

Analysis of The Nutrient Content of Infant Complementary Food Fortificant - *Moringa oleifera* Leaves with the Commonly Consumed Local Infants Foods in Nigeria: *Zea mays* and *Glycine max*

ABSTRACT

Aims: Analysis of the nutrient content of maize (*Zea mays*), soybean (*Glycine max*) and *Moringa oleifera* leaves commonly consumed by infants in Nigeria were done to determine the nutrient composition of the complementary foods and leaves.

Methodology: Yellow maize (*Zea mays*) grain were fermented for 48h and oven-dried. Soybean (*Glycine max*) seeds were boiled for 1h, dehulled and oven-dried. *Moringa oleifera* leaves were shade-dried. All the food materials were milled into fine flours. The proximate, energy, mineral and β -carotene contents of the flours were determined using standard methods. The result was analyze using SPSS version 17 to determine the standard deviation (SD) and percentage nutrient composition in 100g sample.

Result: The proximate and energy composition of food materials (Maize, soybean and *Moringa oleifera* leaves) used. The crude protein level was 36.46% in soybean, 27.45% and 10.22% in *Moringa oleifera* leaves and maize respectively. The energy level was 1,849KJ in soybean, 1,531KJ in maize and 1,134KJ in *Moringa oleifera* leaves. The minerals and β -carotene contents of maize, soybean and *Moringa oleifera* leaves (%). Calcium was 1,335mg in *Moringa oleifera* leaves, 14.49mg in soybean and 11.67mg in maize. *Moringa oleifera* leaves had 26.44mg iron, soybean had 9.65mg and maize had 5.95mg. Zinc level was 7.49mg in *Moringa oleifera* leaves, 3.46mg in soybean and 1.87mg in maize. β -carotene was 3,846.15RE in *Moringa oleifera* leaves, 538.46RE in soybean and 102.56RE in maize.

Conclusion: Incorporation of pulverized *Moringe oleifera* leaves in infants' food could diversity food intake, ensure food security and reduce some micronutrient deficiency diseases.

Key words: *Nutrient Content, Complementary Food Fortificant, Moringa oleifera, Zea may and Glycine max*

Introduction

Malnutrition is a major public problem of infants and young children in Nigeria. The problem is more common amongst children aged 6 months to two years. This coincides with the period of complementary feeding- when the family food is gradually being introduced to the child^(1, 2). Research showed that PEM at 6 months to 2 years was 43.1% while moderate and severe malnutrition was 22.3% in Nigeria⁽³⁾. There is equally high rate/level of stunting and wasting among these children. The high rate of malnutrition was attributed to the infants been introduced to poor complementary foods, which

are inadequate in protein, energy and micronutrients. In effect, vitamin A deficiency among these children is higher than 16% in some regions in Nigeria⁽⁴⁾ while anemia is as high as 50%.⁽³⁾

Unfortunately, a lot of works have been done which addressed protein-energy malnutrition, but there is still gap in micronutrient deficiency problem. To address these nutritional problems, nutritious complementary foods could be formulated from locally available foods. This study would explore the nutrient content of maize (*Zea mays*), soybean (*Glycine max*) and *Moringa oleifera* leaves commonly consumed by infants in Nigeria.

Methodology

Materials

Yellow maize (*Zea mays*) seeds, soybean (*Glycine max*) seeds and *Moringa oleifera* (Drum stick) leaves were used for the study. The maize and soybean were purchased in bulk from New Market, Enugu. The *Moringa oleifera* leaves were obtained from trees in a family farm in the Government Reserved Area (GRA) Enugu, Nigeria.

Preparation of materials

Maize

Eighteen kilogrammes (18kg) of yellow maize were hand-picked and cracked with a laboratory harmer-mill (Thomas Willey, mold ED-5) to separate the bran from the grain. The cracked grains were winnowed to remove the bran. The seeds were then steeped in water in a ratio of 1:3 weight of grain/volume of water (w/v) and allowed to ferment at $28 \pm 2^{\circ}\text{C}$ (ambient temperature) for 48h by the micro flora inherent in the seed. The water was changed after 24h to remove sour taste. At the end of the fermentation period, the grains were drained, dried in hot air oven at 55°C for about 10h, dry milled and packaged in polythene bags as fermented maize flour and stored frozen at a temperature of -4°C until when used.

Soybean

Fifteen kilogrammes (15kg) of soybean seeds were cleaned by hand-picking. The samples were boiled with water in the ratio of 1:3 weight of seeds/volume of water (w/v) for 1h. The grains were dehulled manually and dried in a hot air oven (Gallenkamp BS oven, model 320) at 55°C for about 10h and milled in a laboratory harmer mill (Thomas Willy, Model ED-5) to a fine flour (70mm mesh screen). The flour was packaged in a polythene bag and stored frozen at -4°C until used.

Moringa oleifera leaves

Eight kilogrammes (8kg) of fresh *Moringa oleifera* leaves were plucked, washed and drained, shade-dried, pulverized and packaged in polythene bag and stored in the freezer at -4°C until used.

Chemical analysis

Proximate analysis

Determination of moisture and ash content was done using AOAC method^(5, 6). Crude fibre was determined by Joselyn method^(5, 6). Protein content was determined using micro-Kjeldahl method of AOAC^(5, 6), carbohydrate was determined by difference method, determination of fat, AOAC Soxhlet system HT2 method was adapted^(5, 6) and Energy was determined by the "Atwater factor" formula.

Pro-vitamin A (beta carotene) was determined using AACC method⁽⁷⁾. The method described by Ranjham and Gapal was used to determine calcium, iron and zinc⁽⁸⁾. The iron, zinc and calcium were analyzed using absorption spectrophotometric method.

RESULTS

Table1 presents the proximate and energy composition of food materials (Maize, soybean and *Moringa oleifera* leaves) used. Moisture levels were 8.84% in *Moringa oleifera* leaves, 10.26% in maize and 6.66% in soybean. The crude protein level was 36.46% in soybean, 27.45% and 10.22% in *Moringa oleifera* leaves and maize respectively. Fat (ether extract) was 21.07% in Soybean, 3.47% in maize and 2.27% in *Moringa oleifera* leaves. Ash values ranged from 7.85% in *Moringa oleifera* leaves and 4.22% in soybean while maize had 1.80%. Crude fibre was 19.24% in *Moringa oleifera*

leaves, 5.06% in soybean and 1.98% in maize. Carbohydrate was 72.28% in maize, 34.34% and 26.44% in *Moringa oleifera* leaves and soybean, respectively. The energy level was 1,849KJ in soybean, 1,531KJ in maize and 1,134KJ in *Moringa oleifera* leaves.

Table1: Proximate and energy composition of maize, soybean and *Moringa oleifera* leaves (%).

Nutrients	Maize	Soybean	<i>Moringa oleifera</i> leaves
Moisture	10.26 ± 0.01	6.66 ± 0.02	8.84 ± 0.01
Crude protein	10.22 ± 0.03	36.46 ± 0.01	27.45 ± 0.03
Fat	3.47 ± 0.01	21.07 ± 0.02	2.27 ± 0.01
Ash	1.80 ± 0.02	4.32 ± 0.03	7.85 ± 0.01
Crude fibre	1.98 ± 0.01	5.06 ± 0.01	19.24 ± 0.02
CHO	72.28 ± 0.02	26.44 ± 0.02	34.34 ± 0.01
Energy (KJ)	1,531 ± 0.5	1,849 ± 1.28	1,134 ± 0.50

Mean ± SD of three determinations

Table 2 presents the proximate and energy composition of food materials (maize, soybean and *Moringa oleifera* leaves) used on dry matter basis per 100g sample. The protein was 11.39% in maize, 39.06% and 30.11% in soybean and *Moringa.oleifera* leaves respectively. Maize had 3.87% fat, soybean 29.57% and *Moringa oleifera* 2.49%. Crude fibre was 2.21%, 5.42% and 21.10% in maize, soybean and *Moringa oleifera* leaves respectively. Ash was 2.01%, 4.63% and 8.61% in maize, soybean and *Moringa oleifera* respectively. Carbohydrate ranges from 28.33% in soybean to 37.66% in *Moringa oleifera* and 80.54% in Maize. Energy was 1,706KJ in maize, 1,981KJ in soybean and 1,244KJ in *Moringa oleifera* leaves.

Table 2: Mean proximate composition of maize, soybean and *Moringa oleifera* leaves on dry matter basis (%)

Nutrients	Maize	Soybean	<i>Moringa oleifera</i> leaves
protein	11.39±0.03	39.06±0.01	30.11±0.03
Fat	3.87±0.01	29.57±0.02	2.49±0.01
Ash	2.01±0.02	4.63±0.03	8.61±0.01
Crude fibre	2.21±0.01	5.42±0.01	21.10±0.02
Carbohydrate	80.54±0.02	28.33±0.04	37.66±0.01
Energy (KJ)	1,706±0.54	1,981±1.28	1,244±0.50

Mean ± SD of three determinations

Table 3 shows the minerals and β-carotene contents of maize, soybean and *Moringa oleifera* leaves (%). Calcium was 1,335mg in *Moringa oleifera* leaves, 14.49mg in soybean and 11.67mg in maize. *Moringa oleifera* leaves had 26.44mg iron, soybean had 9.65mg and maize had 5.95mg. Zinc level was 7.49mg in *Moringa oleifera* leaves, 3.46mg in soybean and 1.87mg in maize. β-carotene was 3,846.15RE in *Moringa oleifera* leaves, 538.46RE in soybean and 102.56RE in maize.

Table 3: Minerals and β-carotene contents of maize, soybean and *Moringa oleifera* leaves (mg/100g)

Nutrient	Maize	Soybean	<i>Moringa oleifera</i> leaves
Calcium	11.67 ± 0.01	14.49 ± 0.04	1,335 ± 0.10
Iron	5.95 ± 0.02	9.65 ± 0.01	26.44 ± 0.04
Zinc	1.87 ± 0.01	3.46 ± 0.01	7.49 ± 0.02
β – carotene (RE)	102.56 ± 0.00	538.46 ± 0.00	3,846.15 ± 0.00

Mean ± SD of three determinations

Table 4 shows the minerals and β-carotene contents of soybean, maize and *Moringa oleifera* leaves (dry weight basis: mg/100). Calcium of maize was 13.00mg, soybean was 15.52mg and *Moringa oleifera* leaves 1,464.36mg. Maize had 6.63mg iron, soybean had 10.34mg and *Moringa oleifera* leaves had 31.60mg. Zinc was 2.09mg in maize, 3.71mg in soybean and 8.22mg in *Moringa oleifera* leaves β-carotene was 102.56RE in maize, 538.46RE in soybean and 3846.15RE in *Moringa oleifera* leaves.

Table 4: Minerals and β- carotene contents of maize, soybean and *Moringa oleifera* leaves (dry matter basis, mg/100g)

Nutrient	Maize	Soybean	<i>Moringa oleifera</i> leaves
Calcium	13.00±0.01	15.52±0.04	1,464.36±0.10
Iron	6.63±0.02	10.34±0.01	31.60±0.02
Zinc	2.09±0.01	3.71±0.01	8.22±0.02
β – carotene (RE)	102.56 ± 0.00	538.46 ± 0.00	3,846.15 ± 0.00

Mean ± SD of three determinations

DISCUSSION

Proximate and energy composition of maize, soybean and *Moringa oleifera* leaf

The protein level of maize (10.22%) was higher than reported by Ihekoronye and Ngodi ⁽⁹⁾. This could be as a result of maize variety and fermentation of the sample. During fermentation, there is microflora hydrolysis of protein into free amino acids (AAs) and subsequent synthesis of free AAs to new protein ⁽¹⁰⁾. The protein content of soybean (36.46%) was similar to that recorded by George (36.50%)⁽¹¹⁾. It is equally similar to that reported by Osho (40.00%)^(12, 13) and Ene-

Obong and Carnovale (43.00%) on dry matter basis (39.06%)⁽¹⁴⁾. This is high because soybean is one of the richest natural food sources of protein. The protein content of *Moringa oleifera* leaves (27.45%) was similar to that recorded by Fuglie 27.1%⁽¹⁵⁾. However, it was higher than that observed by Okoyeh and Obizoba (16.75%)⁽¹⁶⁾. The high protein level could be due to method of processing.

The 21.07% ether extract of soybean confirms that it is an oil seed. Food and Agricultural Organization documented that soybean seed was the largest single producer of edible oil and account for roughly 50% of the total oilseed production of the world⁽¹⁷⁾. Maize has 3.47% fat which is close to 4.6% reported by Ihekoronye and Ngoddy^(12, 13). *Moringa oleifera* leaves with 2.27% fat content were normal because leafy vegetables are known to be poor sources of fat⁽¹⁸⁾.

The high fibre (19.24%) of *Moringa oleifera* leaves is of interest because fibre is important for effective digestion. Research by different groups recorded similar high fibre levels for *Moringa oleifera* leaves.^(15, 16, 19) The fibre level of maize (1.98%) was in line with that reports.^(9, 20) This low level of crude fibre of maize could be as a result of fermentation which decreases the crude fibre value of plant food products⁽²¹⁾. This is due to increased hydrolytic activities of enzymes inherent in the grains which hydrolyze complex carbohydrate to increase the level of true sugars⁽²²⁾. Soybean had 5.06% fibre which is lower than that reported by George (9.3%)⁽¹¹⁾. The low fibre content of processed soybean is an advantage for the formulation of low fibre infant complementary food. This is because bulk would be reduced and nutrient intake increased. This is particularly important because of the small stomach capacity of the infants.

The high (7.85%) ash content of *Moringa oleifera* leaves was suggestive of high mineral content. This is in line with Fuglie who noted that Moringa family is rich in a number of minerals⁽¹⁵⁾. Soybean also had high (4.32%) ash level, which is indicative of high mineral content. The result supports George who documented that the soybean is possibly the richest natural food that exists in protein, minerals and vitamins⁽¹¹⁾. The ash content of maize (1.80%) is similar to that reported by Onuoha and Okeke (1.24%) and Ihekoronye and Ngoddy (3%)^(9, 20).

The high carbohydrate content of maize (72.28%) was not a surprise. Maize is a staple (cereal) high in carbohydrate. The carbohydrate level of soybean is low (26.44%) because it is an oil seed with high protein level. *Moringa oleifera* leaves had moderate carbohydrate level as a result of drying which concentrated nutrients. This led to high energy level (1134KJ). The high energy level (1849KJ) of soybean in this study was probably due to high fat content of the seed. This is of advantage to underweight children and even wasted adults. Soybean could also be used to boost the energy intake of infants and individuals who are critically ill.

Mineral and B-carotene of maize, soybean and *Moringa oleifera* leaves.

Soybean and maize had low calcium (14.49 & 11.67mg), moderate iron (9.65 & 5.95mg) and zinc (3.46 and 1.87mg) and appreciable quantity of β -carotene (538.46 & 102.56%). The calcium level of *Moringa oleifera* leaves was as high as 1335mg/100g. It was close to 2,003mg/100g observed by Figlie⁽¹⁵⁾. The tree for life organization noted that "Ounce for ounce" (gramme for gramme); Moringa leaves contain more vitamin A than carrots, more calcium than milk, more iron than spinach, more vitamin C than oranges, and more potassium than banana", and that the protein quality of Moringa leaves rivals that of milk and egg⁽²³⁾. The high calcium content of Moringa leaves makes it suitable for infant complementary food since infants need calcium for bone and teeth formation. The iron was high (26.44%), zinc significant (7.49%) and β -carotene very high (3846.15RE). Fahey noted that the *Moringa oleifera* tree is extraordinary in that all parts of the tree are edible and has exceptionally high nutrient content.⁽²⁴⁾

Conclusion

Incorporation of pulverized *Moringa oleifera* leaves in infants' food could diversity food intake, ensure food security and reduce some micronutrient deficiency diseases. *Moringa oleifera* leaves processing and utilization through nutrition education should be encouraged amongst mothers and caregivers. *Moringa oleifera* tree cultivation around homes would ensure availability all year round to reduce micronutrient disease during fruits and vegetables off season.

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