, 28.98% and 28.90%) when compared with the Control (26.71%) (Table 1) reflects that some cooking treatments of the sample increase activity of proteolytic enzymes which hydrolyzed inherent proteins to their constituent amino acids and peptides (Jaffe, 1975). The protein content of B3 (32.04%) was the highest showing that boiling *Moringa oleifera* seeds at a longer interval increase the activity of the proteolytic enzymes. The protein content of the B3 (32.04%) is higher than the protein content of African oil seed (Alinnor and Eze, 2011) but lower than that obtained for the seed of *Luffa cylindrical* (43.1%) (Olaofe *et al.*, 2008). This shows that boiled *Moringa oleifera* seeds at a longer interval could be used as an alternative source of protein in human feed. The fat content of the Control had the highest value (30.59%) when compared with the processed samples; this means that treatment of *Moringa oleifera* seeds do not improve the fat contents of the seeds. The fat content of the Control is higher when compared with the fat content of soybean seeds (23.55%) (Paul and Southgate, 1985). The result indicates unprocessed *Moringa oleifera* seeds are a better source of oil than soybean seed hence it could be grouped under oil rich plant foods. Its seeds could also be a source of vegetable oil for domestic and industrial purposes. The comparable ash value for R2 and R3 (3.53% and 3.44% respectively) (Table 1) indicates that either of the two food processing methods could be used to increase ash content (inorganic nutrients) in *Moringa oleifera*. The lower ash for B1 (1.41%) (Table 1) might be due to utilization of minerals or leaching during cooking into their media.

Table 1: Proximate and micronutrient composition of *Moringa oleifera* seeds at different treatments

Nutrient (%)	R1	R2	R3	B1	B2	B3	C
Moisture	6.38±0.01	5.58±0.00	3.51±0.01	14.87±0.01	19.02±0.01	19.43±0.01	6.78±0.01
Protein	25.92±0.00	28.98±0.00	26.62±0.00	21.60±0.00	28.90±0.00	32.04±0.02	26.71±0.00
Fat	20.48±0.00	10.57±0.00	20.47±0.00	10.41±0.00	11.33±0.00	12.33±0.00	30.59±0.00
Ash	2.56±0.00	3.53±0.00	3.44±0.00	1.41±0.00	2.14±0.00	2.11±0.01	2.55±0.00
Fibre	3.68±0.00	3.71±0.00	3.75±0.00	1.86±0.00	2.11±0.00	2.25±0.00	1.41±0.00
CHO	40.98±0.00	47.63±0.00	42.21±0.00	49.85±0.00	36.50±0.00	31.84±0.01	31.96±0.00
Vitamin A	1.87±0.00	1.75±0.00	1.73±0.00	2.09±0.00	2.80±0.00	2.30±0.01	2.04±0.00
Vitamin B1	0.87±0.01	0.66±0.00	0.49±0.00	0.97±0.00	0.84±0.00	0.82±0.01	0.94±0.01
Calcium	0.74±0.00	0.64±0.00	0.57±0.01	0.89±0.01	0.58±0.01	2.56±0.01	0.55±0.00
Iron	0.77±0.01	0.77±0.00	0.79±0.01	0.38±0.00	0.40±0.01	0.40±0.01	0.38±0.00
Zinc	1.04±0.01	1.15±0.01	1.16±0.01	0.64±0.00	0.71±0.00	0.73±0.00	0.39±0.00

Mean±SD of triplicate determination. R1 = Roasted *Moringa oleifera* seeds at 10 min interval; R2 = Roasted *Moringa oleifera* seeds at 20 min interval; R3 = Roasted *Moringa oleifera* seeds at 30 min interval; B1 = Boiled *Moringa oleifera* seeds at 10 min interval; B2 = Boiled *Moringa oleifera* seeds at 20 min interval; B3 = Boiled *Moringa oleifera* seeds at 30 min interval; C = Control

Table 2: Anti-nutrient composition of *Moringa oleifera* seeds at different treatments

Anti-nutrient (%)	R1	R2	R3	B1	B2	B3	C
Saponin	0.20±0.00	0.35±0.01	0.34±0.00	0.42±0.00	0.41±0.00	0.46±0.00	0.12±0.00
Tannin	6.15±0.00	7.37±0.01	1.23±0.00	7.78±0.01	1.71±0.12	1.78±0.00	9.83±0.00
Phytate	3.89±0.01	3.89±0.01	5.85±0.01	11.70±0.01	5.85±0.01	3.9±0.000	3.28±0.00
Oxalate	3.58±0.01	3.25±0.00	2.87±0.00	2.52±0.01	2.88±0.01	3.13±0.01	2.87±0.00

Mean±SD of duplicate determinations. R1 = Roasted *Moringa oleifera* seeds at 10 min interval; R2 = Roasted *Moringa oleifera* seeds at 20 min interval; R3 = Roasted *Moringa oleifera* seeds at 30 min interval; B1 = Boiled *Moringa oleifera* seeds at 10 min interval; B2 = Boiled *Moringa oleifera* seeds at 20 min interval; B3 = Boiled *Moringa oleifera* seeds at 30 min interval; C = Control

The ash content of the Control (2.55%) was lower than the ash content of *Monodora myristica* seed and fluted pumpkin seed which are 6.50% and 4.80% respectively (Fagbemi and Oshodi, 1991). The fibre content of the Control (1.41%) was lower than that of the processed seeds. This explains that treatment of the seeds improves the fibre content of *Moringa oleifera* seeds. The high value of fibre content of R1, R2 and R3 (3.68, 3.71 and 3.75%) explains that roasting at a longer time increases the fibre content of the seeds. The lower carbohydrate content of the control was not surprising when compared with the processed samples (Table 1). This might solely be attributed to loss in moisture. The carbohydrate content of B1 (49.85%) had the highest value when compared to the other samples.

The higher vitamin A values of B1, B2 and B3 (2.09, 2.80 and 2.30 mg/100 g) when compared with the Control (2.40 mg) (Table 1) revealed that boiling increases the vitamin A content of *Moringa oleifera* seeds. It also explains that B1, B2 and B3 serve as the better source of this nutrient than the other samples. The higher vitamin B1 value of sample B1 (0.97 mg) when compared with the other samples showed that boiled *Moringa oleifera* seeds at 10 min interval is a better source of the nutrient than the other samples. The calcium content of the B3 sample had the highest value (2.56 mg) (Table 1) when compared with the other samples. This implies that short-boiling interval increase the calcium content of the *Moringa oleifera* seeds more than the other processing methods. The higher iron values of R1, R2 and R3 (0.77, 0.77 and 0.79 mg respectively) (Table 1) when compared to the other samples indicate that roasting had an edge over boiling for iron retention/availability in *Moringa oleifera* seeds. The higher iron value for R3 (0.79 mg) suggested that it is a better source of iron. The higher and comparable zinc values for R2 and R3 (1.15 and 1.16 mg) (Table 1) suggest that neither of the processed had an advantage to improve zinc quality in *Moringa oleifera* seeds. On the other hand, the increases in zinc suggest that micro-flora enzymes hydrolyzed the zinc-protein enzymes bonds to release much more free zinc for utilization. This result implies that roasting of *Moringa oleifera* seeds increases its zinc availability.

The saponin content of the samples was generally low (0.12-0.46 mg/100 g) (Table 2). The Control had the least saponin value (0.12 mg/100 g) which implies that

processing methods (boiling and roasting) increases saponin value of the *Moringa oleifera* seeds. Saponin has been shown to have both beneficial and deleterious properties and to exhibit structure dependent biological activities (Price *et al.*, 1987). The tannin composition ranged from 1.23-9.83 mg/100 g (Table 2). The Control had the highest value (9.83 mg/100 g) which explains that processing methods (boiling and roasting) reduces the tannin content of *Moringa oleifera* seeds. This is also an indication that the processed samples have good protein availability. Tannins are known to inhibit the activities of some digestive enzymes such as trypsin, chymotrypsin, amylase and lipase. They are also known to precipitate proteins in the gut; thereby making them unavailable. The boiled *Moringa oleifera* seeds at 10 minutes interval had the highest phytate value (11.70 mg/100 g) when compared with the other samples. The Control had the least phytate value (3.28 mg/100 g). This shows that processing methods increase the phytate content of *Moringa oleifera* seeds. Phytates are known to pose threat to leguminous seeds (Osagie, 1998). The oxalate composition varied from 2.52-3.58 mg/100 g.

Conclusion: There are few investigations regarding *Moringa oleifera* seeds. The result of this study showed that treatments (boiling and roasting) increases the availability of protein, fibre, vitamin A, iron and zinc. This implies that *Moringa oleifera* seeds should be consumed whole when boiled or roasted. It also showed that *Moringa oleifera* seeds had a good nutrient profile.

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