Production and Physiochemical Evaluation of Fresh Cow Milk-Based Beverage

ABSTRACT

The aim of this work was to produce and evaluate the physiochemical properties of cow milk based beverage made from a blend of cow milk and natural ingredients: honey, cocoa powder, ginger and garlic. Milk beverage samples were produced from a blend of cow milk, honey, and cocoa powder as base ingredients and prepared 1 % ginger, 0.5 % garlic were added to samples C and D, respectively. Samples A (cow milk) and E (vitamilk) served as control I and control II respectively. The physiochemical analyses of the fresh milk samples were investigated. From the result, the pH of all the samples were slightly acidic (6.11 to 6.52) while the titratable acidity ranged from 0.086% (sample A) to 0.168% (sample D) showing little fermentation. Statistical analysis of data revealed that there was a significant difference ($P<0.05$) between results of mean values of moisture (87.7-90.75%), carbohydrate (3.95-6.63%), protein (2.85-5.35%), fat (1.84-4.86%), ash (0.58-0.96%) and fiber (0.00-2.25%). There was also significant differences between the mean values of the minerals (mg/100mL); calcium (93.76-193.37), zinc (1.815-3.155), potassium (271.02-585.635), phosphorous (51.765-88.125), magnesium (33.625-58.66) and vitamins (mg/100mL); A (0.0532-0.0874), D (0.335-0.85) contents. This worked showed that fresh milk beverage samples were produced from the named natural ingredients and these natural ingredients also provided more nutrients which will help improve nutrients intake and health of members of a household considerably.

Keywords: production, milk beverage, physiochemical, samples

1.0 Introduction

Milk is a complex nutritious product of mammary gland secretion containing water, protein, fat, carbohydrate mainly lactose, mineral and vitamins [1]. Amongst all food, milk has the most complete and balanced nutritional contents. Milk is an essential component of the diet of about 6 billion people and the world production of milk stands at 730 million tons/year [2]. Milk and milk beverages, if sufficiently available, could efficiently cure many diseases caused by deficiencies in most Africans' diets. Apart from improving nutrition and health of members of the household, dairy also increases farmers' incomes [3]. Milk products are important commodities in the world market, providing many possibilities for new value added products to meet consumer's demand for convenience, nutrition, and health. Milk products are main constituents of the daily diet, especially for vulnerable groups such as infants, school children and aged [4]. In rural Africa, approximately 70 % of milk is utilized in the liquid form, while various indigenous dairy products such as cheese and yoghurt are produced under unhygienic conditions and practices [5]. Microbial contamination of milk and dairy products is a universal problem which affects dairy farmers leading to spoilage of milk and subsequent financial loss in profit.

Processing of dairy products gives small–scale dairy producers higher cash incomes than selling fresh milk and offers better opportunities to reach regional and urban markets and helps to deal with seasonal fluctuations in milk supply. The transformation of fresh milk into processed milk and products can benefit entire communities by generating off–farm jobs in milk collection, transportation, processing and marketing [6]. Natural ingredients may also be added to milk to produce different dairy products, add value to milk and above all extend the shelf life of the milk product. The quantity of these ingredients

added may be varied to obtain a product with good sensory properties, reduced microbial load, acceptable pH levels and longer storage period.

Milk is the most complete food, rich in protein, carbohydrates, mineral, vitamin and calcium [7]. Natural ingredients such as honey, cocoa powder, garlic and ginger also contain a good quantity of these nutrients. Thus adding them to fresh milk is enhancing the nutritional preference of consumer in terms of improving human health and nutritional balance. Furthermore, these ingredients contains active components which play responsive roles in human health and nutrition: honey (peroxides and sugars), cocoa powder (antioxidants), ginger (gingerol, zingerone, shogaol) and garlic (allicin).

Keeping in mind the threats posed by spoilage and pathogenic microorganisms to both the milk industry and the smallholder cattle farmers, several procedures have to be applied in order to extend the shelf life of milk while adding value to it. This will drastically reduce the incidence of losses due to spoilage. This could be done by the production of milk beverage produced from cow milk using natural ingredients like garlic, ginger, honey, and cocoa powder. These ingredients contain carbohydrates, proteins, fats, fiber, minerals and vitamins in varying proportions with milk can boost the nutrient intake of consumers [8].

In dietary guidelines for Americans, 2010 milk and its products are recommended because of their positive effect to dietary intake. Cow's milk contains proteins, fats, vitamins like A, B and D, minerals like calcium, phosphorus, Potassium and iodine, which contribute to multiple and different vital functions in the human body. Calcium of this natural product has good effect on strengthening the bones and potassium is known to control blood pressure [8]. To obtain the valuable nutritional of milk natural ingredients may also be processed with milk.

The main aims of this study were to develop milk beverage from a blend of cow milk and some natural ingredients (honey, cocoa powder, ginger, and garlic); to evaluate the physiochemical properties of the milk beverage samples so developed, that are of particular interest for human health, thus giving improved nutritional composition of the milk for human consumption.

2.0 MATERIALS AND METHODS
2.1 Procurement of Materials
Garlic, ginger, honey cocoa powder and *Vitamilk* were purchased from Wurukum market, Makurdi. Cow milk was bought from vendors at Wadata market, Makurdi, Benue State, Nigeria, in September prior to production.

2.2   Preparations of Materials
2.2.1   Milk
Fresh cow milk was bought from vendors at Wadata market, Makurdi, Benue State, very early in the morning. It was pasteurised in an oven at 70 ^{0}C for 30 minutes [9]. It was then allowed to cool naturally and kept for immediate processing.

2.2.2   Ginger
Fresh mature rhizomes of ginger were separated, thoroughly washed, peeled and sliced (about 2 mm thickness) with stainless steel knife and then oven dried at 60 ^{0}C for 48 h. It was then ground into powder using electric blender. The powder was sieved with a wire mesh of 4mm aperture to remove very rough particles sizes. The fine ginger flour was then kept in sterile bottles for further use.

2.2.3   Garlic
After removing the outer cover, garlic cloves were peeled off; washed with clean water; sliced with a stainless steel knife; and then oven dried at 60 ^{0}C for 48h. It was then ground into powder using electric blender. The powder was further sieved with a wire mesh of 4mm aperture to reduce particle sizes. The fine flour was packed in sterile glass bottle and stored in dry and clean area according to Douglas *et al.*, [10]

2.2.4   Honey
Pure, natural and unadulterated honey was bought and used in its natural form.

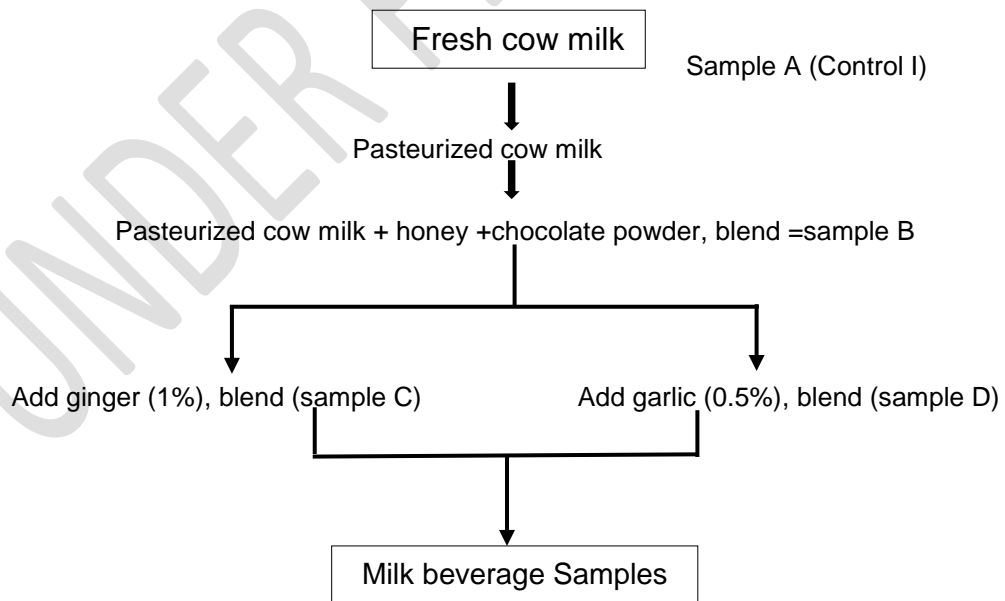### 2.3. Recipes formulation for milk beverage

Chart 1: Milk beverage composition per sample

Component	Milk beverage composition per sample				
	A	**B**	**C**	**D**	**E**
Cow milk (L)	1	1	1	1	0
Honey (L)	0	0.3	0.3	0.3	0
cocoa powder (g)	0	25	25	25	0
Ginger (g)	0	0	10	0	0
Garlic (g)	0	0	0	5	0

Modified sources: Regu , Abiola *et al.,* [11, 12]

2.4 Production of milk beverage
Figure 1: Flow chart for the production of the milk beverage samples

Fresh cow milk   Sample A (Control I)

Pasteurized cow milk

Pasteurized cow milk + honey +chocolate powder, blend =sample B

Add ginger (1%), blend (sample C)   Add garlic (0.5%), blend (sample D)

Milk beverage Samples

*Sample E is *Vitamilk* obtained from grocery shop (control II)

2.5 Physiochemical Analyses

All the physiochemical analyses of the samples were carried out in the Food Science and Biochemical Laboratories of Benue State University, Makurdi, Nigeria.

2.5.1   Determination of pH

The pH was determined at room temperature using a digital pH meter. The pH meter was calibrated with buffer standards of pH 4 and pH 10 prior to use. 50 mL of each treatment sample milk juice was placed in a beaker and the probe of the pH meter inserted into each sample and pH value recorded [13].

2.5.2 Measurement of titratable acidity

The titratable acidity was measured by titrating 15 mL of each milk beverage sample with 0.1 M sodium hydroxide until the substance reached a pH value 8.2, corresponding to the end point of phenolphthalein. Readings was done using pH meter [14, 15]. When this value was reached, the spent NaOH volume was recorded and the acid percentage of the substance was calculated using the formula

$$\text{Titratable acidity} = \frac{\text{Titre value x M x 90 x 100}}{\text{Volume of sample x 1000}}$$

where; M = Molar concentration of NaOH

2.5.3 Proximate analysis

2.5.3.1 Moisture content determination

Moisture content was determined using the oven drying method as outlined by AOAC, [16]. Two (2) grams of samples was weighed into pre-weighed dry crucibles and heated in hot air oven at 105 ^{0}C for 3 h. Cooling and weighing of dried samples were done at intervals of 30 minutes until there was no weight change after three successive weight measurements. The electronic balance was used in taking weight measurements. The final weight of dried samples was noted and the moisture content calculated as:

$$\text{\% Moisture} = \frac{(\text{Wt of crucible +Fresh}) - \text{Wt of crucible +dry sample}}{\text{Weight of fresh sample}} \text{ X 100}$$

2.5.3.2 Determination of protein

The amount of protein was determined by total-Kjeldahl Nitrogen method according to AOAC, [16]. Two (2 g) of sample was digested in concentrated sulphuric acid with one Kjeldahl tablet followed by neutralization using 40 % sodium hydroxide and distillation. The resulting solution was titrated with 0.1N hydrochloric acid using a mixed indicator (methyl red and bromocresol green). The Percent nitrogen (N) concentration was calculated using the following equation

% Nitrogen= (S−B) ×N×0.014×D×$\frac{100}{W}$×V

where:

D = dilution factor, T = titre value = (S-B), W = weight of sample,

Crude protein was obtained by multiplying the corresponding total nitrogen (N) content by a conventional factor of 6.25

 Thus: Crude protein (%) =% N ×6.25

2.5.3.3 Determination of fat

Crude fat was determined by the soxhlet extraction method as outlined by [16]. Two (2) grams of dried samples was weighed into preconditioned and weighed (W0) extraction thimble and placed in the soxhlet extraction apparatus. Fat content of the samples was extracted using organic solvent (petroleum ether) and boiled under reflux for 6 hours. The extraction thimbles was then removed and dried in an oven at 105^{0}C for 30 minutes then cooled and weighed (W1). Percentage of fat content was calculated using the following formula:

$$\text{\% Crude fat} = \frac{\text{Weight of fat in sample}}{\text{Weight of dry sample}} \text{X 100}$$

$$= \frac{W0 - W1}{\text{Weight of dry sample}} \text{ X } 100$$

2.5.3.4 Determination of total ash

Two (2) grams of samples was weighed in dry crucibles, carbonized on a hot plate and heated on a muffle furnace at 600 ^{0}C for 8 hours after which it was cooled in a desiccator and weighed. Ash content was determined by the difference in weight after cooling the samples in desiccators to ambient temperatures AOAC, [16].

% ash content = $\frac{\text{Weight of incinerated sample}}{\text{Weight of fresh sample}}$ X 100

2.5.3.5 Determination of carbohydrate content

The lactose content was estimated by the method, as described by AOAC, [16] according to the following equation:

% Carbohydrate =100 − (moisture + fat + protein + ash) %

2.5.3.6 Determination of mineral content

Analysis of potassium(K) and phosphorus (P) contents of the samples were carried out using flame photometry method AOAC, [17]. The other elemental contents (Ca, Mg, and Zn) were determined, after wet digestion of sample ash with an Atomic Absorption Spectrophotometer [17]. All determinations were carried out in duplicates.

2.5.3.7 Determination of vitamin content

Vitamins A and D were determined according to the methods of AOAC, [17]

3.0 RESULTS AND DISCUSSION

The result obtained from the physiochemical analysis of milk beverage samples are presented in the Tables below.

3.1 pH and Titratable acidity

The results shown in Table 1 revealed that the mean pH values of the five milk beverage sample ranged from 6.3-6.52. The mean titratable acidity of samples A, B, C, D and E were 0.116, 0.150, 0.136, 0.168, and 0.086 respectively. pH is a measure of the hydrogen ions (H+) activity in solution. The pH values of all the samples were, however, lower than those reported by [18] but higher than those reported by [19] . The mean pH values obtained for the five samples of milk beverage analysed from this work indicated that they were near neutral pH and since lower pH (acidic) in food helps to reduce the activity of spoilage microorganism it implies that all the milk beverage samples may have low shelf stability.

Titratable acidity measures the predominant acid present in the milk beverage samples. From the result presented in Table 1, the values of TTA were slightly less than those reported by Klaenhammer *et al.,* [18]); they cited 0.19 %. The TTA usually increases with storage due to increase production of lactic acid by lactic acid producing bacteria. The score of 0.17 % or less of TTA is desirable for safe consumption of the product according to International Food Standard (IFS).

Table 1: chemical properties of milk beverage samples

Samples	pH	Titratable acidity (TTA)
A	6.320±0.014[bc]	0.116±0.015[b]
B	6.495±0.007[d]	0.150±0.010[d]
C	6.520±0.014[de]	0.136±0.005[c]
D	6.300±0.014[b]	0.168±0.005[e]
E	6.110±0.014[a]	0.086±0.005[a]
ANOVA (sig.)	0.001	0.001

Values are mean ± standard deviation of mean. Values with different superscripts are significantly different (p<0.05) for Duncan multiple range test.

3.2 Proximate composition

The mean values of the proximate composition such as moisture, carbohydrate, protein, fat, ash and fiber contents of the formulated milk beverage samples are presented in Tables 2. Few reports were found in the literature concerning the determination of the chemical composition of unfermented milk drinks. Therefore, the results of the present work were compared with more of fermented dairy drinks. Proximate composition is important in determining the quality raw materials and it is often used as a basis of establishing the nutritional value and overall acceptance of the formulated food products [20].

From the results, the moisture of the milk beverage samples ranged from 87.7% (sample C) to 90.75% (sample A). Moisture provides a measure of the water content of a food material and it is also an index of storage stability of food products [21]. High moisture contents in food has been shown to encourage microbial growth [22]. In this work, sample C had the least percent of moisture content and this could be justified by the thickness of the sample due to the dry ingredients added like ginger and cocoa powder. A similar trend is observed in sample D which had dry garlic. From the results, there was significant differences (P< 0.05) in moisture content of milk beverage samples. Sample A had the highest moisture content. This could be due to adulteration of milk by unscrupulous farmers. Barham *et al.*, [23], reported that water is the easiest way and cheap source for adulteration of milk. These values of moisture content are almost equal with those reported by Johanson *et al.*, [19] and Dublin-Green *et al.,* [19, 24] and all these values were close to the earlier findings, from 80 % to 90 % [19]. Water serves as a medium for solution and colloidal suspension for the other components present in milk.

The carbohydrate content of the samples was between 3.95% (sample A) to 6.63% (sample C). The mean values of the carbohydrate content of the milk beverage samples were all significantly different at 5 % level of significance. The difference was accounted for the fact that honey, cocoa powder, and ginger contributed a huge amount of carbohydrate in samples B, C and D coupled with the lactose in cow milk. Sample A (control I) had only lactose. Eckles *et al.,* [25], reported that lactose, or milk sugar, is the main carbohydrate found in milk. It's broken down into its subunits - glucose and galactose in human digestive system.

The protein content of the milk beverage samples ranged from 2.85% (sample A) to 5.35% (sample C). The mean values of the protein content for the milk beverage samples were significantly different at P<0.05. The reason for sample C having the highest protein content could be that the ginger added to the sample contained substantial amount of protein that added up to the protein content of the milk beverage

6

sample. Garlic also contain some considerable quantity of protein making sample D have a higher protein value (4.67%). Also honey, cocoa powder contain a good quantity of protein and this account for the high protein content in samples B, C and D. These values are higher than those reported by Eckles *et al.,* [25] because of the above mentioned reason. Proteins help to build and maintain lean muscle. The high protein and calorie content of the ingredients added to milk beverage samples could solve the problem of protein-calorie malnutrition in Africa especially for children and the elderly.

The fat content of the milk beverage samples ranged from 1.84% (sample E) to 4.86% (sample C). The fat content of the fresh milk beverage samples ranged from 1.84% to 4.86%. The fat content of all the samples were significantly different at P<0.05. The milk beverage sample with the highest value was C (4.86%) and the lowest was sample E (1.84%). Cocoa powder and ginger contain fat that may have added up to the existing fat in cow milk in sample B, C and D. Sample E (control II) may have been partially defatted.

The ash content of the formulated milk beverage samples was between 0.58% (sample E) to 0.96% (sample C). The ash contents of the milk beverage samples were significantly different at P<0.05 for all the samples. Sample C had the highest ash content of 0.95% while the least was sample A. The value of ash content increased in sample C when certain ingredients were added to the samples. Sample B that had ginger had the highest ash content and samples with cocoa powder had similar increase in ash content. Olusegun *et al.,* [26], reported increase in the ash contents of *kunun zaki* enriched with extract of sesame seeds over the control sample without the extract. Ash content is an indication of mineral content of the milk beverage samples.

The crude fiber content of the milk beverage samples ranged from 0.00% (sample A) to 2.25% (sample C). From the result presented in Table 2, the crude fiber contents were significantly different at P<0.05 for all the samples. Sample A (control I) had the lowest while sample C had the highest. Empty cow milk (sample A) has no fiber but ingredients like cocoa powder, ginger (sample C), garlic (sample D) had a substantial quantity of fiber and that accounted for high fiber in those samples. Thus, the fiber present in these milk beverage samples may contribute to positive effects on the consumer's health considering the induced changes in intestinal microbiota and systemic effects on the host's intestinal lumen [27].

Table 2: Proximate composition of milk beverage samples

Samples	Moisture (%)	Carbohydrate (%)	Protein (%)	Fat (%)	Ash (%)	Fiber (%)
A	90.75 ± 0.21^{e}	3.95 ± 0.07^{a}	2.85 ± 0.07^{a}	2.55 ± 0.07^{bc}	0.68 ± 0.007^{ab}	0.00 ± 0.00^{a}
B	88.45 ± 0.07^{bc}	4.85 ± 0.07^{c}	4.26 ± 0.07^{c}	2.34 ± 0.07^{b}	0.83 ± 0.007^{c}	1.35 ± 0.07^{b}
C	87.70 ± 0.28^{a}	6.63 ± 0.07^{e}	5.35 ± 0.07^{e}	4.86 ± 0.07^{e}	0.96 ± 0.007^{e}	2.25 ± 0.07^{e}
D	88.15 ± 0.07^{c}	5.15 ± 0.07^{d}	4.67 ± 0.07^{d}	2.96 ± 0.07^{d}	0.87 ± 0.007^{d}	1.63 ± 0.04^{d}
E	88.65 ± 0.07^{d}	4.46 ± 0.07^{b}	3.93 ± 0.07^{b}	1.84 ± 0.07^{a}	0.58 ± 0.007^{a}	1.48 ± 0.04^{c}
ANOVA (Sig.)	0.001	0.001	0.001	0.001	0.001	0001

Values are mean ± standard deviation of mean. Values with different superscripts are significantly different (p<0.05) for Duncan multiple range test.

3.3 Minerals and Vitamins (mg/100mL)

Minerals

The results of mineral content of the milk beverage samples presented in Table 3 showed that the concentration of Ca, Zn, K, P and Mg in the milk beverage samples ranged from 93.76 mg/100g (sample A) to 193.37 mg/100g (sample C), 1.765 mg/100g (sample E) to 3.115 mg/100g (sample C), 271.02 mg/100g (sample A) to 585.63 mg/100g (sample C), 51.76 mg/100g (sample A) to 88.125 mg/100g (sample C) and 33.62 mg/100g (sample E) to 88.125 mg/100g (sample C). Generally, the mineral potassium (K) from the sample A had the highest value of 413.835mg/100g, while zinc (Zn) has the least value of 1.655 mg/100g from the milk beverage sample E. The increase in the quantity of these mineral is due to the addition of ginger (sample C), garlic (sample D), honey and cocoa powder (samples B, C and D). Minerals are nutritionally important components in food and they could be classified as essential or non-essential elements. Minerals are essential for health and as such are part of all aspect of cellular function and they are involved in structural components of human beings [28]. Some mineral elements form an integral part of enzyme or protein structure. They are vital for normal growth, maintenance, effective immune system and prevention of cell damage [28]. Calcium (Ca) together with phosphorus (P) help build and maintain strong bones and teeth and reduce the risk of stress fractures and osteoporosis later in life. They also play a role in promoting normal blood pressure [29].

Table 3: Minerals (mg/100mL)

Samples	Ca	Zn	K	P	Mg
A	93.760 ± 0.014^a	1.815 ± 0.007^b	271.020 ± 0.014^a	51.765 ± 0.007^a	34.515 ± 0.007^c
B	146.035 ± 0.007^c	2.850 ± 0.000^c	415.735 ± 0.007^c	80.435 ± 0.007^c	33.955 ± 0.007^b
C	193.370 ± 0.014^e	3.155 ± 0.007^e	585.635 ± 0.007^e	88.125 ± 0.007^e	58.660 ± 0.014^e
D	173.155 ± 0.007^d	3.045 ± 0.007^d	511.025 ± 0.007^d	84.355 ± 0.007^d	45.160 ± 0.014^d
E	143.950 ± 0.000^b	1.765 ± 0.021^a	345.260 ± 0.014^b	73.375 ± 0.007^b	33.625 ± 0.007^a
ANOVA (Sig.)	0.001	0.001	0.001	0.001	0.001

Values are mean ± standard deviation of mean. Values with different superscripts are significantly different ($p < 0.05$) for Duncan multiple range test.

Vitamins

The lowest value of vitamin A was recorded in sample E (0.053 mg/100g) and the highest value was in sample C (0.0874 mg/100g). For vitamin D, the highest mean score was recorded by sample C (0.850 mg/100g) while the least was recorded by sample E (0.335 mg/100g).The vitamins examined in this work were vitamins A and D (fat soluble). The means values for Vitamins A and D of the milk beverage samples are shown in Table 4. The high values of vitamins A and D in sample C could be as a result of addition of honey, cocoa powder and ginger which content a certain quantity of these vitamins. Fulgoni *et al.,* [29], reported that cocoa powder contains vitamins A, D, and other water soluble vitamins.. Vitamin A is very important for good vision, healthy skin, and a healthy immune system while vitamin D helps absorb calcium for healthy bones [29].

Table 4: Vitamins (mg/100mL)

Samples	Vit A	Vit D
A	0.0559±0.007[b]	0.450±0.000[b]
B	0.0797±0.000[d]	0.715±0.007[c]
C	0.0874±0.014[e]	0.850±0.014[e]
D	0.079±0.014[c]	0.760±0.014[d]
E	0.0532±0.007[a]	0.335±0.021[a]
ANOVA (Sig.)	0001	0.001

Values are mean ± standard deviation of mean. Values with different superscripts are significantly different ($p < 0.05$) for Duncan multiple range test

5.0 CONCLUSION

This study showed that the five milk beverage samples were conveniently produced from cow milk and natural ingredients: honey, cocoa powder, ginger and garlic. These ingredients provided an opportunity for value to be added to cow milk which in its natural form is not palatable and do not yield high profit. Milk beverage is an excellence source of vitamins, calcium, phosphorus, potassium and proteins so should be consumed by both children and adults. The pH of all the samples were near neutral pH, this could negatively affect the shelf stability of the milk beverage samples as a result of possible microbial infestation and thus there is every need to keep the products always under refrigeration before use.

References

[1]   Griffiths, M.W. (2006). Major advances in fresh milk and milk products. Fluid milk products and frozen desserts. American Dairy Science. 69: 1163 – 1173.

[2]   Hemme, T.O.J. (2010), Status of and prospects for smallholder milk production—a global perspective. Rome: FAO.

[3]   ILRI, (1998). Livestock, people and environment, ILRI (International livestock research institute), Working paper 2, Nairobi, Kenya.

[4]   Enb, A., Abd-Rabou, N.S. Abou-Arab, A.A.K. and El-Senaity, M.H. (2009). Chemical composition of raw milk and heavy metals behavior during processing of milk products. Journal Global Veterinaria, 3 (3): 268-275.

[5]   Bayemi, P.H., Webb, E.C., Ndambi, A., Ntam, F. and Chinda, V. (2008). Impact of management interventions in smallholder dairy farms of the Western highlands of Cameroon. Tropical Animal Health and production, DOI 10.1007/s11250-008-9278-3.

[6]   FAO, (2013). Dairy production and products: Milk processing. Accessed October 15th 2019 http://www.fao.org/agriculture/dairy-gateway/milk-processing.

[7]   Abdelgadir, W.S., Ahmed, T.K. and Dirar, H.A. (1998). The traditional fermented milk products of the Sudan. Int J Food Microbiol 44(1-2): p. 1-13.

[8]   Bahar, A., Angelo N., and Patrizia P. (2017). Production of Chocolate Powdered Beverage with Enhanced Instant Properties. DOI: 10.3303/CET1757147.

[9]   Banik, S.D. and Kamal U. (2014). Microbiological quality analysis of raw, pasteurized, UHT milk samples collected from different locations in Bangladesh. Stamford Journal of Microbiology Vol. 4, DO-10.3329/sjm.v4i1.22753

[10]   Douglas, M. and Smallfield, B. (2005). Herbs, spices and essential oils. Post-harvest operations in developing countries. Rome, Italy: UNIDO and FAO.

[11]   Regu, M. and Seifu, E. (2015). Effect of garlic (Allium sativum) and ginger (Zingiber officinale) powder on chemical composition and sensory property of Ayib - Ethiopian cottage cheese. International Food Research Journal 23(3):1226-1232.

[12]   Abiola, F., Abiose, A.H., Adeniran, M. (2015). Biopreservative Effect of Ginger (Zingiber officinale) and Garlic Powder (Allium sativum) on Tomato Paste. . https://doi.org/10.1111/jfs.12193.

[13]   Omodamiro, R. M, Chijoke, U. and Oti E., (2012). Storage and consumer acceptability of fruit: Ginger based drinks for combating micronutrient deficiency. Journal of Stored Products and Postharvest Research Vol. 3(6), pp. 80–82.

[14]   Joseph, A.O., Joy, E.O. (2011). Physico-chemical and Sensory Evaluation of Market Yoghurt in Nigeria. Pakistan Journal of Nutrition 10 (10): 914-918, 2011 ISSN 1680-5194.

[15]   Adeiye, O.A., Gbadamosi, S.O. and Taiwo, A.K. (2013). Effects of some processing factors on the characteristics of stored groundnut milk extract. . African Journal of Food Science, 7(6): 134 – 142.

[16]   AOAC, (2000). Official Methods of Analysis. Association of Official Analytical Chemists, Arlington, D.C., U.S.A.

[17]   AOAC, (2005). Official methods of analysis. Association of official analytica chemists. 15th Edition. Washington D.C.

[18]   Klaenhammer, T.R. (2005). "Bacteriocins of Lactic Acid Bacteria," Biochimie, Vol. 70, No. 3, pp. 337-349.

[19]   Johanson, H.A. (1980). The Composition of milk. In: Fundamentals of Dairy chemistry, 2nd Ed., Webb, H.B., Johanson, H. A. and Al – ford, A. J. (eds.), The AVI Publishing co., Inc., Westport, Connecticut, USA.

[20]   Marco, A.P., Yasmine, A.A.M., (2015). Sensory profile of fermented milk drinks flavored with fruits from the Brazilian Cerrado. African Journal of Food Science. Vol. 9(6) pp. 379-389

[21]   Ocloo, F., Bansa, D., Boatin, R., Adom, T. and Agbemavor, W. (2010). Physiochemical, functional and pasting characteristics of flour produced from jackfruits (Artocarpus heterophyllus) seeds. Agriculture and biology journal of North America, 1 (5):903-908

[22]   Persson, A. (1996). Clinical assessment of udder health status of sows at time of weaning with special reference to bacteriology and cytology in milk. Zentralbl Veterinarmed A; 44:143–58.

[23]   Barham, G.S, Soomro A.H, Nizamani Z.A, (2014). Detection and Extent of Extraneous Water and Adulteration in Milk Consumed at Hyderabad, Pakistan. Food Nutr Sci 2: 47-52.

[24]   Dublin-Green, M.S. (2005). Quality evaluation of yogurts produced commercially in Lagos, Nigeria. Afr. J. Applied Zool. Environ. Biol., 7: 78-82.

[25]   Eckles, C.H. (2004). Milk and Milk Products, 4th ed. New Delhi. India.

[26]   Olusegun, A.O. (2018). Determination of vitamins, minerals, and microbial loads of fortified nonalcoholic beverage (kunun zaki) produced from millet. Journal Food Science and Nutrition, Volume 4, Issue 1. Pp 34-56

[27]   Shah, N.P. (2001). Functional foods from probiotics and prebiotics. Food Technology, v. 55, n. 11, p. 46-53

[28]   Kassa, B. (2014). Determination of trace metals Oliefera using atomic absorption spectroscopy. Journal of Biology, Agriculture and Healthcare. 4(17): 52-55.

[29]   Fulgoni, V.L. (2010). Food sources of calcium, phosphorus, vitamin D, and potassium in the U.S. FASEB J. 24:325.1.