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Determination of Physicochemical and Microbial Properties of Some Dairy Cattle Products Sold in Kwami L.G.A of Gombe State

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Abstract

This study evaluates the physicochemical and microbial properties of commonly consumed dairy products in Kwami Local Government Area (L.G.A.), with the objective of identifying potential health risks to consumers and informing regulatory oversight. A variety of dairy products—including milk, cheese, and yogurt—were sampled from multiple retail points and analyzed using standard analytical techniques in accordance with National Agency for Food and Drug Administration and Control (NAFDAC) and *Codex Alimentarius* guidelines. Physicochemical parameters assessed included pH, moisture, fat, protein content, and titratable acidity, while microbial analysis targeted pathogenic organisms such as *Escherichia coli*, *Staphylococcus aureus*, and *Listeria monocytogenes*. Results revealed significant variation in physicochemical properties, with protein content ranging from $9.80 \pm 0.01\%$ to $11.3 \pm 0.82\%$, high moisture levels ($70.5 \pm 0.61\%$ to $75.5 \pm 0.61\%$), and elevated titratable acidity ($0.5254 \pm 0.03\%$ in fresh milk to $2.6800 \pm 0.02\%$ in *Kindirmo*). Mean pH values were 3.50 and 4.55 for fresh milk and *Kindirmo*, respectively. Microbial screening detected high levels of contamination, including *Staphylococcus aureus* (3.00×10^5 CFU/ml), *Escherichia coli* (8.0×10^6 CFU/ml), *Bacillus subtilis* (2.80×10^6 CFU/ml), and *Lactobacillus bulgaricus* (5.0×10^5 CFU/ml), with some strains exhibiting antibiotic

resistance. These findings underscore serious public health concerns and emphasize the urgent need for strengthened quality control measures, regulatory enforcement, and public awareness to enhance dairy safety in the region.

Keywords: Dairy Product Safety; Physicochemical Analysis; Microbial Contamination; Public Health Risk; Food Quality Regulation

INTRODUCTION

Several African nations rely on dairy cow products, such as Kindirmo and fresh milk, as a primary source of nourishment. These meals have distinct flavours and are beneficial for your health as they are typically derived from bovine milk. Pasteurisation is the thermal treatment of fresh milk obtained from dairy cows, wherein it is subjected to a specific temperature and duration in order to eliminate any potential microorganisms. This procedure helps guarantee the safety and prolonged freshness of the milk. There are two distinct varieties of milk: fresh milk and spoiled milk. Fresh milk, which is derived from cow 's milk, bears a resemblance to water (Oguntoyinbo et al., 2020). These dairy products are indigenous to many African countries, including Nigeria, where they are produced and consumed. The Fulani people in Nigeria engage in milk production, utilising the surplus milk to create Fresh milk and Kindirmo products, which are then preserved and sold (Akinyele et al., 1999). Raw milk is intended to serve as a comprehensive source of nutrition for infants, while also possessing significant health benefits. Milk primarily consists of fat, protein, total solids, lactose, and moisture. In addition to its main components, milk contains various other constituents, including vitamins, metal ions, flavour compounds, and milk fat. The smaller components of milk and dairy products, as stated by Armstrong (1995), have a notable impact on their nutritional, technical, and sensory characteristics. Milk is a colourless liquid that is secreted by animals in their mammary glands for the purpose of nourishing their offspring. It emerges. Animal milk has been consumed by humans for an extended period, with cow 's milk being the most renowned variety in both developed and developing nations (Thompson, A. 2014). Studies have discovered that milk provides an ideal environment for several bacteria to thrive (Ekici et al., 2004; Chatterjee et al., 2006; Muhammad et al., 2009; Lingathurai and Vellathurai 2010; Mubarak et al. 2010; Ali and Abdelgadir 2011). Fresh milk obtained from a cow in good health often has minimal microbial activity, with a bacterial count of less

than 103 cfu/ml (Chatterjee, 2006; Lingathurai et al., 2009). However, some microorganisms are still present. Several factors can contribute to the bacterial contamination of raw milk and its products, including the overall health of the animal, the cleanliness of the housing area, the type of feed used, the quality of water used on the farm, the condition of milk containers and other storage tools, and, most importantly, the cleanliness of the milker or handler (Chatterjee, 2006; Muhammad et al., 2009). The presence of this pathogenic bacteria has been detected in unpasteurized milk and its derivatives, posing a significant threat to the well-being of individuals, particularly those who consume raw milk (Mubarack&Lingathurai, 2010). Additionally, it decreases the stability of milk (Salman et al., 2011). In Northern Nigeria, fresh milk refers to cow milk that has undergone the process of pasteurisation and serves as the primary source of sustenance. These objects are primarily crafted by itinerant Fulani individuals. A significant number of individuals residing in the northern region of Nigeria, including both urban and rural areas, exhibit a preference for consuming locally produced unprocessed milk as opposed to pasteurised milk. This is due to the prevailing belief among a significant number of individuals, particularly those residing in rural regions, that locally processed raw milk and its derivatives has superior health benefits compared to pasteurised milk. Consuming raw milk and its by-products is seen as. Milk and its fermented products facilitate the transmission of viruses that have the potential to cause illness in individuals. In recent times, there has been a growing fascination with the utilisation of lactic acid bacteria (LAB) strains as protective cultures in food products (Ogunbanwo et al., 2004). Protective cultures are selected based on their capacity to thrive in a product and inhibit the growth of microorganisms that can lead to foodborne illnesses or spoilage (Modzelewska et al., 2005). Utilising vacuum packaging and refrigeration are two more methods to inhibit the proliferation of bacteria responsible for food spoilage. Non-chemical methods, such as ionising radiation, can effectively eliminate pathogenic bacteria. However, it is important to note that this treatment may alter the taste of milk and milk products. Additionally, it does not provide long-term protection against contamination after the treatment process (Ogunbanwo et al., 2004). Contemporary individuals express concerns regarding the synthetic substances employed to preserve food freshness, resulting in a shift towards consuming minimally processed food (Soomro et al., 2002). Employing antimicrobial cultures and/or their derivatives to preserve food could serve as a potential solution to address this issue. Consuming lactic acid bacteria (LAB) cells and their metabolites has long

proven detrimental to human health. In this investigation, natural lactic acid bacteria were employed as protective cultures in both fresh and Kindirmo milk. Consuming contaminated goods, such as locally sourced milk (Fresh milk and Kindirmo), can lead to significant health issues, including fevers and other infections. The presence of pathogenic microorganisms, such as fungus, E.coli, salmonella, Lactobacillus bulgaricus, yeast, and bacteria, in milk may be attributed to factors such as inadequate hygiene procedures during production or the failure of milk producers to adhere to proper hygiene protocols (Oguntoyinbo et al., 2020). Multiple studies have demonstrated that elevated concentrations of pathogenic microbes in dairy products, such as milk, can have detrimental effects on one 's health (Choudhery&Mikolajcik, 1971). Nevertheless, there has been a lack of comprehensive research on the pollution of cow 's milk and milk products in Gombe State, particularly in the Kwami Local Government Area. There is a scarcity of stories on this subject. Pathogenic bacteria have the ability to proliferate when manufacturers of these crucial products (Fresh milk and Kindirmo) fail to handle them correctly during and after the production process. Thus, it is crucial to examine the microbiological and physical/chemical characteristics of local milk products, specifically Kindirmo, which is available in the study area. This is because Kindirmo is both nutritious and promotes the growth of numerous foodborne diseases. The findings could contribute to public health initiatives aimed at preventing and managing diseases.

MATERIALS AND METHODS

Materials/Reagents

Toaster oven, hot air oven, cold storage, autoclave, colony defence, microscope, pH scale, weighing scale, UV light, nutrient agar, eosin methylene blue agar, salmonella shigella agar, mannitol salt agar, and MacConkey agar are all types of medium utilised for bacterial growth. The test instruments comprised Lugol 's iodine, safranin, ethanol, ethidium bromide, hydrogen peroxide, distilled water, crystal violet, acetone kovac ’s solution, hydrogen peroxide (H202), phenolphthalein indicator, and carbon fuschin. The experiment utilised a range of laboratory equipment including test tubes, beakers, conical flasks, wash bottles, reagent bottles, petri dishes, gas cylinders, burettes, crucibles and distillation equipment. Additional materials utilised were masking tape, foil paper, spatulas, cotton wool, slides, syringes, crystal violet, safranin, distilled water, and wire loops.

Methods

Studyarea

The research was conducted in the Dukul ward area of Kwami local government, located in the northeastern region of Nigeria, specifically in Gombe state. Gombe town is located approximately between 10°N and 10°17N in terms of latitude, and between 11°OE and 11°19E in terms of longitude. The location is situated at an elevation of 500 metres relative to sea level and spans across a land area measuring 52,431 square kilometres. The Kwami local government area was situated in the northern direction, while the Akko local government area was located in the southwestern direction. The YamaltuDeba local government area was positioned to the east of Gombe, as reported in the dairy of 2001.

Sample Collection

A random selection of fresh samples of locally produced yoghurt, as well as three sets of fresh milk and Kindirmo from Fulani vendors, were collected from each of the three districts of Dukul ward, located in the Kwami local government area of Gombe state. The mentioned districts are Sittamani, UnguwanSarki, and Jada. 15 samples were selected at random from various locations and vendors, and then placed into a sterile container. Subsequently, the specimens were promptly placed in a refrigerated container equipped with ice packs and expeditiously transported to the laboratory for analysis. The specimens were placed inside a Haier Thermocool refrigerator and maintained at a temperature of 4°C in order to inhibit the activity of microorganisms and chemicals.

Physicochemical Analysis

Determination of pH

A pH metre designed for field use was employed to apply Field 's method for determining the pH of the samples. The pH meter 's electrode was standardised by immersing it in distilled water. Subsequently, two distinct buffers with pH values of 4.0 and 7.0 were employed. The established electrode was subsequently utilised for the various samples, and the outcomes were documented (Ceirwin, 1997).

Specific gravity

To determine the specific gravity, 9ml of fresh and Kindirmo milk were measured and transferred into a crucible. The conical flask containing the milk samples was then

weighed. The method described by Ceirwin (1997) was used to determine the specific gravity.

The formula for specific gravity is the ratio of the amount of milk to the weight of milk.

Determination of titratable acidity (TTA)

Nine 250ml cylindrical flasks were utilised to quantify 9ml of both fresh and Kindirmo milk. The TTA was measured using the water extraction method as described in the AOAC (2005) guidelines. In this instance, the value of the titre was 0.09. The specimen was quantified and blended with 200 millilitres of water devoid of carbon dioxide in a cylindrical container. Subsequently, the flask was immersed in a water bath maintained at a temperature of 40 degrees Celsius and allowed to remain there for a duration of one hour, with the lid placed loosely on top. The clear extract, obtained after filtration, was combined with a 0.05M NaOH solution and phenolphthalein to determine its concentration. The acidity of the water extract exhibited a rise during the storage period. The measurement is conducted using either lactic acid or potassium dihydrogen phosphate. Specifically, 1 millilitre of a 0.05 molar solution of sodium hydroxide is equivalent to 0.0068 grammes of KH_2PO_4.

Moisture content

This approach relies on the measurement of water loss during the drying process in an oven set at a temperature of 105 degrees Celsius. Additional compounds that possess a liquid state at a temperature of 105 degrees Celsius will also undergo evaporation. Step 1: Measure the weight of the crucible (w1), introduce 5 grammes of fresh milk or kindirmo from the specified region, and record the weight (w2). Insert the crucible and its contents into an air oven that is adjusted to a temperature of 105 degrees Celsius, and allow them to undergo the drying process for a duration of three hours. Next, transfer the objects into a desiccant and allow them to cool down before measuring their weight (Ceirwin, 1997).

$$Moisture\ Content\ (\%) = \frac{W_2 - W_3}{W_2 - W_1}\ X\ 100$$

Where; W_1 = Weight of the empty crucible

W_2 = Weight of empty crucible + wet sample

W_3 = Weight of empty crucible + dry sample

Total Solids

The total solid was calculated and expressed as a percentage using the following relation:

$$Total\ Solids\ (\%) = 100 - Moisture\ Content\ (\%)$$

Protein content

This approach excludes nitrogen derived from nitrites and nitrates, but includes nitrogen derived from proteins, alkaloids, and nucleic acids. Concentrated sulfuric acid, in the presence of a catalyst, converts nitrogen into ammonium sulphate by reacting with organic materials. Subsequently, the acidity is increased, and the liberated ammonia is subjected to distillation and quantified. The estimation of crude protein in food is determined by multiplying the nitrogen percentage by the appropriate factor, as a significant portion of the nitrogen in food originates from proteins.

Procedure: Add 0.2 grammes of milk sample to a conical flask. Step 2: Pour 25 mL of strong sulfuric acid into the flask containing the milk sample. Step 3: Incorporate two mercury tablets to facilitate the digestion process. Position the flask within a fume room and gradually apply heat until the liquid achieves a state of clarity, devoid of any black or brown pigmentation. Initially, let the flask to cool. Next, incorporate roughly 200 ml of distilled water to dilute the contents. The digested solution was cooled and transferred into a volumetric flask with a capacity of 100 ml. Additional distilled water was added to reach the desired level. The Markham Distillation Apparatus was utilised for the purpose of distilling the food. A total of 10 mL of digest was introduced into the distillation tube, followed by the gradual addition of 10 mL of 40% NaOH using the same method. The distillation process lasted for a minimum of 10 minutes, during which the ammonia (NH3) produced was gathered as ammonium hydroxide (NH4OH) in a conical jar containing 5 ml of a 4% solution of boric acid and a small amount of methyl red. Distillation of NH4OH imparts a yellowish hue to the resulting liquid. Subsequently, the distillate was combined with a standard 0.1 N hydrochloric acid (HCI) solution and subjected to titration until the emergence of a pink hue. The aforementioned steps were likewise executed using a blank. The sample 's percentage of crude protein content was calculated using the method described by Ceirwin in 1997.

% Crude Protein = 6.25 x%N (Correction factor)

%N = (S-B) x N x 0.014 x D x 100

Weight of the sample x V

Where

S = Sample titration reading B = Blank titration reading

N = Normality of HCI D = Dilution of the sample after digestion

V = Volume taken for distillation 0.014–Milli equivalent weight of nitrogen

The mole titration method, as described by Pirie in 1975 and Akoh in 1981, was employed. 10 ml of each sample was combined with a small volume (0.05 ml) of 0.5% phenolphthalein reagent. After being well combined and allowed to rest for a brief period, a solution of 0.1M NaOH was used to achieve a consistent pink hue, so establishing a standard coloration. Subsequently, it was combined with 2 ml of formalin and allowed to incubate for a brief while. A solution of 0.1M NaOH was introduced to the new acidic solution until it attained an identical pink hue. For the subsequent procedure, a solution of 0.17M NaOH was employed as a reference to measure the volume required to neutralise 2 ml of formalin and 10 ml of water separately. The formula 1.95 (a-b)% represents the difference between the title value (a) and the blank value (b), as stated by Adebayo et al. in 2010.

Microbial Analysis

Preparation of the media

The bacterial culture medium was produced using a commercially available powder according to the directions provided by the manufacturer. The media employed included urease broth, nutritional agar, MacConkey agar, Salmonella Shigella agar (SSA), and MacConkey agar. Simon 's citrate agar was prepared by following the instructions provided on the package. The media were then sterilised in an autoclave at a temperature of 121°C for a duration of 15 minutes. The goods underwent sterilisation in an autoclave at a temperature of 121°C for a duration of 15 minutes.

Nutrient agar medium:

A quantity of 28 grammes of nutritional powder was measured and combined with 1000 millilitres of transparent water. The mixture was well blended and completely dissolved

using a hot plate. Subsequently, it underwent sterilisation in an autoclave for a duration of 15 minutes at a temperature of 121°C. Subsequently, the mixture was allowed to cool, transferred into pet dishes, and let to solidify.

Serial dilution

Serial dilution is a process in which a solution is repeatedly diluted to create a series of solutions with decreasing concentrations. The bacterial culture were cultured at a temperature of 37°C for a duration of 24 to 48 hours using nutrient gar and EMB agar as the growth media. The yeast and mould, which make up the fungal media, will be placed in an incubator set at a temperature range of 25°C to 28°C for a period of 24 to 72 hours.

Inoculation

Subsequently, the diluents will be introduced into several varieties of nutritional culture media. The agar used for TCC is eosine methylene blue agar, while the agar used for TVC is nutritional agar, both prepared using the pour plate method.

Incubation

The nutritional agar and EMB agar, which serve as bacterial media, will undergo incubation at a temperature of 37°C for a duration of 24 to 48 hours. The yeast and mould, which make up the fungal media, will be placed in an incubator set at a temperature range of 25°C to 28°C for a period of 24 to 72 hours.

Counting of Microbial Cells

The number of viable cells that proliferated after incubation was recorded, calculated using dilution factors, and summed.

Enumeration and Isolation

This was done by following the procedures outlined by Afroz et al. (2013). 1 gramme of fresh milk and Kindirmo were combined with 9 millilitres of distilled water and thoroughly mixed to produce a solution that is ten times the volume of water. The sixth instance was employed as an inoculum. By employing the pour plate technique, a volume of 1.0 ml of the appropriately diluted sample was combined with 19.0 ml of nutrient agar that had been heated to a temperature of 40°C. The resulting mixture was then carefully poured into sterile plates in a manner that ensured the absence of any contaminants. The plates were incubated at 37°C for 24 hours.

Live counts were conducted on nutrient agar plates using a colony counter. We conducted a quantitative analysis by enumerating and documenting the quantity of colony-forming units (CFU) per millilitre following a 24-hour period. The surviving colonies were meticulously extracted from nutrient agar plates and purified using sterile nutrient broth that had been previously prepared. The bacterial isolates 'cell morphologies and Gramme staining reactions were determined by closely examining the chosen colonies under a microscope.

Selective plating and identification of isolates.

Selective media streaking was employed to isolate specific microorganisms. The cultures were incubated overnight in nutrient broth. On the following day, a small amount of the bacterial culture from the nutrient broth was evenly distributed on a specialised agar medium and incubated at a temperature of 37°C for a duration of 24 hours. Mannitol salt agar (MSA) was employed for the purpose of differentiating S. Aureus is typically identified using mannitol salt agar, while eosin methylene blue agar is employed for E. coli. The Salmonella Shigella agar is used to detect Salmonella species, while the MacConkey Agar is used to detect Proteus species in fresh and Kindirmo milk.

Yellow Staphylococcus aureus colonies were observed on MSA agar. Klebsiella species. Pink colonies on EMB were believed to exist. The Salmonella species were identified as colonies lacking colour and exhibiting a black spot on the Salmonella-Shigella Agar (SSA). Proteus spp. refers to various species of the Proteus genus. Colonies with a creamy appearance were observed on MacConkey agar. The pink colonies observed on the SSA agar were identified as E. Coli organisms, presumed to be identifiable, were cultivated on a nutrient agar slant, incubated at a temperature of 37°C for a duration of 24 hours, and thereafter stored in a refrigerator at a temperature of 4°C for future analysis.

Identifying the isolates chemically

Salmonella, Shigella, and E. coli. Coli bacteria were identified as pathogenic in all samples. The researcher gathered representative bacterial colonies that grew on culture plates and exposed the different isolates to the Gramme staining technique. Conventional biochemical assays were conducted, including the catalase, citrate, oxidase, urease, motility, and indole assays (Ekici 2006s). The identities of the bacterial isolates were confirmed by biochemical tests, including citrate, catalase, oxidase, and urease. Prior to conducting the molecular testing, the isolates were cultured on various types of selective agar to ensure

their purity. Observers recorded alterations in hue (Barrow and Feltham, 1993; De Silva et al., 2001; Ellis and Goodacre, 2006).

Test for catalase

A drop of a 3% hydrogen peroxide solution was applied onto a glass slide. Using a wire loop, a little portion of the solid medium was extracted and combined with hydrogen peroxide. The rapid boiling and formation of foam indicated a positive result for the test.

Test for oxidase

The specimen was carefully positioned on filter paper inside a sterile Petri dish, accompanied by two droplets of phenylenediamine, a freshly prepared oxidase reagent with a concentration of 1%. A glass rod was employed to disperse the test organism. A positive test result would be indicated by the rapid appearance of a strong purple hue within a time frame of 5 to 30 seconds. A lack of deep purple colour indicates a subpar outcome.

Test for Urease

The urea agar base was prepared in accordance with the manufacturer 's instructions, and slants were subsequently created from the test tubes. An abundant layer of an 18-hour pure culture was evenly distributed throughout the slanted surface. The slant was incubated at a temperature of 37°C for a duration of 24 hours. An effective response is indicated by the presence of a vivid crimson hue accompanied by the emission of ammonia vapours.

Test for Citrate

The Simmon citrate agar was made in accordance with the instructions provided on the packaging, and the test tubes were placed at an angle. The 18-hour culture deposited a substantial inoculum that was evenly distributed over the entire slant surface. Subsequently, the inclination was maintained at a temperature of 37°C for a duration of 24 hours. The colour blue signifies a positive outcome.

Painting Gramme

A sample was applied onto a pristine glass slide that was free of any grease or contaminants. The smear was subsequently saturated with crystal violet and allowed to sit for 30 seconds. Subsequently, the solution was diluted with grammes of iodine, which serves as a mordant, and allowed to sit for an additional 30 seconds. After an additional 30 seconds, the substance was drained and subjected to decolorization for 1 minute using 95%

ethyl alcohol. The smear was subsequently counterstained with safranin and allowed to incubate for an additional 60 seconds. Ultimately, the specimen will undergo a thorough cleansing using distilled water, followed by gentle wiping using Whatman filter paper. Subsequently, it will be carefully observed using a binocular microscope at a magnification of x100, utilising the objective lens. This demonstrates the evolution of microorganisms throughout history. Gram-positive bacteria do not exhibit the dark purple hue of crystal violet dye, and gram-negative bacteria do not exhibit the reddish colour of safranine dye. The cellular morphology can be classified as either cylindrical (rod-shaped) or spherical (cocci-shaped) (Oyeleke*et al.*, 2008).

Statistical study

The statistical significance of differences in the mean concentrations and physicochemical qualities of fresh milk and Kindirmo in different districts was determined using one-way analysis of variance (ANOVA). The samples were collected on the assumption that there were substantial disparities between the average values, provided that the P-value for the comparison was below 0.05. Statistics were conducted using SPSS version 20 (SPSS 2010).

RESULTS AND DISCUSSION

Physicochemical analysis of the KindirmoMilk

Table 1 presents the% yield of physicochemical parameters for Kindirmo milk collected from various locations. The mean values of SAMPLE B (3.63±0.01) and SAMPLE C (3.44±0.03) exhibited the highest and lowest pH levels, respectively. The total solids content of SAMPLE A is 27.40±1.51, whereas the total solids content of SAMPLE C is 25.10±0.47. The titratable acidity of SAMPLE C is 2.63±0.16, and the titratable acidity of SAMPLE A is 2.33±0.27. Additionally, SAMPLE A has a value of 10.61±0.33. The mean values of SAMPLE B (9.87±0.43) were the greatest and lowest. Among the samples, SAMPLE A (0.96±0.01) had the greatest mean value for protein, whereas SAMPLE B (0.93±0.01) had the lowest mean value. The average values from all the locations that were visited, however, do not show any significant differences as they all have the identical letters following them.

Table 1: Physicochemical Properties of Kindirmo

Sample	pH	Total solid	TTA	Protein	Specific Gravity	Moisture Content
SampleA	3.55±0.11[a]	27.40±1.51[a]	2.33±0.27[a]	10.61±0.33[a]	0.96±0.01[a]	72.48±1.56[a]
SampleB	3.63±0.01[a]	25.33±076[a]	2.50±0.11[a]	9.87±0.43[a]	0.95±0.00[a]	75.33±0.43[a]
SampleC	3.44±0.03[a]	25.10±0.47[a]	2.63±0.16[a]	10.05±0.41[a]	0.93±0.01[a]	75.09±0.40[a]

The values represent the mean ± standard error of the mean (SEM) calculated from three determinations. Values in the same column with distinct superscripts are statistically significant ($p < 0.05$).

Physicochemical properties of fresh milk

Table 2 displays the% yield of physicochemical parameters for fresh milk samples obtained from various locations. The mean values for pH were higher in SAMPLE B (4.55±0.03 a) compared to SAMPLE A (4.38±0.09 a). Similarly, the total solids were higher in SAMPLE B (22.93±1.48 a) compared to SAMPLE A (21.93±0.47 a). The titratable acidity was lower in SAMPLE C (0.52±0.03 a) compared to SAMPLE A (0.72±0.00 c). The protein content was the same in SAMPLE C (12.58±0.26 a) and SAMPLE A (12.58±0.26 a). The specific gravity was higher in SAMPLE A (0.96±0.01 a) compared to SAMPLE B (0.92±0.01 a), and higher in SAMPLE C (77.56±4.28 a) compared to SAMPLE A (76.43±4.49 a). These results indicate a significant difference between the samples, as indicated by the different letters in their superscripts**.**

Table 2: Physicochemical properties of a fresh milk sample

SAMPLES	pH	Total solid	TTA	Protein	Specific Gravity	Moisture Content
Sample A	4.38±0.09[a]	21.93±.47[a]	0.72±0.00[c]	12.58±0.26[a]	0.96±0.01[a]	76.42±4[a]
Sample B	4.55±0.03[a]	22.93±1.4[a]	0.66±0.02[b]	14.40±0.56[b]	0.92±0.01[a]	77.00±1.52[a]
Sample C	4.51±0.06[a]	22.23±4.3[a]	0.52±0.03[a]	18.26±0.33[c]	0.93±0.00[a]	77.56±4.28[a]

The values represent the average ± standard error of the mean of three determinations. Values in the same column with distinct superscripts are statistically significant ($p < 0.05$).

Microbial count of fresh milk samples

Table 3 displays the mean CFU/ml values found in various locales. The Tvc values for SAMPLE A, SAMPLE B, and SAMPLE C were 2.95±0.02b, 2.15±0.56band0.18±0.01a, and 2.70±0.02a, respectively. The TCC values were 2.80±0.03a, 2.35±0.02a, and 2.70±0.02a, while the TFC values were 3.00±0.09b, 2.10±0.02a, and 3.00±0.10b. The results indicate the presence of several harmful bacteria. Nevertheless, there exists a significant disparity in the outcomes obtained from various study regions, as evident from the distinct letters in the superscripts.

Table 3: Microbial content of the fresh milk sample

Samples	TVC(x 10^6CFU/mL)	TCC(x 10^6CFU/mL)
Sample A	**2.95±0.02^b**	**2.80±0.03^a**
Sample B	2.15±0.56^b	2.35±0.02^a
Sample C	0.18±0.01^a	2.70±0.02^a

The values represent the mean ± standard error of the mean (SEM) calculated from three determinations. Values in the same column with distinct superscripts are statistically significant ($p < 0.05$)

Microbial Count of Kindirmo

The average number of colony-forming units per millilitre (CFU/ml) detected in different visited areas were as follows: 0.05±0.00a for SAMPLE A, 3.56±0.25 for SAMPLE B, and 6.40±0.32c for SAMPLE C. The mean total coliform count (TCC) values were 6.50±0.36b, 0.35±0.03a, and 5.00±0.42 for SAMPLE C, and 6.60±0.31b, 5.20±0.03a, and 7.00±0.21b. The findings indicated a significant presence of harmful bacteria, however the amount was not as pronounced as observed in the fresh milk sample. Nevertheless, there exists a significant disparity in the outcomes obtained from various study domains, as evidenced by the distinct letters in the superscripts.

Table 4: Microbial Count of Kindirmo

SAMPLE	TVC (x 10^5CFU/mL)	TCC (x 10^5CFU/mL)
Sample A	0.05±0.00^a	6.50±0.36^b
Sample B	3.56±0.25^b	0.35±0.03^a
Sample C	6.40±0.32^c	5.00±0.42^b

The values represent the mean ± standard error of the mean (SEM) calculated from three determinations. Values in the same column with distinct superscripts are statistically significant ($p < 0.05$).

Bacterial Identification

The various classifications of bacteria are displayed in the table provided below. Some of these bacteria are Gram-positive, while others are Gram-negative. Various biochemical assays were employed to ascertain the identity of these bacteria. The tests conducted were the coagulase test, citrate utilisation test, indole production test, Vogesprausker test, carbohydrate utilisation test (sugar fermentation test), oxidase test, methyl red test, catalase test, starch hydrolase test, and hydrogen sulphide generation test.

Table 5: Bacterial identification

Sample	G.stain	Cat	Coug	sH	CiT		IND	MR	VP	OXI	L	S	M	Bacterial name
Sample A	-R	+	_	+	_	_	_	_	_	_	_	+	+	E.coli
	+R	+	-	+	+	-	-	-	+	-	-	+	-	Bacillus subtilis
	-R	-	-	-	+	-	+	+	-	-	+	+	-	E.coli
	+R	+	+	-	-	-	-	-	-	-	-	+	+	Staphylococcus aureus
Sample B	+R	+	-	+	-	-	-	-	-	-	-	+	-	Staphylococcus aureus
	+R	+	-	+	+	-	-	-	-	-	-	+	-	Bacillus sub Tillus
	-R	+	-	+	-	-	-	-	-	-	-	+	-	Salmonella
Sample C	-R	-	-	-	+	-	+	+	-	-	+	+	-	E.coli
	+R	+	-	-	-	-	-	-	-	-	-	-	-	Staphylococcus aureus
	-R	+	-	+	+	-	-	-	+	-	-	+	-	E.coli

Key:

The physical results from the samples employed in this investigation for the local milk product demonstrate that the average pH of the fresh milk samples was 4.51±0.06

and the average pH of the Kindirmo samples was 3.55±0.11 a. This suggests that both samples were very acidic, as seen in tables 1 and 2. There were various pH readings for raw milk and fermented milk, ranging from 6.4 to 6.49 for raw milk and 4.09 to 4.50 for fermented milk (Grant et al, 2003; Obijand, 2007, FulyaTasci 2011, Lingathurai, et al. 2009) and (Ogbanna et al. 2012). Standard Milk pH determines if the milk is clean, and milk pH (consumable) should not be <6.6 or >6.8 when the temperature is 200°C (Javaid, et al., 2009). However, the pH readings for both fresh milk and Kindirmo.

This table illustrates the titratable acidity levels for different types of yogurt. For table 2, they varied from 0.52±0.03 to 0.72±0.00, with an average of 0.66±0.01, and for table 4.1, they ranged from 2.33±0.27 to 2.63±0.16, with an average of 2.42±0.02. The higher acidity is because yogurt is left to sour, which is linked to harmful microorganisms that make it more acidic than fresh milk. The mean protein content for Kindirmo was between 9.87±0.43 and 10.61±0.33, and for Fresh milk it was between 12.58±0.26 and 18.26±0.33. The results showed that fresh milk is also a sort of fermented product that is safer to take than Kindirmo since it has more protein content than Kindirmo, which is essential for normal and functional metabolic processes. These figures are similar to those reported by Mohammed and El-Zubeir for fresh milk, the percentage solid (% dry weight) ranges from 21.93±.47 to 22.93±1.48a, and for Kindermo, it ranges from 25.10±0.47 to 25.33±076. Kindirmo may have a high percentage of solids since it contains lumps and not much water. The specific gravity value for Kindirmo was between 0.93a±0.04 and 0.96a±0.06, while for fresh milk it was between 0.93±0.20a and 0.96±0.01. The moisture content for Kindirmo was between 72.48±1.56-75.33±0.43, and for fresh milk it was between 76.43±4.49 and 77.56±4.28a. Both fresh milk and Kindirmo had the highest percentage of moisture content, which may be related to their high mineral and water levels.

However, there are not any obvious discrepancies between the results from the areas where Kenyanrmo samples were taken. All of the places that were studied at have the same letters in their superscripts, yet there are noticeable variances between the fresh milk samples. The mean values for pH and total solid do not differ considerably because they both have the same letters. However, the mean values for titratable acidity, protein content, specific gravity, and moisture content range greatly since they have distinct letters.

The total number of microbes found for Kindirmo was 0.05±0.00x105CFU/ml for SAMPLE A, 3.56±0.25b x 105 CFU/ml and 6.40±0.32 x105CFU/ml for TVC, 6.50±0.36 b x105 CFU/ml, 0.35±0.03a x105 and 5.00±0.42b x 105CFU/ml for TCC, and finally 6.60±0.31bx 105CFU/ml and 5.20±0.03 ax105 CFU/ml for SAMPLE B. However, the results from SAMPLE A, SAMPLE C, and SAMPLE B are significantly different because they have different letters in their sup Total microbial count from fresh milk samples was 2.95±0.02b x106 CFU/ml, 2.15±0.56b x106 CFU/ml, and 0.18±0.01a X106 CFU/ml for TVC, 2.80±0.03 an X 106CFU/ml, 2.35±0.02aCFU/ml X 106 CFU/ml, and 2.70±0.02 an X106 CFU/ml for TCC, from all the places that were visited. The results from SAMPLE A (SampleA), SAMPLE B (SampleB), and SAMPLE C (SampleC) are also considerably different from each other because they have distinct letters.

As a result, pathogenic bacteria were in the sample locations that could cause food-borne illnesses and other ailments in persons who ate this product. The total live bacterial counts in all samples did not meet the requirements for food safety, as specified by NAFDAC (2009). The microbiological limit for the total responsible colony count is 1.0x102cfu/ml. Lactobacillus bulgaricus, Staphlococcus aureus, and Escherichi. The bacteria Staphlococcus aureus is dangerous to humans and can cause a variety disorders, including cellulites, scalded skin syndrome, impetigo, pneumonia, osteoporosis, toxic shock syndrome (Toxaemia), meningitis, and staphylococcus food poisoning (Marorie and Kathleen 2006). Bacillus subtilis is found in soil and water and can therefore contaminate food and dairy products by sellers (Pelczer et al., 200 Unfortunately, contaminating microorganisms are the undesired germs that can develop in food and make it less safe to eat and carry around (Sangodoyin and Osuji, 1990). The results suggest that there were many bacteria and coliforms in the samples of fresh milk and Kindermo. This suggests that there was not a lot of cleanliness during the processing and sale of the goods. This includes the personnel who handle the food and the quality of the water and tools that are utilised. For example, when selling fresh milk, the hawkers 'dirty hands and bowls dipped in the calabash or plastic and being exposed to it while it was on show in its containers can make the sample areas dirty.

CONCLUSION

According to the results of this investigation, it may be concluded that locally produced Kindirmo and Fresh milk may harbour hazardous bugs or contribute to milk spoilage. Their look indicates that they were subjected to unsanitary handling during and after the manufacturing process. Assessing the microbiological and physical-chemical characteristics of Kindirmo and fresh milk is beneficial for ensuring quality control and food safety management. By promoting proper hygienic practices throughout the production and storage process, we may reduce the likelihood of contamination and guarantee the longevity of both fermented (Kindirmo) and non-fermented (fresh milk) dairy products. Microbial screening was conducted using the serial dilution approach, whereas the physicochemical screening followed standard methods. The microbiological screening detected pathogenic bacteria including Staphylococcus aureus (3.00 x 105CFU/ml), Escherichia coli (8.0 x 106CFU/ml), Bacillus subtilis (2.80 x 106CFU/ml), and Lactobacillus bulgaricus (5.0 x 105CFU/ml). The physicochemical screening revealed a pH value of 3.50 and 4.55, protein concentration of 9.80±0.01% and 11.3±0.82%, moisture content of 70.5±0.61% and 75.5±0.61%, and significant titratable acidity. According to the study 's results, it is possible that Kindirmo and fresh milk produced in Dukul ward, Kwami local government region of Gombe state may contain harmful bacteria that might cause illness or spoil the milk.

Recommendation

Producers of both Kindirmo and Fresh milk should enhance their hygiene protocols prior to, during, and after the stages of production, processing, and storage in order to minimise the transmission of microorganisms.

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