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NUTRIENT COMPOSITION OF BISCUIT MADE FROM YELLOW COCOYAM (*Colocasia esculenta*), YAM (*Discorea rotundata*), CASSAVA (*Manihot esculenta*) AND WHEAT (*Triticum aestivum*) COMPOSITE FLOUR

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ABSTRACT

Background: Tubers especially cocoyam is highly underutilized and considered food for the poor in Nigeria. The study evaluated the nutritional potentials of these tubers and how to increase the utilization in the production of biscuits which is widely consumed by all age groups. The proximate, mineral and vitamin composition of biscuit made from yellow cocoyam, yam, cassava and wheat composite flour was determined.

Materials and Methods: The tubers were processed into flour using standard method. The biscuits were made using standard recipe and labelled: Sample A (50%cocoyam, 20% yam, 20% cassava, 10% wheat), Sample B (60%cocoyam, 10% yam, 10% cassava, 20% wheat), Sample C (40%cocoyam, 20% yam, 20% cassava, 10% wheat) and Sample D (100%cocoyam). The proximate, mineral and vitamin composition of samples were determined using standard analytical procedures. Data was analyzed and compared statistically using one-way analysis of variance.

Results: The result shows that the value of carbohydrate ranged from 60.44% in sample B to 66.3% in sample D. Protein content was highest in sample B (19.96%) while sample C had the least value of 13.1%. Fat level differed significantly among the samples ($P<0.05$) with sample A having the highest value of 16.96%. Moisture level was highest in sample D (4.44%), crude fibre was most found in sample A (2.01%) while sample C contained the highest value of ash (3.81%). Mineral results showed that copper in all samples significantly differed, with sample A having the highest value 5.96mg/100g. Zinc levels varied from 23.30mg/100g in sample C to 36.80 mg/100g in sample A. There was significant difference ($p<0.05$) in potassium values among the samples. Sodium was highest in sample C(0.81mg/100g), calcium was highest found in sample B (0.096mg/100g) and least in sample C (0.002mg/100g). Iron levels ranged from 53.51mg/100g in sample D to 59.03mg/100g sample A. Beta carotene content of sample C was highest(0.21mg/100g) followed sample B (0.16mg/100g). Vitamin B_2 ranged from 1.89mg/100g in sample D to 3.63 in sample C. The value of vitamin C differed significantly among the samples ranging from 1.76mg/100gin sample A to 2.89mg/100g in sample C.

Conclusion: Commercial bakers in Nigeria can incorporate local flours in baking to improve the mineral contents of the products especially iron with reduced sodium content. This will as well enhance dietary diversification and utilization of local crops.

Keywords: *Cocoyam, Yam, Cassava, Wheat, biscuits*

INTRODUCTION

Biscuit is the most consumed snacks in Nigeria, as it is eaten across people of all age groups. They are mostly prepared from cereal flours and made into palatable dough and baked in an oven (1). The dough is not allowed to ferment like in bread making as reported by Adeleke (2). Various ingredients like sugar, milk, flavouring agents and chemical additives are incorporated to enhance the nutritive and sensory quality of biscuits. Among all cereals, wheat is widely used because of its ability to form dough due to cohesive nature of gluten (3). However, the rising cost of importation of wheat flour into Nigeria demands that locally available alternative sources from composite flour that will substitute or supplement wheat flour is needed to reduce the economic burden and diversify our local produce (4). Composite flours are defined as mixture of several flours obtained from roots and tuber, cereals and legumes with or without the addition of wheat flour (1, 4). The use of composite flour improves nutritive quality of products made from them as well as increases dietary diversity. In choosing the components of composite flour, it is necessary to select readily available and culturally acceptable foods with nutrient potential (5, 6).

Yam (*discorearotundata*) is a major staple food in tropical countries of West Africa and beyond. It is

consumed in different ways like flour, boiled and eaten with oil, fried or roasted. It is also used as a thickener in white soup (Nsala) consumed among Niger Delta states of Nigeria. Currently it has been used by industries in making custard powder (7).Yam is also made into fufu and eaten with soup in different parts of Nigeria as pounded yam. Similarly, cocoyam (*colocassia esculenta*) is another common tuber consumed in different forms in Nigeria but the utilization of cocoyam is limited when compared with yam, also, many people perceive it to be food for poor people (8).Cocoyam has different varieties, most of them are consumed mostly with red oil after boiling or pounded into fufu and eaten with soup. It also serves as soup thickener in South Eastern Nigeria. Nutritionally, it contains substantial amount of protein, fibre, vitamin C, thiamine, riboflavin, potassium, magnesium, phosphorus and easily digestible starch (1,2,5). The major resentment with cocoyam consumption comes with the scratchiness in the throat when poorly cooked due to presence of glucosides on the peels. Presence of alkaloids, saponin and calcium oxalate are reported to limit the use in food systems (1).

Cassava (*manihot esculenta*) is another well-known root crop across Africa and Asia. In Nigeria, it is most popular because of various ways it could be consumed; tapioca, cassava fufu, garri, cassava cake, lafun and starch. This wide utilization is encouraged by the yield on the farm (9,10). Improved species of cassava UMUCASS 36, UMUCASS 37 AND UMUCASS 38 are being grown for their high concentration of beta-carotene, a precursor of vitamin A which has a public health importance of reducing vitamin A deficiency among growing children. However, these species are lower in protein and have higher perishability compared to the conventional types (9,11).Wheat (*triculumaetivum*) has unique properties in confectionary production above any other flour.Huge revenue accrues to nations like USA and Mali who are leading exporters of the commodity (12). This study was not aimed at reducing the income of other nations but to enhance the utilization of locally available crops and increase the income of Nigeria through exportation of the products. Besides reducing the over dependence on wheat flour biscuit making, the use of composite flour will encourage dietary diversification and cultivation of underutilized staples. The study seeks to supplement wheat flour with composite flour from yam, cocoyam and cassava to produce nutrient dense biscuits.

Materials and Methods

Source of materials

Yam tubers and wheat flour were purchased from Eke Umuagwo market, Ohaji-Egbema local government area, Imo State. Cocoyam tubers were harvested from Imo state Polytechnic Umuagwo cocoyam farm. Cassava flour was obtained at Imo State Polytechnic cassava processing while other ingredients; sugar, vanilla flavor, eggs, nutmegs and baking powder were purchased from Eke-Ukwu Owerri, Imo state.

Preparation of yam and cocoyam flour

Cocoyam tubers were peeled and cut into thin slices using kitchen knife and blanched with sodium meta-disulphide to prevent browning reaction. The sliced cocoyam was dried in gas moisture oven (model 689) in the food science laboratory at temperature a temperature of 70^0C for 30 minutes and milled using attrition mill. The flour was sieved through a 250nm mesh and stored in all an air tight container after cooling according to the method of Singh (13) and (14). The same procedure was used to process yam flour.

Composite flour formulation.

The flours were mixed in different ratios using a Kenwood mixer at speed 4 for 4 minutes to obtain a uniform composite mixture in different ratios as follows;

Sample A= 50%cocoyam, 20%yam, 20%cassava and 10%wheat
Sample B= 60% cocoyam, 10%yam, 10%cassava and 20%wheat
Sample C= 40%cocoyam, 20%yam, 20cassava and 10%wheat
Sample D=100% cocoyam.

Recipe for biscuit production

Ingredients: Margarine (40g), baking powder (1.0g), milk powder (7.5g), sugar (2.5g), vanilla flavor (5.0ml), salt (1.0g), nutmeg (0.3g), egg (31.2g) and flour (100g). All measurements were carried out using a digital kitchen scale.

Flour and powdered ingredients were sieved to remove crumbs and measured out according to different sample of biscuit. Margarine was cut into pieces and rubbed into the composite flour until a coarse crumb is derived. Granulated sugar and full fat milk were subsequently added and the mixture was kneaded into smooth dough and refrigerated for 15minutes. The dough samples were moulded into different shapes and sizes, greased with butter and panned. Also, the baking trays were greased with margarine. Baking was done in preheated gas oven for 50minutes at a temperature of 180^0C. The biscuits samples were removed from

oven, cooled and packaged in an air tight cellophane until needed. Flow chart is shown in figure 1.

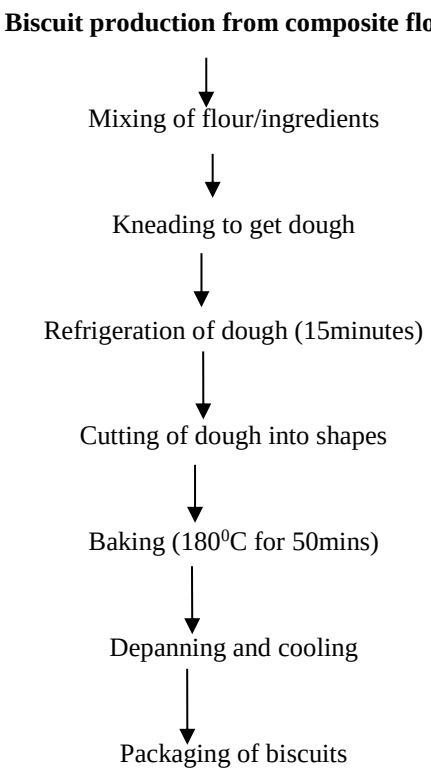

Figure 1: Flow chart for production of biscuits from composite flour.

Chemical analysis

Proximate composition; moisture content, carbohydrate, protein, fat and ash were determined by AOAC (15). Mineral determination; Sodium, manganese, potassium, magnesium, calcium, copper, zinc and iron were carried out using AOAC (16)**.** Beta carotene, vitamin C and vitamin B2 were also determined using atomic absorption spectrophotometer absorbance method described by AOAC (16).

Statistical Analysis

The value obtained from chemical evaluation were subjected to analysis of variance (ANOVA) using SPSS package version 20 to separate the means at 0.5 level of significance.

RESULTS

Table 1 shows the proximate composition of the samples. Carbohydrate value ranged from 60.44% in sample B to 66.3% in sample D. protein content was highest in sample B (19.96%) while sample C had the least value of protein (13.1%). Fat level differed significantly among the samples (P<0.05) with sample A having the highest value of 16.96%. Moisture level was highest in sample D (4.44%), crude fibre was most found in sample A (2.01%) while sample C contained the highest value of ash (3.81%).

Table 1: Proximate Composition of Biscuit Samples (%)

Parameters	Sample A	Sample B	Sample C	Sample D
Moisture	2.18 ^{a} ±0.01	2.43 ^{b} ±0.00	3.05 ^{c} ±0.01	4.44 ^{d} ±0.01
Carbohydrate	61.5 ^{b} ±0.01	60.44 ^{d} ±0.01	64.44 ^{c} ±0.01	66.3 ^{d} ±0.01
Protein	14.34 ^{c} ±0.0	19.96 ^{d} ±0.01	13.1 ^{a} ±0.00	13.6 ^{b} ±0.01
Fat	16.96 ^{d} ±0.02	14.27 ^{c} ±0.01	14.2 ^{b} ±0.01	11.73 ^{d} ±0.01
Crude fibre	2.01 ^{d} ±0.01	1.11 ^{d} ±0.01	1.48 ^{b} ±0.01	1.96 ^{c} ±0.01
Ash	3.05 ^{c} ±0.01	1.84 ^{d} ±0.01	3.81 ^{d} ±0.01	2.02 ^{b} ±0.01

Values with different superscript are significantly different (p<0.05) in rows, while those the same superscript are not significantly different.
Sample A: 50%cocoyam, 20% yam, 20% cassava, 10% wheat
Sample B: 60%cocoyam, 10% yam, 10% cassava, 20% wheat
Sample C: 40%cocoyam, 20% yam, 20% cassava, 10% wheat
Sample D: 100%cocoyam

Table 2 presents the mineral composition of the biscuit samples produced from composite flours. The result shows that the value of copper in all samples significantly differed, with sample A having the highest value 5.96mg/100g. Zinc levels varied from 23.30mg/100g in sample C to 36.80 mg/100g in sample A. The level of magnesium was similar in all samples 0.06mg/100g to 0.08 mg/100g. There was significant difference (p<0.05) in potassium values among the samples. Sodium was highest in sample C(0.81mg/100g), calcium was highest found in sample B (0.096mg/100g) and least in sample C (0.002mg/100g). Notably, iron levels ranged from 53.51mg/100g in sample D to 59.03mg/100g sample A.

Table 2: Mineral composition of biscuits samples (mg/100g)

Parameters	Sample A	Sample B	Sample C	Sample D
Copper	5.96^{d}±0.02	4.34^{a} ± 0.01	4.75^{b} ± 0.00	5.80^{c} ± 5.81
Zinc	30.04^{c} ± 0.01	29.15^{b} ± 0.06	23.20^{a} ± 0.00	36.80^{d} ±0.04
Magnesium	0.06^{a} ± 0.00	0.06^{a} ± 0.00	0.06^{a} ± 0.00	0.08^{b} ± 0.00
Potassium	0.73^{a} ± 0.01	1.28^{d} ± 0.00	0.77^{b} ± 0.00	1.11^{c} ± 0.00
Sodium	0.75^{c} ± 0.00	0.59^{a} ± 0.00	0.81^{d} ± 0.00	0.67^{b} ± 0.00
Calcium	0.086^{b} ± 0.00	0.096^{d} ± 0.07	0.02^{a} ± 0.00	0.09^{c} ± 0.00
Manganese	10.51^{b} ± 0.01	11.99^{c} ± 0.00	10.51^{a} ± 0.01	14.49^{d} ± 0.01
Iron	59.03^{d} ± 0.03	56.51^{c} ± 0.02	55.01^{b} ± 0.01	53.51^{a} ± 0.01

Values with different superscript are significantly different ($p<0.05$) in rows, while those the same superscript are not significantly different.
Sample A: 50%cocoyam, 20% yam, 20% cassava, 10% wheat
Sample B: 60%cocoyam, 10% yam, 10% cassava, 20% wheat
Sample C: 40%cocoyam, 20% yam, 20% cassava, 10% wheat
Sample D: 100%cocoyam

Vitamin composition of the biscuits samples is presented in Table 3. Beta carotene content of sample C was highest(0.21mg/100g) followed sample B (0.16mg/100g). Vitamin B_2 ranged from 1.89mg/100gin sample D to 3.63 in sample C. The value of vitamin C differed significantly among the samples ranging from 1.76mg/100gin sample A to 2.89mg/100g in sample C

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Table 3: Vitamin composition of biscuits samples (mg/100g)

Parameters	Sample A	Sample B	Sample C	Sample D
Beta carotene	0.12^{b}±0.01	0.16^{c} ± 0.01	0.21^{b} ± 0.00	0.11^{a} ± 0.00
Vitamin B2	2.23^{b} ± 0.00	2.45^{c} ± 0.00	3.63^{d} ± 0.00	1.89^{a} ±0.04
Vitamin C	1.76^{a} ± 0.00	2.15^{c} ± 0.00	2.89^{d} ± 0.00	1.98^{b} ± 0.00

Values with different superscript are significantly different ($P<0.05$), while those the same superscript are not significantly different.
Sample A: 50%cocoyam, 20% yam, 20% cassava, 10% wheat
Sample B: 60%cocoyam, 10% yam, 10% cassava, 20% wheat
Sample C: 40%cocoyam, 20% yam, 20% cassava, 10% wheat
Sample D: 100%cocoyam

Discussion

Biscuit is a major snack consumed by both young and old and as such should contribute meaningfully in nutrition sense. The proximate value of biscuit made from blends of cocoyam, yam, cassava and wheat show that carbohydrate content range from 60.5% - 66.3%, sample D contained the highest amount. These were within recommended dietary allowance (60-65%) for healthy people across age groups. The carbohydrate range was similar to the work of Adebiyi, and Agwo, (17). who reported a range of 51.68%−72.73% in biscuit made from composite flour of cassava and soymilk. The carbohydrate value will add to body requirement of calories. Srilakshmi (18) reported that growing children between the ages of 10-12years requires 2010-2190kcal/day, which can be met by consumption of healthy snacks. Basically, it is important people use the nutrition facts to distribute their daily allowance for energy. But the carbohydrate value changed with the ratio of wheat and cocoyam flour added. The moisture range (2.18%-4.44%) was smaller than the amount found by Adebiyi, *et al.* (17). (7.27%−8.15%), this may be attributed to protein from soymilk as protein have affinity for moisture. Titilope and Aabdulresak (19) found moisture value of 4.9 – 5.5% in commercial biscuits sold in Nigeria. The protein value (13.1%−19.9%) was slightly higher than the amount found in most commercial biscuits (8.6 – 12.0%) according to Titilope and Abdulrasek (19). This means that biscuit can contribute dietary protein allowance of an individual. Protein is necessary for growth in children and maintenance of wormout tissues in adults. Crude fibre content ($1.11 \pm 0.01\% - 2.01 \pm 0.01$) was slightly lower than the value found in the commercial biscuits (2.09 – 2.81%), this can be attributed to the grating and sieving which could have removed substantial amounts of naturally occurring fibre from the products. People who consume a lot of biscuits and snacks made from flours generally must find alternative sources of dietary fibre like fruits and vegetables (20). The American Health Foundation recommends fibre for children 3-20 years, their requirement is the age of the child plus 5g dietary fibre (18), although no recommendations were made for children from the developing countries. Fat can increase the overall energy contribution of biscuits but this study found a lower value of 11.73%−16.96% which is below the RDA for most healthy individual but could benefit those on low calorie diet for weight reduction, diabetes or risk of cardiovascular diseases. According to Srilakshmi (18), total fat below 25% of energy value is considered to affect growth in children because of their high demand of energy for metabolic activities.

Mineral composition of the samples revealed that the products have valuable amounts of mineral, sample A have the highest value of iron (59.03±0.03mg/100) which indicates it could be a good source of dietary iron relevant in prevention of iron deficiency anaemia in children who mostly consume biscuits (21). This finding exceeds the amount reported by Anoshirike *et al* (1). Also the level of iron exceeds the value found in commercial biscuits (4.62mg/100g) sold in Malaysia (22). But the products from Malaysia contained higher levels of sodium (323.83mg/100g) which was higher than the recommendation for dietary values across all age group which pose health challenges for people suffering hypertension and on sodium restricted diet. It is needful that consumers understand nutrition facts on biscuits. Similarly the amount of calcium found in this study (0.086mg/100g) is similar to the levels in most commercial products in both Nigeria and Malaysia. This explains the reason why children need to obtain calcium from other dietary sources for development of strong bones and teeth, cell metabolism and muscle contraction (1,5,17). The biscuits (A,B and D) with higher amounts of cocoyam contained more calcium, this is contrary to the finding of Anoshirike *et al* (1) and FAO (6) where increasing the proportion of cocoyam lead to decrease in calcium levels in biscuits. They attributed to lower calcium levels reported in cocoyam.

Vitamin C contents of the biscuits 1.76±0.00 to 2.89±0.00 differed significantly among the samples ($p<0.05$), but were lower than the values (3.68-9.13mg) reported by Ayogu *et al*., (12) and (23)**.** Physiologically foods with high vitamin C content have the potential to increase hemoglobin status of children which enhances the absorption of non heme iron. Iron deficiency anaemia is known to be a public health challenge among school (12,24). The reported values of vitamin B2 (2.23±0.00-3.63±0.00) and Beta carotene (0.12±0.01 – 0.21±0.00) explains the reason individuals need to consume high amounts of fruits and vegetables which can provide readily available vitamins needed as antioxidant and other physiological processes in the body (22,25,26).

Conclusion

These nutritionally enriched biscuits could serve consumers by providing carbohydrate, protein, iron, calcium, potassium and lower sodium levels which have public health significance. Ensuring the use of composite from locally available staples foods will enhance dietary diversification. Despite been a snack, nutritious biscuits can help the nutrient needs of children and adults.

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REFERENCES

1. Anoshirike, C.O., Chidozie, C., Ugwumba, A and Asinobi, C.O. (2018). Chemical composition and organoleptic properties of Biscuits made from Wheat, African Yam Bean, and Cocoyam composite flour. *Nigerian Journal of Nutritional Sciences, 30* (1): 75-80.
2. Adeleke, P.O. (2000). Functional properties of raw heat processed cassava flour. *Journal of Food Sciences* 53 (6) 17-18.
3. Udensi, A.U., and Okoronkwo, B.C. (2008). Studies on the Proximate Composition and effect of particle size on acceptability of biscuits. *Pakistan Food Journal*. 14:16-29.
4. Adeyemi, B.C., and Ogazi, P.O. (2014). Nutritional value of biscuits from blends of maize, sorghum and millet. *Journal of Bangladesh Agricultural University*. Vol 12 No 2. 30-31.
5. Chinma, C.E., Ingbian, E.K., and Akpapunam, M. (2007). Processing and acceptability of fried cassava balls ("Akara-apku") supplemented with melon and soybean flours. *Journal of Food Processing and Preservation*, Vol 30 Issue 2: 143-156.
6. FAO (2007). Amino acid content of leguminous foods and biological data on proteins. *Food and Agricultural Nutritional Studies*. 11:21-26.
7. Akanbi. (2015). Evaluation of proximate and mineral content of biscuits samples produced from groundnut and maize flour. *Nigerian Journal of Nutrition*. Vol 6:30-33.
8. Okaka, P.C. (2005). Development and quality evaluation of cowpea wheat biscuit. Handling, storage and processing of plant foods. Enugu, OCJ Publishers, 45-78.
9. Akinyosoye, B.C. (2015). Quality characteristics of biscuits food samples from blends of wheat, soybean millet. *Nutrition Journal*. 1818-20.
10. Ikeagwu, P.O. (2003). Evaluation of proximate and mineral content of biscuit samples produced from groundnut and maize flour. *Nutrition Journal of*. Vol 6:30-33.
11. Olaoye. (2007). Physicochemical and functional properties of winged bean flour isolate and compared with soy isolate. *J.Food Sciences*: 53(11) 450-454.
12. Ayogu, R.N.B, Abraham, G.O., and Nnam, M.N. (2017). Evaluation of nutrient, antinutrient and phytochemicals in wheat based cookies

incorporated with two cowpea species. Nigerian Journal of Nutritional Sciences. Vol 38 No.1Pg 90-99.

13. Singh, N. ; Arya, R. S. ; Sharma, T. ; Dhuria, R. K. ; Garg, D. D., 2008. Effect of feeding of clusterbean (*Cyamopsis tetragonoloba*) straw based complete feed in loose and compressed form on rumen and haemato-biochemical parameters in Marwari sheep. Vet. Pract., 9 (2): 110-115.
14. Sakia, G. and Anneek, W.V. (1997). Small scale production of biscuit. *Journal of Applied Science and Technology*. 6:13-15.
15. AOAC, (2005), *Official methods of analysis*, 17th ed. Association of official analytical chemist Washington D.C. 70-83.
16. AOAC, (2000). Official Methods of Analysis, 17th Edition.Washington D.C., Association of Official Analytical Chemist 70-83.
17. Adebiyi, R.N, Adebowale T.I, and Agwo, P.O, (2016) Evaluation of proximate and mineral content biscuit samples produced from groundnut and maize flour. *Nutrition Journal. Vol.4 20-25.*
18. Srilakshmi, B. (2019). Dietetics; Nutritional and food requirements of children 8th Edition. New Age International Publishers. 118.
19. Titilope, A.O, and Abdulrasek, B.C (2016).Effect of retreatment on the drying of biscuit raw materials in production of infant formula.*Nutrition Journal*Pp. 15-18.
20. *Wardlaw*, G.M. and M. W. *Kessel, M.. (2002)*, "Perspectives in Nutrition," 5th Edition, McGraw-Hill Education, New York.
21. Olusanya, G.O. (2005). Compositional characteristics and sensory qualities of biscuits, prawn crackers and fried chips. *Nutrition Journal of Pakistan.* 38:64-72.
22. Evans, D.C. (2008). Proximate composition, sensory properties and acceptability of low viscous biscuit gruel based on local staples. *Nigerian Journal of Nutrition Science*. Vol. 30:103-111.
23. Wilson, A.D. and Badmus, O.A. (2002). Nutritional evaluation of biscuits food developed from maize and wheat protein sources. *Nutrition Journal* 41:11-120.
24. Ihekeronye, A.I. and Ngoddy, P.O. (1985). Integrated food science for the tropics. *Macmillan Publishers Limited*. 185-187.
25. Enwere, P.O. (1998). Effect of blending of cereals on the nutritional content of yellow root cassava and sorghum. *Journal of food Science*. Vol. 23. Pg 52-53.
26. WHO (2013). Biscuit feeding "family foods for breast fed children genera. *Nutrition and Dietetics Journal* 18:16-18.