# DETERMINATION OF PROXIMATE, MICRONUTRIENTS AND SENSORY QUALITIES OF NON-ALCOHOLIC BEVERAGE (KUNUN GYADA) PRODUCED FROM SORGHUM (*Sorghum bicolor*) groundnut (*Arachis hypogea*) BLENDS

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## ABSTRACT

*Proximate, micronutrients and sensory qualities of non-alcoholic beverage (kunun-gyada) produced from sorghum-groundnut blends was examined. Kunun-gyada was produced by blending sorghum with groundnut at different proportions (0, 10, 20, 30 and 40%). Proximate, micronutrients and sensory qualities was determined using standard methods. Substitution of groundnut in sorghum beverage significantly increased the protein from (2.20–5.00%), ash (0.32–0.99%), Fat (0.40–1.30%) and carbohydrate (2.33–14.90%) compared to 100% sorghum. The sodium, potassium, calcium, magnesium and phosphorus contents of the blends increased significantly from 24.11–30.42mg/100g, 139.33–183.66mg/100g, 4.06–6.74mg/100g, 29.40–32.72mg/100g and 1.12–4.10mg/100g respectively. Also the beta-carotene and ascorbic acid content of the beverage increased significantly from 1.99–4.35mg/100g and 2.99–8.69mg. The sensory evaluation of the kunun-gyada samples indicated that higher mean scores were reported for samples containing groundnut than control without groundnut in most of the attribute tested. Sample C was most preferred, having highest mean score of 7.06, 7.46, 7.40, 7.13 and 7.73 in the attribute of taste, colour, flavour, mouth-feel and overall acceptability respectively. The study concluded that inclusion of groundnut in kunun-gyada resulted in an improved local beverage which could help in reducing/preventing malnutrition among consumers of kunun in Northern Nigeria.*

**KEYWORDS:** *blends, kunun-gyada, micronutrients, proximate composition, sensory qualities.*

## INTRODUCTION

Beverages such as kunun-zaki, juice, coffee, tea, milk and soft drinks are liquid foods that serve as a source of both fluids and nutrients that refresh and nourish the body (Ihekoronye and Ngoddy, 1985; Maxwell *et al.,* 2018).Traditional beverages are of two types; alcoholic and non-alcoholic. Most beverages are made up of about 90% water, sugar, flavouring agents and sometimes preservatives.

A beverage such as kunun-zaki contains no alcohol and plays a very important role in the dietary pattern of people in developing countries like Nigeria (Abidoye *et al.,* 2017). Kunun-zaki is a cereal based non-alcoholic drink. It is a locally produced beverage and is made from millet, sorghum and maize grains and flavoured with such spices as ginger, black pepper and tamarind for improvement in its taste and aroma, which also serve as purgative and cure for flatulent conditions (Abidoye *et al.,* 2017). The basic ingredients of kunun-zaki are low in protein and some essential minerals and increasing prices of protein rich foods continue to force greater percentage of the populace, to eat food supplying less of the required dietary nutrient (Akintunde, 2005). This may have a negative effect on the nutritional status of the people who drink it, especially on the growth rate of children who are given kunun-zaki as a complementary drink. Due to inadequate supplies of animal proteins, there has been a constant search for new protein sources, for use as both functional food ingredients and nutritional supplements that will support growth and sustain life (Adelekan *et al.,* 2013; Abidoye *et al.,* 2017).

Groundnut is the 6th most important oil seed crop and a good source of protein (Asibuo *et al.,* 2008). It contains 48-50% oil, 26-28% protein and 11-27% carbohydrate, minerals, vitamin and also rich in essential amino acids, which help in preventing malnutrition (Mukhtar, 2009; Pelto and Armar, 2011).

Kunun beverage are popularly consumed by majority in Northern Nigeria and it is produced majorly from cereals which are deficient in nourishing quality, especially essential amino acids, vitamins and minerals. Hence, the need for fortification with richer source of nutrient. The objective of the study was to determine the proximate, micronutrient and sensory qualities of non-alcoholic beverage (kunun-gyada) produce from sorghum-groundnut blends. The data from this study could actually be used for providing information on nutritional quality of the improved beverage blends which can contribute to recommend daily requirement of the populace. Also in designing nutrition intervention for school children in order to prevent malnutrition and providing policy in the State that will aid the achievement of the Sustainable

Development Goals 2 (SDG's). "End hunger, achieve food security and improved nutrition and promote sustainable agriculture".

## METHODOLOGY

### Proximate analysis

### Determination of ash content

2ml of the sample was measured into crucibles in replicate, and the sample dried in oven, the sample was then cooled in desiccators and weighed. The weighed sample was incinerated in a muffle furnace at 550°c using Gallenkamp muffle furnace (Model OV160, Leicestershire, United Kingdom) until a light grey ash was observe and a constant weight obtained. The sample was cool in the desiccators to avoid absorption of moisture and to obtain ash content (AOAC, 2005).

$$\%\text{Ash Content} = \frac{W_3 - W_1}{W_2 - W_1} \times 100$$

Where
$W_1$= weight of empty crucible
$W_2$= weight of crucible +food sample before ashing
$W_3$= weight of the crucible+ food sample after ashing

### Determination of moisture content

This analysis was carried out to ascertain the amount of moisture in a giving sample.
Materials; oven, weighing balance, spatula and petri dish.
Method: 10g of sample was weighed into a dry petri dish using a spatula. The weighed sample was loaded into the oven and dried at 105°c until a constant weight was achieved. The sample was removed, cooled and weighed.
Moisture content was calculated as.

$$\frac{A - B}{A} \times 100$$

A=initial weight f sample.
B=weight of oven dry sample.

### Determination of fat content

2.5ml of the sample was measured and poured into a test tube in triplicate. 5ml of hydrochloric acid was added to each test tube, the test tube was then put in a beaker and water was added up to 200ml and allowed to stand for some time. The beaker was put on a cooker for 5minutes and cooled for some minute, the test tube were put in the test tube rack after cooling. 5ml of ethanol was put into each test tube then 12.5ml of petroleum spirit. Empty petri dish was weighed, using syringe and needle the upper white layer of the mixture was drew out from the test tube into the weighed petri dish, and the petri dish was in the oven to dried, it was then cooled in a desiccators and weighed until a constant weighed was obtained.

The percentage fat content was calculated as follows:

$$\text{Percentage of total fat content} = \frac{W_2 - W_1}{2.5ml} \times 100$$

Where $W_1$= weight of empty petri dish
$W_2$= weight of petri dish + dried sample

### Determination of protein content

This test was carried out to know the percentage of crude protein in the sample. Materials used were; complete digestion block set, sulphuric acid ($H_2SO_4$), weighing balance, hydrochloric acid, boric acid, sodium hydro-oxide (NaOH), burette, pipette, pipette filler, cornical flask, makahmps apparatus, indicator (Bromocresol green and Methyl red), selenium tablet,

**Digestion stage:**
Method: 0.5g of sample was taken and added into the digestion tube where also 20ml of concentrated sulphuric acid was added. One selenium tablet was added as catalyst. The content in the tube was heated at a temperature of 350°c for 6 hours until a clear digest was achieved that is a clear solution. This solution was poured into a standard flask and made up to 100ml.

**Distillation stage:**
10ml of 2% boric acid was taken into a 100ml conical flask and added with three drops of mixed indicator (Bromocresol green and Methyl red) and the colour changes to pink which was then placed under the collecting spot. 10ml of the digested sample was pipetted into the open chamber of the makhamps apparatus then followed by 10ml of 40%NaOH. The mixture was force to boil by the steam produced by the boiling water in the flat bottom flask. As the mixtures boil, a gas (ammonia) was evolve and condense by the condenser of the apparatus which was collected inform of liquid into the boric acid. As the ammonia was collected in the boric acid, the solution turned blue.

**Titration stage:**
The distillate collected was titrated using 0.1M HCL until an end point is reached by the colour of the distillate changing to pink colour which is the initial colour of the boric acid and the mixed indicator.
Crude protein is calculated as

$$\frac{Tv \times 0.014 \times MA \times df}{wt\ of\ S} \times 100$$

TV= titre value.
0.014=nitrogen standard.
MA= molarity of acid.
Wt of S = weight of sample.

### Determination of carbohydrate content

Determination of carbohydrate content of the kunun-gyada beverage was carried out by simple mathematical calculation method. It is usually obtained by subtracting all the sum of percentages of all the nutrients that are already determined from 100. The remaining value obtained is the carbohydrate content of the sample. %carbohydrate = 100– (%moisture+%ash+%protein+%fat)

**Determination of vitamin and mineral**
**Determination of ascorbic acid**

The ascorbic acid of the sample was determined using the method describe by Onwuka (2005). 5ml of stock was transferred into a conical flask of 100ml and 4% oxalic acid of 10ml was added and titrate with indophenols (V1 ml) until a pink coloration was obtained which indicate the end point. The quantity of indophenols used was equal to the quantity of stock used. 5ml of sample was added in 4% oxalic acid and make up to 100ml and centrifuge. To the supernatant (clear decanted liquid) 5ml, oxalic acid 10ml was added and titrate with the indophenols blue (V2 ml). The ascorbic acid content will be calculate as shown below

$$\text{Ascorbic acid} = \frac{0.5}{4.5} \times \frac{titre\ value}{5} \times \frac{100}{5} \times 100\text{mg}/100\text{g}$$

**Determination of beta-carotene**

The beta-carotene of the sample was determined using the method outline by AOAC (2005). Beta-carotene analysis was carried out using the acetone extraction method, 20ml of sample was measured into a conical flask, 40ml of acetone was measured into the conical flask containing the sample and was allowed to stand for 15 minutes for separation to occur. 5ml syringe was used to draw liquid out of the conical flask, into another conical flask and was allowed to stand for 5 minutes. The extract was poured in a cuvet and absorbance was read in spectrophotometer at wavelength of 663nm, 644nm, 452nm. The beta-carotene content will be calculate as shown below

$C_{a+b} = (6.4\ Q_{663}+18.8D_{644})$

Carotene = $(4.75D_{452}-0.226C_{a+b})$ mg/100g

**Determination of minerals**

The method of AOAC (2005) was used for mineral determination. 1ml of sample was weighed into 100ml and 20ml of acid mixture was added (Nitric and perchloric acid 1:1) and heat at 200°C until a clear solution is achieved. The sample was allowed to cool and transfer into a standard conical flask and made up to 100mls.

**Determination of sensory properties**

Sensory evaluation of kunun beverage were determined using (Ihekoronye and Ngoddy, 1985) method for consumer acceptability and using 30 panelists who were randomly select. The panelist accessed the samples base on taste, flavour, colour, mouth-feel and overall acceptability using a 9-point hedonic scale where 1 represent extremely dislike and 9 extremely like.

**Statistical analysis**

Data generated were subjected to statistical analysis using Computer package (SPSS version 20) was used to analysis all data. Analysis of variance (ANOVA) was carried out while means of significant figure were separated using Duncan Multiple range test.

## RESULTS AND DISCUSSION

**Proximate Analysis**

The proximate composition of fortified kunun-gyada beverage is presented in Table 1. The result showed that the moisture content of the beverage samples ranged from 79.81 - 94.06 %. Sample E (control) had significantly higher moisture content than other samples; sample B and sample C were not significantly different from each other but shows significant difference from other samples. The results obtained for moisture content were higher than those reported in previous studies (Amusa and Ashaya, 2009; Umaru *et al.*, 2014).

The protein value of the samples ranged from 2.20 - 5.00 %. Sample D was significantly difference across all the samples analyzed with sample D having the highest value of 5.00% while sample E appears to have a lower value of 2.20%. Kunun-gyada fortified with groundnut recorded higher protein contents than the control containing no groundnut. The protein content of some of the samples in this study were similar to each other than those reported in previous studies (Olaoye *et al.*, 2017).

The ash content of the beverage ranged from 0.32-0.99 %. Sample B and C were not significant different from each other while sample E shows a lowest significant difference from other samples. The result of the ash content of the beverage samples was lower when compared to previous studies (Olaoye *et al.*, 2017). Makinde and Oyeleke (2012) reported increase in the ash contents of kunun zaki enriched with extract of sesame seeds over the control sample without the extract. However, Ogbonna *et al.*, (2013) and Adelekan *et al.*, (2013) obtained ash content of higher values in their finding on kunun-zaki than those recorded in this study. The difference could be attributed to the different types of cereals used in the production of the beverage in the different studies. Different cereal types have abilities to contribute to

the ash content of kunun as a result of the differences in their ash compositions.

The percentage of fat obtained in this work is lower but quite higher than that reported by (Akoma *et al.*, 2006). The fat content shows some varying degree of variation with sample D having a higher value of 1.30, sample A, B and C appear to have no significant difference to each other but significantly different to sample D.

The carbohydrate content of all the sample shows a significant different across all the sample with sample D having the highest value followed by sample C while sample E appearing to have the lowest value of 2.33%. The results obtained for carbohydrate content in this study were lower when compared with previous studies carried out by (Amusa and Ashaye 2009). This may be as a result of the experiment which shows that kunun processed from un-sieved flour retained most of the nutrients according to (Abidoye *et al.*, 2017).

**Mineral Contents Analysis**

The mineral results of fortified kunun-gyada beverage is presented in Table 2. The results ranged thus: Na (24.11- 30.42), K (1.39-1.83), Ca (4.06-6.74), Mg (29.40-32.72) and P (1.12-4.10). From the table, it shows that there was a significant difference at $p \leq 0.05$ for sodium in all the sample analyzed with sample C having the highest value of 30.42mg/100g. This variation is also observed for potassium across all the samples although, sample B and D shows no significant difference with sample C and E following a similar trend. There is also an observable difference in the calcium content of the samples analyze although, no major difference between sample C and D so also sample A and E respectively. No significant difference is observed in magnesium between sample A and B and also sample C and D while sample E was significantly different to all the sample although, having the lowest value of 29.40mg/100g. The concentration of phosphorus in all the samples shows a significant difference although, sample B and C were not significant to each other at $p \leq 0.05$ level of significance while sample E appear to have the lowest value of 1.12mg/100g. The results of blended kunun-gyada had higher values compared to the unblended sample. The values of Na, K, Ca, and Mg were in close agreement with those values reported for fortified kunun beverage (Abulude *et al.*, 2006). It was also in line with those values reported for Apricot purees (Voi *et al.*, 1995) and fortified sobo drinks (Abulude and Adebusoye, 2005).

**Vitamin Contents Analysis**

The vitamin results of fortified kunun-gyada beverage is presented in Table 3. The beta-carotene content of the sample ranged from 1.99-4.35mg/100g. Sample C and D had a significant higher $p<0.05$ beta-carotene values than other samples while sample E (control) had the lowest value. The ascorbic acid of the beverage ranged from 3.00-8.69. Sample D had a significant higher value of ascorbic acid compared to other samples. The increase recorded in the vitamins contents especially beta-carotene and vitamin C in the samples could be due to incorporation groundnut blends.

**Sensory Analysis**

The sensory qualities of fortified kunun-gyada beverage is presented in Table 4. Sample C recorded highest scores of 7.06, 7.46, 7.40, 7.13 and 7.73 in the attribute of taste, colour, flavour, mouth-feel and overall acceptability respectively. Significantly differences ($p<0.05$) were recorded between the sample without the addition of groundnut. A similar result was reported in previous studies of kunun-zaki samples by Olaoye *et al.*, (2017) indicated that the sample containing tigernut milk extract recorded highest scores in the respective attributes of appearance, flavor, taste and overall acceptability.

**CONCLUSION AND RECOMMENDATIONS**

The fortified kunun-gyada produced from blends of sorghum-groundnut yielded better result in respect of their protein content and micronutrient values. The improved blends also recorded greater acceptability rate in relation to the commonly consumed kunun made from sorghum. This improved blend of kunun will bridge the gap in macro and micro-nutrient deficiency. The use of other cereals and legumes in local beverage drink production will bring about diet diversification. From the results obtained in this study, we concluded that incorporation of groundnut into kunun will supply some degree of fortification of the product and also improved sensory qualities. Based on the results of the research work, it is recommended that inclusion of groundnut should be encouraged among producers of the kunun beverage drink as a result of the derivable nutritional benefits that consumers can gain. Also further studies should be carried out to determine the storage stability, microbial and safety of the product.

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Table 1: Proximate composition of Kunun-gyada beverage

| Samples | Moisture content | Crude protein | Ash content | Fat content | Carbohydrate |
|---|---|---|---|---|---|
| A | 89.72±0.10$^{b}$ | 3.40±0.05$^{d}$ | 0.70±0.10$^{b}$ | 0.60±0.20$^{c}$ | 5.21±0.01$^{d}$ |
| B | 79.87±0.05$^{d}$ | 4.26±0.15$^{c}$ | 0.83±0.10$^{ab}$ | 0.65±0.23$^{c}$ | 12.48±0.10$^{c}$ |
| C | 79.81±0.10$^{d}$ | 4.66±0.15$^{b}$ | 0.83±0.18$^{ab}$ | 0.96±0.10$^{bc}$ | 13.76±0.00$^{b}$ |
| D | 80.73±0.15$^{c}$ | 5.00±0.25$^{a}$ | 0.99±0.05$^{a}$ | 1.30±0.10$^{a}$ | 14.90±0.60$^{a}$ |
| E | 94.06±0.20$^{a}$ | 2.20±0.25$^{e}$ | 0.32±0.25$^{c}$ | 0.40±0.00$^{c}$ | 2.33±0.04$^{e}$ |

Values are mean ± standard deviation of triplicate determination. Samples with different superscript vary significantly ($p \leq 0.05$) while those with the same letters are not significantly different.

Keys

A 90 sorghum + 10 groundnut
B 80 sorghum + 20 groundnut
C 70 sorghum + 30 groundnut
D 60 sorghum + 40 groundnut
E 100 sorghum (control)

Table 2: Mineral composition of Kunun-gyada beverage

| Sample | Sodium | Potassium | Calcium | Magnesium | Phosphorus |
|---|---|---|---|---|---|
| A | 27.95±0.27$^{c}$ | 183.66±2.51$^{a}$ | 4.15±0.20$^{c}$ | 31.05±0.13$^{b}$ | 2.81±0.00$^{c}$ |
| B | 28.65±0.46$^{b}$ | 141.66±1.52$^{c}$ | 5.61±0.01$^{b}$ | 31.00±0.00$^{b}$ | 3.44±0.01$^{b}$ |
| C | 30.42±0.00$^{a}$ | 151.33±2.30$^{b}$ | 6.72±0.01$^{a}$ | 32.72±0.43$^{a}$ | 3.24±0.26$^{b}$ |
| D | 27.25±0.04$^{d}$ | 153.66±3.21$^{b}$ | 6.74±0.08$^{a}$ | 32.64±0.01$^{a}$ | 4.10±0.06$^{a}$ |
| E | 24.11±0.00$^{e}$ | 139.33±3.05$^{c}$ | 4.06±0.02$^{c}$ | 29.40±0.51$^{c}$ | 1.12±0.01$^{d}$ |

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B 80 sorghum + 20 groundnut
C 70 sorghum + 30 groundnut
D 60 sorghum + 40 groundnut
E 100 sorghum (control)

Table 3: Vitamin composition of Kunun-gyada beverage

| Sample | Beta-carotene mg/100g | Ascorbic acid mg/100g |
|---|---|---|
| A | 2.25±0.05$^{c}$ | 4.39±0.05$^{d}$ |
| B | 3.00±0.10$^{b}$ | 7.58±0.20$^{c}$ |
| C | 4.35±0.05$^{a}$ | 8.19±0.05$^{b}$ |
| D | 4.35±0.15$^{a}$ | 8.69±0.20$^{a}$ |
| E | 1.99±0.10$^{d}$ | 3.00±0.02$^{e}$ |

Values are mean ± standard deviation of triplicate determination. Samples with different superscript vary significantly ($p \leq 0.05$) while those with the same letters are not significantly different.

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D 60 sorghum + 40 groundnut
E 100 sorghum (control)

Table 4. Sensory analysis of Kunun-gyada beverage

| Sample | Taste | Colour | Flavour | Mouth-feel | Overall Acceptability |
|---|---|---|---|---|---|
| A | 6.13±1.57$^{b}$ | 6.63±1.52$^{a}$ | 6.23±1.77$^{bc}$ | 6.00±1.52$^{b}$ | 6.80±1.24$^{b}$ |
| B | 7.53±1.43$^{a}$ | 7.30±1.48$^{a}$ | 7.06±1.46$^{ab}$ | 7.20±1.49$^{a}$ | 7.46±1.27$^{ab}$ |
| C | 7.06±1.28$^{a}$ | 7.46±1.22$^{a}$ | 7.04±1.22$^{a}$ | 7.13±1.22$^{a}$ | 7.73±0.98$^{a}$ |
| D | 6.00±1.55$^{b}$ | 6.83±1.70$^{a}$ | 6.03±1.67$^{c}$ | 5.70±1.72$^{b}$ | 6.00±1.33$^{c}$ |
| E | 4.56±2.02$^{c}$ | 5.56±2.07$^{b}$ | 5.10±2.12$^{d}$ | 4.53±2.28$^{c}$ | 4.90±1.90$^{d}$ |

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**REFERENCES**


Abidoye O. A., Taiwo K. and Adeniran H. (2017). Fortification of kununzaki drink with cocoa powder. *African Journal of Food Science* Vol. 11(4) pp. 112-123.

Adelekan, A.O., Alamu, A.E., Arisa, N.U., Adebayo, Y.O., and Dosa, A.S. (2013). Nutritional, Microbiological and Sensory Characteristics of Malted Soy-Kunu Zaki: An Improved Traditional Beverage. Advances in Microbiology. 3, 389-397.

Abulude, F. O., Adebusoye, A. J., (2005). Chemical composition and acceptability of fortified sobo drinks. *Pal. J. Indeed. Science. Res.* 5(1): 155-162.

Abulude, F.O., Ogunkoya, M.O., and Oni V.A. (2006). Mineral composition, shelf life and sensory attributes of fortified kunuzaki beverage. *Acta Sci. Pol.,Technol. Aliment* 5(1): 155-162.

Akintunde T.Y. (2005). Nutritional and sensory qualities of soymilk-kunnu blends. *African J. of Food Agric., Nutrition and Development.* 5:2.

Akoma, O., Jiya, E., Mishilia, E. (2006) Influence of malting on the nutritional characteristic of kunu-zaki. *African Journal of Biotechnology* 5(10): 996-1000.

Amusa, N., Ashaye, O., (2009). Effect of processing on nutritional, microbiological and sensory properties of kunu-zaki (a sorghum based non-alcoholic beverage) widely consumed in Nigeria. *Pakistan Journal of Nutrition* 8(3): 288-292.

AOAC. Official Methods of Analysis International. 18thEdition. Association of Official Analytical Chemist. USA. 2005.

Asibuo, J.Y., Akromah, R., Safo-Kantanka, O.O., sei,AduDapaah, Hanskofi, O.S., and Agyeman, A. (2008). Chemical Composition of Groundnut, Arachis hypogaea (L) landraces. *African Journal of Biotechnology.* Vol, 7(13).pp: 2203-2208.

Ogbonna, A. C., Abuajah, C. I., Akpan, M. F. and Udofia, U. S. (2013). A comparative study of the nutritional values of palm wine and kunnu zaki. AFST 14, 39–43.

Onwuka, G.I. (2005). Food Analysis and Instrumentation: Theory and Practice. Napthali prints, Lagos, Nigeria. PP. 140-146.

Pelto Gretel, H. and Margaret Armar -Klemesu (2011). Balancing Nurturance, cost and time: Complementary feeding in Acera, Ghana. Maternal and Child Nutrition /Volume 7, Issues 3.

Ihekoronye,A.I. and P.O. Ngoddy, 1985.Integrated Food Science and Technology for the Tropics. Macmillian Publishers, London, uk, PP: 75-77.

Makinde, F. and Oyeleke, O. (2012). Effect of sesame seed addition on the chemical and

sensory qualities of sorghum based kunun-zaki drink *African Journal of Food Science and Technology. 3*(9): 204-212.

Maxwell Y.M.O., Alabi M.O. and Edorhe A.O. (2018). Effect of Spices on Anti-nutritional Properties of Tiger-nut Beverage *(kunun aya). Proceedings of the 42nd Annual Conference and General Meeting of the Nigerian Institute of Food Science and Technology, Abeokuta, Nigeria. October 15-18th, Pp. 24-25.* Shittu T.A. Adeola A.A., Omohimic C., Bolarinwa I.F. Badejo A.A. and Abu J.O. (Editors).

Mukhtar, F.B. (2009). Effect of storage temperature on post-harvest deterioration of banana and plantain (Musa sp.). *Int. J. Phys. Appied Sci., 3*: 28-38.

Voi, A. L., Impembo, M., Fasanaro, G. and Gastaldo, D. (1995). Chemical characterization of apricot puree. *J. Food Comp. Anal 8*, 78-85.

Umaru, G., Tukur, I. and Adamu, N. (2014). Microflora of kunu-zaki and zobo drinks in relation to public health in Jalingo metropolis, North-Eastern Nigeria. *International Journal of Food Research 1*: 16 21.