**Evaluation of Quality characteristics and storage stability of peanut beverage added ginger, moringa leaf powder and Lime**

**Keywords**: Peanut beverage, moringa, stability, ginger, lime

**Abstract**

Peanut seeds were roasted at 80 $^0$C for 20 min milled and blended with ginger (GI) ,with moringa leaf powder (MP), with lime (LI) with moringa leaf powder and ginger (MG) with lime and moringa leaf powder (LM) with lime and ginger (LM) into paste. Heated water (at 80 $^0$C) was added to the paste while stirring for 30 min. The mixture was further heated in a boiling bath and filtered with muslin cloth cooled to obtain a drink which was flavored with pineapple, banana and milk flavor and sucrose was also added.

The results showed moisture content of GI ranged from 79.87 – 83.95 %, with sample LI having the highest value was not significantly different ($p \geq 0.05$) from MO, MG, LM and LG but sample GI having the lowest value, which was significantly ($p \leq 0.05$) difference form LI, MG and LG. The ash content ranged from 1.92 – 2.41 %, with sample GI having the highest value which was significantly ($p \leq 0.05$) different from LI and MG but not significantly ($p \geq 0.05$) different from other samples. The crude fat content ranged from 2.92 -3.07 %, of which sample GI having the highest value and sample LI having the lowest value which are not significantly ($p \geq 0.05$) different from one another. The crude protein ranged from 4.01 – 4.74 % of which sample GI having the highest value and sample LG having the least value which are not significantly ($p \geq 0.05$) different from one another. The carbohydrate contents ranged from 3.49 – 6.49 % with sample LI had the highest value which was not significantly ($p \geq 0.05$) different from sample GI and MO and sample MG having the lowest value which was significantly ($p \geq 0.05$) difference from other sample except LG. pH of beverages decreased from 7.90 MG week 1 to 3.21 in LM in week 3.Total titretable acidity present in the beverages were GI in week 1; (0.13), MO(0.17), LI(0.18), MG(0.12), LM(0.19) and LG(0.16).At week 3, GI(0.18), MO(0.23), LI(O.24), MG(0.82), LM(0.24) and LG(0.24). The beverages contained low number of total plate counts

($1.9 \times 10^2$ - $2.8 \times 10^4$) and fungi/yeasts counts ($1.2 \times 10^4$- 4.2 X $10^6$). Overall acceptability was high for all samples.

## 1.0 Introduction

Peanut beverage is easy to prepare and its amino acid composition meets people's nutritional requirements (Howard *et al.,* 2010; Jain *et al.,* 2013). Plant protein beverages as alternative sources of dietary protein are desirable in developing countries where cow's milk may be costly, unavailable or not consumed due to dietary constraints or religion (Lee and Beuchat 1992). Organic beverage provides a lot of nutrients needed by the body which comes from sources like protein, carbohydrate, vitamins, materials and lipids that help in boosting blood circulation in the body, building of strong bones and teeth, prevents cancer, reduces diabetes and development of heart complication.

Peanut beverage is a beverage created using peanuts and water. Recipes variations include lime, ginger, sweeteners and grains. It does not contain any lactose and is therefore suitable for people with lactose intolerance. Peanuts are roasted, dehulled sorted and grounded, and sometimes heated and then filtered through fine filter; the resulting liquid is considered the beverage. The shelf life of peanut beverage is dependent on many factors e.g. the type of peanut used in the preparation, the heating process and the method used in preserving it. peanut beverage are rich in essential nutrients, in a long serving, peanut provides 570 calories and are excellent source of several B vitamins, Vitamin E, several dietary minerals such as manganese (95 % DV), magnesium (52 % DV) and potassium (48 % DV) and dietary fibre. They also contain about 25 % protein per 100 g serving, a higher proportion than in many tree nuts (Conde Nast, 2015). Anuonye *et al.,* 2012 reported unripe banana and pigeon blends could be made into semi-solid gel by adding boiling water at $100^0$C and stirring till the pasty beverage became firm.

*Moringa oleifera* plants are among the most nutritious and useful botanical products available. The seed can be used in variety of ways including medicinal, nutritional supplements and for industrial and agricultural purpose. (www. themoringa.com/moringa _seeds, 2016). *Moringa oleifera* leaves are rich

in phytonutrients, such as carotenoids (Saini *et al.,* 2014), tocopherols, and ascorbic acid. It has also been found to contain appreciable amount of total phenols and flavonoids which can be used as antioxidant (Vazguez-leon *et al.,* 2017). Chinma *et al.,* 2017 reported that the protein solubility value of moringa seed flour ranged from 32.50 to 75.52 % with trough viscosity 74.68 after 24 h of germination. Chinma *et al.,* finally concluded that germination of moringa seed flour resulted in increased protein and ash contents while fat, crude fibre and carbohydrate contents decreased.

In many parts of the world including Africa, the use of *Moringa oleifera* as a food fortificant is on the increase. In Nigeria, *Moringa oleifera* is known as "Ewe-ile" in the south western yoruba speaking language, "Samarin dange" in northern hausa speaking language and "Okwe oyibo" in south easthern igbo speaking language.

The production process of peanut beverage is highly prone to microbial contamination, which reduces its shelf life. A large numbers of lactic acid bacteria, coliforms, molds and yeast have been reportedly implicated in its spoilage. As these microorganism use the carbohydrate content for fermentation processes which is undesirable. The objective of this study was evaluate the proximate, physicochemical, microbiological and sensory qualities of ginger, lime and moringa leaves powder added beverages and to determine the storage stability of peanut beverage.

## 2.0 Materials and Methods

### 2.1 Raw materials

The raw materials (sucrose, muslin clothes, plastics, flavours, ginger, and lime) were purchased from Kure ultra-modern market, Minna, Niger state. The peanuts were gotten from the International institute of tropical Agriculture Ibadan, Oyo state Nigeria while the moringa leaves were gotten from crop production research farm of Federal University of Technology Minna, Niger State.

The experiment was conducted at the Food Science and Technology laboratory of School Agriculture and Agricultural Technology. Federal University of Technology, Minna, Niger state.

### 2.2 Preparation of Samples

Ten kilograms of matured and dried peanuts were manually cleaned to remove stones and damaged dirty seed, which was done by winnowing and hand picking.

**2.3 Preparation of Peanut beverages**

The peanut seeds were roasted at 80 $^0$C for 20 min which made dehulling easier. It was then wet milled and blended with ginger (GI), with moringa leaf power (MP), with lime (LI) with moringa leaf powder and ginger (MG) with lime and moringa leaf power (LM) with lime and ginger (LM) into paste. Portable water was heated at 80 $^0$C and then it was gradually added to paste obtained while stirring for about 30 min the mixture was further heated in a boiling bath (THELCO, model 83,USA) for 2 h at 10 $^0$C. The mixture was filtered with muslin cloth and cooled to obtain a drink which was flavored with pineapple, banana and milk flavor and sucrose was also added, (Rustom *et al.*, 1995).

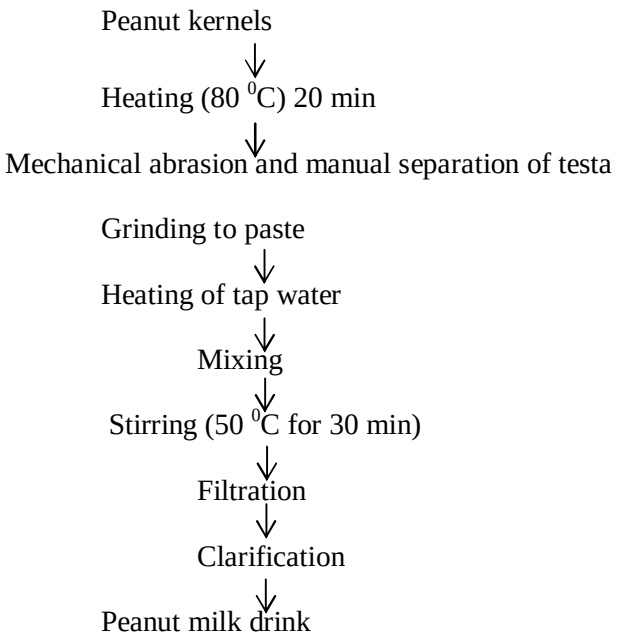


Fig 1: Flow chart for production of peanut beverages (Rustom *et al.*, 1995)

**2.4 Preparation of ginger**

Five grams of dried ginger were thoroughly washed with warm tap water to remove the dirts and knives were manually used to scrape adhering sands and stones.

**2.5 Preparation of moringa leaves**: The processing of moringa leaves into powder adopted the method described by De-Saint Sauveur (2010). All leaflets were stripped from the leaf petiole. Diseased and damaged leaves were discarded. Leaflets are washed in troughs using clean portable water to remove dirt. The leaves are washed again in 1 % saline for 3 min to remove microbes and finally washed again in

clean tap water and allowed to drain. The washed leaves are allowed to drain for 15 min in perforated buckets. Leaf-lets were spread thinly on mesh trays tied on racks in a well-ventilated room, which is insect, rodent and dust proof. The leaves were turned over at least once, with sterile gloves, to improve uniform drying. Leaves completely dried within a maximum of 4 days. Dried leaves are milled using a stainless steel hammer mill. The leaf powders were sieved with the desired screen size. Recommended particle sizes are, fine (0.5 mm – 1.0 mm) .

**2.6 Preparation of lime**

Lime citrus were cut into halves and the liquid content of limes were squeezed with manually. This was done for 30 min until a reasonable quantity of lime of about 5 litres were obtained. The lime was then pasteurized at 65 $^0$C for 10 min.

**2.7 Analytical methods**

**Proximate compositions**

**Determination of moisture content**

The moisture content of the beverage was determined according to AOAC, 2012. Empty moisture dishes were cooled in desiccators for about 12 h. The dishes were weighed along with covers ($W_1$), five grams (% g) of samples were weighed into dishes and weighed again ($W_2$). The samples were placed in the air over with the container at 102 $^0$C and dried to a constant weight the dishes were then transferred into desiccators and cooled and then reweighed ($W_3$). A triplicate determination was made and the percentage calculated as below.

$$\%\, moistrure \quad content = \left(\frac{lossinweight}{weightofthesample}\right) \times 100$$

**Determination of crude Fat**

Sample of 2 g was weighed into thimble and tightly ploughed with cotton wool. AOAC, (2012).The thimble was inserted into a soxhlet Extractor. Flat bottom flax of 500 mL of known weight containing 250 mL petroleum ether (B.PT.40-60 $^0$C) was fitted into the extractor. The three samples were extracted for 3 h at 60$^0$C. The sample was removed and the solvent evaporated. The remaining oil in the flask was measured.

$$\%fat = \left(\frac{weightgainedby\ the\ flask}{weightosample}\right) x100$$

**Determination of crude protein**

The protein content was determined using Kjedahl techniques by AOAC (2012). Three grams of sample was weighed into Kjedahl digestion flask with the addition of catalyst (Selenium). Analytical grade concentration tetraoxosulphate (VI) 10 mL was added to the flask. The Kjedahl digestion flask content was heated for 4 h in a digestion chamber until a digest is obtained. The sample which now digested were allowed to cool, distilled water was used to dilute the digest and was made up to 100 mL. The digest were then transferred into the Markham's distillation chamber and 20 mL of 40 % NaOH was added unto 10 mL of boric acid of which contain bromocresol green/methyl red, 3 drops indicator until 50 mL of distillate was collected. The titration of distillate was done with standardized 0.1N HCI until pink colour was observed. The crude protein was calculated as shown below.

$$\%N = \frac{\left(\frac{S-Bx0.1Nx0.014x10}{weightofthe\ sample}\right)x100}{1}$$

$$\%crudeprotein = \%Nx6.25$$

$$s = sampletitrecalueB = blanktitrevalues$$

**Determination of carbohydrate**

The energy composition of the sample were determined by the standard method describe by AOAC (2012) using Atwater factor of 4.4 and 9 kcal of carbohydrate, crude protein and fat respectively. The total amount of energy present in each sample were calculated by multiplying carbohydrate content by 4, crude protein by 4 and fat content by 9 kcal respectively. The summation of these parameters after multiplication equal to the energy (kcal) in each sample.

**2.8 Physicochemical Analysis**

**Determination of total titretable acid (TTA)**

The procedure outline by AOAC (2012) was used to determine the TTA of the sample. One gram of the sample was weighed into a beaker containing 9 mL of distilled water. The sample was titrated against 0.1N NaOH to the end point (pink) using 3 drops of phenolphthalein. The total titretable acid as expressed as lactic acid was calculated as follows

$$\textbf{TTA (\% lactic acid)} = \frac{\textbf{Titretable value} \times \textbf{(0.009)} \times \textbf{100}}{\text{Weight of sample}}$$

0.009= weight of lactic acid

**pH Determination**

pH determination was carried out as described by Afoakwa *et al.*(2006) using the glass electrode TOA pH meter

**Determination of total dissolved solids (TDS)**

The total solids was determined according to AOAC (2012), after determining moisture content, it was subtracted from 100 to get total dissolved solids.

A total dissolved solids (TDS) was calculated as 100 – moisture content.

**2.9 Microbiological Analysis**

Serial dilution was carried out by measuring 1mL of sample in nine millilitre of distilled water in the test – tube. One millilitre of the mixture was transferred into the second test – tube which was shaken vigorously to make up 10 mL. The process was repeated and 1ml hopped into the sink. 1ml of the sample diluted 10 -3 was measured with the use of pipette and inoculated onto Saboraud Dextrose Agar (SDA) for growth of both yeasts and moulds while for bacteria count, it was inoculated in nutrient agar (NA) plates. The SDA plates are incubated at 25 $^{0}$C (room temperature) for 72 h. All the plates were counted using colony counter at the incubation period and results recorded

**Sensory Evaluation**

A voluntary panel of 20 untrained judges made up of 15 males and 5 females of students of Food Science and Technology and Animal Production departments of Federal University of Technology, Minna were educated on testing terminologies and requested to evaluate the various beverage samples. The samples were assessed organoleptically for colour, appearance, flavour, texture, taste and overall acceptability using a 9 – point Hedonic scale where 9 was equivalent to ”like extremely ” and 1 meant ” dislike extremely ” as described by Iwe (2012).Samples were presented in white plastic cups. The order of presentation of the samples was randomized. Clean

tap water was provided for the judges to rinse their mouths in- between evaluations as described by Anuonye *et al.*, 2012.

**Statistical Analysis**

The data obtained were subjected to statistical analysis (SPSS, 2000) using one way ANOVA where significant differences ($p < 0.05$) of the responses of the 20 panelists existed and mean separation was also done using Duncan Multiple Range Test (Duncan, 2003),

## 3 .0 Results and Discussion

Table 1: Proximate composition of peanut beverage samples

| Sample | Moisture (%) | Ash (%) | Crude fat (%) | Crude Protein (%) | Carbohydrate (%) |
|---|---|---|---|---|---|
| GI | $70.80^{b}$ | $2.41^{a}$ | $3.07^{a}$ | $4.74^{a}$ | $6.45^{a}$ |
| MO | $81.72^{ab}$ | $2.10^{ab}$ | $2.86^{a}$ | $4.37^{a}$ | $6.46^{a}$ |
| LI | $83.43^{a}$ | $1.99^{b}$ | $2.92^{a}$ | $4.43^{a}$ | $6.49^{a}$ |
| MG | $83.95^{a}$ | $1.92^{b}$ | $2.93^{a}$ | $4.14^{a}$ | $3.49^{c}$ |
| LM | $82.19^{ab}$ | $2.10^{ab}$ | $3.01^{a}$ | $4.46^{a}$ | $4.29^{b}$ |
| LG | $82.74^{a}$ | $2.19^{ab}$ | $2.97^{a}$ | $4.01^{a}$ | $3.82^{ac}$ |
| $\pm SE$ | 0.7 | 0.09 | 0.10 | 0.40 | 0.19 |

Data are mean ± Standard error of duplicate determination

Tables 1 shows the proximate composition of peanut beverage added ginger, lime moringa leaf powder, moringa leaf power plus ginger, lime plus moringa leaf powder lime plus ginger. The moisture content ranged from 79.87 – 83. 95, with sample LI having the highest value was not significantly difference ($p \geq 0.05$) from MO, MG, LM and LG but sample GI having the lowest value, which was significantly ($p \leq 0.05$) difference from LI, MG and LG. The ash content ranged from 1.92 – 2.41, with sample GI having the highest value which was significantly ($p \leq 0.05$) different from LI and MG but not significantly ($p \geq 0.05$) different from other samples. The crude fat content ranged from 2.92 -3.07, of which sample GI having the highest value and sample LI having the lowest value which are not significantly ($p \geq 0.05$) different from one another. The crude protein mean core ranged from 4.01 – 4.74 of which sample GI having the highest value and sample LG having the least value which are not significantly ($p \geq 0.05$) different from one another. The carbohydrate mean score ranged from 3.49 – 6.49 with sample LI had the highest value which was not significantly ($p \geq 0.05$) difference from sample

GI and MO and sample MG having the lowest value which was significantly ($p \geq 0.05$) different from other sample except LG.

**Physicochemical properties of peanut beverage add ginger, moringa leaf powder, lime, moringa leaf powder plus ginger, lime plus moringa leaf powder and lime plus ginger.**

The physiochemical properties of peanut beverages are shown in Table 2. At first week, the storage pH ranged from 5.96-7.90 and there was significant different ($\leq$0.05). TTA at week one ranged from 0.12-19 with no significant (p $\geq$0.05) difference between sample MO, LI, LM and LG but were significant difference from GI and MG. That of TDS ranged from

Table 2: Physicochemical properties of the various peanut beverages produced

| Parameters | Weeks | GI | MO | LI | MG | LM | LG | $\pm SE$ |
|---|---|---|---|---|---|---|---|---|
| pH | 1 | $6.74^{d}$ | $7.40^{c}$ | $7.90^{a}$ | $7.60^{b}$ | $5.96^{e}$ | $5.97^{e}$ | 0.00 |
| | 2 | $6.73^{d}$ | $7.41^{c}$ | $7.91^{a}$ | $7.61^{b}$ | $5.96^{e}$ | $5.96^{b}$ | 0.00 |
| | 3 | $5.84^{a}$ | $5.23^{a}$ | $5.41^{a}$ | $5.23^{a}$ | $3.21^{b}$ | $4.38b^{c}$ | 0.00 |
| TTA (%) | 1 | $0.13^{d}$ | $0.17^{ab}$ | $0.18^{ab}$ | $0.12^{d}$ | $0.19^{a}$ | $0.16^{cab}$ | 0.00 |
| | 2 | $0.15^{cab}$ | $0.21^{ab}$ | $0.19^{a}$ | $0.14^{cd}$ | $0.20^{ab}$ | $0.18^{ab}$ | 0.00 |
| | 3 | $0.18^{ab}$ | $0.23^{b}$ | $0.24^{b}$ | $0.82^{d}$ | $0.24^{b}$ | $0.24^{b}$ | 0.00 |
| TDS (%) | 1 | $98.56^{b}$ | $99.46^{a}$ | $99.52^{a}$ | $99.10a^{d}$ | $98.90^{b}$ | $99.20^{ab}$ | 0.12 |
| | 2 | $98.10^{c}$ | $97.49^{cb}$ | $98.02^{b}$ | $98.02^{cb}$ | $97.00^{a}$ | $96.13^{b}$ | 0.12 |
| | 3 | $90.61^{a}$ | 89.35a | $92.56^{c}$ | $92.56^{c}$ | 94.60d | $91.35^{ac}$ | 0.12 |

99.1099.56 of which sample MO, LI, MG and LM were not significant from one another but sample GI and LM were significant ($\leq 0.05$) difference from MO and LI.

At week two of the storage the pH ranged from 5.96-7.91 with sample LI having the highest value while sample LM and LG having the lowest value. TTA at week two ranged 0.21-0.14 with sample GI had the highest value and sample MG having the lowest value, sample GI, MO, LI, LM, and LG were significant ($p \leq 0.05$) different from MG of which MG was not significant ($p \geq 0.05$) different from GI. For that of TDS ranged from MG of which MG was not was not significant ($p \geq 0.05$) different from GI. for that of TDS ranged from 98.10-95.90 which sample GI had the highest and LM had the lowest value, sample GI, MO and LI, MG and LG were significant ($p \geq 0.05$) difference from LM. However at week three of the storage the PH ranged from 2.21-5.84 with sample GI having the highest value with sample LM had the least value but was significant ($p \leq 0.05$) different from sample GI, MO, PNLI and MG except LG. TTA ranged from 0.18-0.82 with sample MG having the highest value while MO having the least value but not significant ($p \geq 0.05$) different from GI, LM, and LG except LI that significant ($p \leq 0.05$) different from MG and other sample.

Table 3: Total plate count and mould/yeast count of peanut beverage samples at the end of week three

| Beverages/parameters | Total plate count (cfu/mL) | Mould/Yeast count(cfu/mL) | Maximum acceptable standard (cfu/mL) |
|---|---|---|---|
| GI | $2.0X10^1$ | $1.4X10^4$ | $3.0X10^5$ |
| MO | $2.3X10^2$ | $1.2X10^4$ | $3.0X10^5$ |
| LI | $1.9X10^2$ | $2.8X10^3$ | $3.0X10^5$ |
| MG | $2.4X10^2$ | $2.8X10^4$ | $3.0X10^5$ |
| LM | $2.6X10^4$ | $3.8X10^3$ | $3.0X10^5$ |
| LG | $2.8X10^4$ | $4.2X10^6$ | $3.0X10^5$ |

Table 3: shows the microbial analysis of peanut beverage samples. The total plate count on samples (GI, MO, LI, MG, LM and LG) ranged from $1.9x10^2$ cfu/mL – $2.8 x10^4$ cfu/mL while the mould/yeast counts ranged from $1.2x10^4$ cfu/mL to $4.2 X10^6$ cfu/mL at the end of week three. The microbial contents of the peanut beverage did not exceed the maximum acceptable standard ($3.0x10^5$ cfu/mL) as given by regulated body. For this reason, the peanut beverage were all microbial stable and for local and international consumption.

Table 4: Sensory properties of peanut beverage sample at week one

| Sample | Colour | Appearance | Flavor | Texture | Taste | Overall acceptability |
|---|---|---|---|---|---|---|
| GI | 7.67[a] | 7.60[a] | 7.93[a] | 7.00[a] | 8.13[a] | 7.70[a] |
| MO | 7.40[a] | 7.13[a] | 7.36[a] | 7.27[a] | 7.53[a] | 7.40[a] |
| LI | 7.13[a] | 6.87[a] | 6.06[b] | 6.07[b] | 5.73[b] | 6.30[ab] |
| MG | 7.60[a] | 7.40[a] | 7.73[a] | 7.27[ab] | 7.45[a] | 7.50[a] |
| LM | 7.70[a] | 7.60[a] | 7.36[a] | 7.20[ab] | 7.45[a] | 7.50[a] |
| LG | 7.73[a] | 7.53[a] | 7.80[a] | 7.67[a] | 7.73[a] | 7.70[a] |
| $\pm SE$ | 0.3 | 0.3 | 0.3 | 0.4 | 0.4 | 0.4 |

Data are mean ±Standard error of duplicate determination

Mean with common superscript are not significantly different ($p < 0.05$)

Table 4 shows the sensory properties of peanut beverage. The value for colours ranged from 7.13-773 with LG had the highest value while sample MG had the lowest and were not significantly ($p \geq 0.05$) different between the samples of which samples LM had the highest value while sample LI had lowest. Value and were not significant ($p \geq 0.05$) difference between each other. Flavor shows no significant ($p \geq 0.05$) difference between the samples of which sample GI had the highest value while sample LI had the lowest texture show that no significant ($p \geq 0.05$) different between the samples, sample LG had the highest value while sample LI had the lowest value. For that of taste, mean score ranged from 5.73-7.73 with sample LG had the highest value and sample LI with the lowest value Sample LI show significant ($p \geq 0.05$) difference from other samples.

General acceptability shows no significant ($p \geq 0.05$) difference between the samples, GI had the highest value while LI had the lowest value.

Table 5: Sensory properties of peanut beverage sample at week two

| Sample | Colour | Appearance | Flavor | Texture | Taste | Overall acceptability |
|---|---|---|---|---|---|---|
| GI | 6.67[a] | 6.87[ab] | 7.40[a] | 7.13[ab] | 8.13[a] | 7.19[c] |
| MO | 5.27[a] | 4.80[c] | 6.40[cb] | 6.13[b] | 7.53[a] | 5.90[a] |
| LI | 6.60[a] | 693[a] | 5.60[c] | 6.07[b] | 5.6[c] | 6.30[b] |
| MG | 6.40[a] | 6.27[b] | 7.27[b] | 7.33[a] | 7.27[ab] | 6.90[b] |
| LM | 6.13[a] | 6.33[b] | 6.00[c] | 7.27[ab] | 6.23[cb] | 6.30[b] |
| LG | 7.07[a] | 7.40[a] | 7.33[a] | 7.67[a] | 7.13[ab] | 5.84[a] |
| $\pm SE$ | 0.4 | 0.4 | 0.3 | 0.3 | 0.5 | 0.4 |

Data are mean ± Standard error of triplicate determination

Mean with common superscript are not significantly different ($p < 0.05$)

Table 5 shows the sensory properties of peanut beverage at week two. The scores for colour ranged from 5.27 – 7.07 with sample LG having the highest value, which was not significantly $(p \geq 0.05)$ different from others. The value for appearance ranged from 4.80 – 7.40 with sample LG having the highest mean score while MO had the lowest. Sample MO was significantly $(p \leq 0.05)$ difference from other samples. Flavour ranged from 5.60 – 7.40 which sample GI was the highest, which was not significantly $(p \geq 0.05)$ different from LI, while sample LI had the lowest and was not significantly $(p \geq 0.05)d$ifferent.

MO, LG and LM for that of texture ranged from 6.13 -7.33 with sample MG having the highest and shows no significantly $(p \geq 0.05)$different between GI, LI, LM and LG but significantly $(p \geq 0.05)$ from MO only. For taste ranged from 5.60 – 7 87 with sample GI had the highest value and significantly $(p \leq 0.05)$difference form sample LI and LM while sample LI was the lowest and was significantly$(p \leq 0.05)$difference from sample GI, MG and LG.

For overall acceptability the means value ranged from 5.84 – 7.19 of which sample GI ha the highest value, which was significantly $(p \leq 0.05)$difference from LG had the lowest value and was significantly $(p \leq 0.05)$difference from GI, LI, MG and LM.

Table 6: Sensory properties of peanut beverage sample at week three

| Sample | Colour | Appearance | Flavor | Texture | Taste | Overall acceptability |
|---|---|---|---|---|---|---|
| GI | 6.20[a] | 6.80[a] | 7.00[a] | 6.80[a] | 6.60[a] | 6.70[c] |
| MO | 4.87[b] | 5.87[cb] | 5.60[b] | 6.27[b] | 6.27[a] | 5.90[b] |
| LI | 6.27[a] | 6.33[c] | 6.80[ab] | 6.13[a] | 6.13[a] | 6.33[a] |
| MG | 6.20[a] | 5.40[c] | 6.13[ab] | 6.53[a] | 6.53[a] | 6.28[a] |
| LM | 6.27[a] | 6.53[ab] | 5.87[ab] | 6.53[a] | 6.20[a] | 6.30[a] |
| LG | 6.00[a] | 6.40[ab] | 6.20[ab] | 6.33[a] | 6.33[a] | 6.30[a] |
| $\pm SE$ | 0.4 | 0.3 | 0.4 | 0.2 | 0.3 | 0.4 |

Data are mean ± Standard error of triplicate determination

Table 6: shows the sensory properties of the peanut beverage at the end of week three. The mean score for colour ranged from 4.87 – 6.27, with sample LI and LM have the highest value were not significantly $(p \geq 0.05)$difference from GI, MG and LG but were significantly$(p \leq 0.05)$difference from sample MO which had the lowest value. For the appearance the mean score ranged from 5.40 – 6.80 with the mean score ranged from sample LI, LM and LG while sample PNMG had the lowest value, and was significantly $(p \geq 0.05)$difference from GI, LI LM, and

LG except MO that were not significantly ($p \geq 0.05$)difference. Flavor shows mean score from 5.6 -7.00, with sample GI had the highest value and sample MO had the lowest of which sample GI, LI, MG, LM and LG were not significantly ($p \geq 0.05$)difference but MO was significantly ($p \leq 0.05$) difference from MO and LI. That of texture ranged from 6.13 – 6.80, while taste ranged from 6.13 -6.60.

**Conclusion**

The sensory evaluation results showed that sample GI (peanut beverage + ginger) had the best overall acceptability which was most preferred by the panelists. It has the least amount of bacteria, yeast and mould contamination. The pH and Total Dissolved solids (TTS) of the sample decreases as Total Titretable Acidity (TTA) increased as the storage days increased. This led to increase in the alcoholic content in week three after which it was no longer acceptable. Sample MO (peanut nut and moringa leaf powder) and sample LI (peanut beverage +lime) all had good sensory qualities but less storage stability. Sample MG (moringa leaf powder + ginger) and LM (lime + moringa leaf powder also had good taste, mouth feel and overall acceptability, but less stability, probably free of less added ginger. Conclusively, it is advisable to add ginger to peanut beverage to give it a more storage stability free of microbial contamination than lime or moringa leaf powder.

**Recommendation**

Attention should be given to the use of ginger by food processors in increasing the shelf life of peanut beverage due to its preservative quality. Further studies should be done on other preservatives like, *phyllanthus*, combination of lime and lemon.

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