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Research Article

Effects of Storage Methods and Storage Durations on Physicochemical and Total Bacterial Count of Bulked Milk from West African Dwarf (WAD) Goats

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Abstract

The quality of goats' milk can become labile if not aseptically handled and stored properly. thus, there is need for immediate cooling of milk to ameliorate putrefaction. This study investigated effects of storage methods and storage durations on physicochemical and total bacterial count of bulked milk from west Africandwarf (wad) goats. The milk collected was bulked, refrigerated at 6°c and frozen at -4°c for duration of 0 hour (fresh), 24, 48, 72, 96, 120, 144 and 168 hours respectively. The result showed that storage method and duration significantly ($p < 0.05$) affected protein, lactose, solid non-fat, moisture, casein, total solids contents, titratable acidity and ph of milk. Refrigerated milk had higher ($p < 0.05$) protein, ph, casein and moisture contents while frozen milk had higher ($p < 0.05$) lactose, solid non-fat and total solids contents. Highest values of protein, casein and ph were obtained at 0 hour (fresh), however, it decreased from 24 to 168 hours without definite trend. The interaction between storage methods and storage duration had effects only on titratable acidity and ph of the bulked milk. Storage method and duration had no significant ($p > 0.05$) effect on total bacterial count (tbc) of milk from wad goats. The isolated bacterial in this study at 0 and 24 hours were *Shigella, Pseudomonas Aeruginosa, Esherichia Coli, Staphylococcus Aureus, Staphylococcus Epidermis, Salmonella Enteric*. The study concluded that bulked milk of wad goats can retain its nutrient content by refrigerating and freezing up to 48 hours.

Keywords: Goat Milk, West African Dwarf Goats, Physicochemical Properties, Storage Conditions, Bacterial Count.

Introduction

Milk is the product of the total secretion by mammary glands of a lactating female animal in good health, well-nourished and not overworked [9]. Its demand by humans is very high due to its nutritional adequacy. Goat milk is a valuable product worldwide, with total production increasing from 12 million tons in 1993 to nearly 19 million tons in the last 24 years [21]. The west African dwarf is an indigenous goat breed found in southern and northern Nigeria, respectively. The meat and skins are mostly harvested, but its milk is scarcely produced, especially in commercial quantity. Milk quality deteriorates rapidly if not aseptically handled and appropriately stored hence contamination by microorganisms which cause spoilage, thereby reducing its quality [1]. Cooling milk at low temperatures can control microbial growth because it slows down chemical deterioration and enzymatic activity. extended storage times of raw milk at low temperatures (2-6°c) have a significant influence on the natural present microbial population [30]. This current study investigates changes in milk's physicochemical and total bacterial count in bulked milk from west African dwarf goats preserved under different storage conditions.

Materials And Methods

Experimental site

The experiment was carried out at the small-holder dairy goat research farm, directorate of university farms (dufarms), federal university of agriculture, Abeokuta, Ogun state, Nigeria. The site is located in the rain forest vegetation zone of south-western Nigeria within latitude 7°13'49.46" n, longitude 3°26'11.98" e and an

altitude of 76 meters above sea level [22]. It lies within the south-western part of Nigeria with a prevailing tropical climate and mean annual rainfall of 1131.1 mm. annual mean temperature and relative humidity is 34^0c and 82% respectively [49]. Milk physicochemical analysis were carried out at the animal physiology laboratory, college of animal science and livestock production, and bacterial analysis was carried out at microbiology post graduate laboratory, college of biological sciences, federal university of agriculture, Abeokuta, Ogun state, Nigeria.

Experimental does and management

Thirteen (13) lactating west African dwarf (wad) goats were managed under a semi-intensive system and fed 0.3-0.5kg of formulated concentrate feed per head per day. The goats were allowed to graze on a *Panicum Maximum* and *Pennisetum Purpureum* Dominated pasture for 2 hours and brought back to their shed, where water was provided, and supplemental forages provided.

Milk collection

The experimental animals were hand milked as described by [36] at 7 am in the morning. Milk was bulked into a milk collection bottle, there after placed in an icepack to cool down in order to prevent putrefaction. The bulked milk was divided into two groups. Each group was appropriately labeled to be refrigerated at 6°c and frozen at -4°c for the duration of storage at 0, 24, 48, 72, 96, 120, 144 and 168 hours.

Determination of various constituents

Protein

Protein determination was done by formaldehyde titration as described by [44]. 10ml of milk was pipetted into a 250ml conical flask. 1ml of phenolphthalein indicator was added to the milk, thereafter, 0.4ml of neutral saturated potassium oxalate solution was added and mixed thoroughly. The mixture was neutralized with 0.1m of sodium hydroxide (NAOH) to a saturated pink colour. Formalin (2 ml) was added and mixed properly and the mixture was allowed to stand for 2mins. the acid produced was titrated with 0.1m NOAH to same pink colour and the titre value noted as 'a'. Mixture of 2ml of formalin and 10ml of water were titrated with 0.1m NAOH separately and the titre value noted as 'b'. then, the protein content was calculated using pyne constant of 1.7 * (a-b) %.

Fat

The fat content of milk was determined Babcock method as described by [25]. 10 ml of liquid milk was measured into a graduated test tube and 92% sulfuric acid was added and shaken appropriately. The mixture was centrifuged at (45^oc)/1,100revolutions/seconds for 4 minutes using refrigerated centrifuge (thermos fisher, d-37520osterode, Germany). The fat content that separated out in the test tube was read.

Casein

The percentage milk casein was determined by multiplying the burette reading obtained from the milk protein determination by a constant [19] as reported by [3] and the formula as shown below:

% Casein Protein = Burette Reading (Obtained from Protein Determination) 1.38

Lactose

Lactose was determined by conducting solid-not-fat, protein and ash analysis as described by [15]. Percentage values of protein plus ash was subtracted from percentage solid-not-fat to obtain percentage lactose.

Lactose = Snf – (% Protein + % Ash)

Solid-Not-Fat

The solid-not-fat of the milk was determined by direct oven – ether extraction where percentage fat was subtracted from percentage total solids to obtain percentage solids-not-fat as described by [10].

Total Solid

Total solid was determined by direct oven drying method as described by [10].

Ash

The ash content was determined by incineration with the muffle furnace (Gallen Kamp sg93/11/895, UK) at 550^oc for 2hours. porcelain dish containing the total solids was transferred into muffle furnace and ashed at 550oc for 2h. Thereafter, was cooled in a desiccator before weighing. The difference in weight was calculated in percentage (%).

% Ash = (weight of crucible + Ash) – Weight of crucible weight of milk sample

Moisture

The moisture content of the milk was determined by direct method (oven drying) according to [6] using oven, (lte Oldham ol37en, Great Britain).

Titratable acidity

[5] using phenolphthalein (Kem light an iso 9001:2008 Mumbai, India) as an indicator. The acidity of the samples was calculated using the following equation:

Titratable acidity (%) = 0.009 x volume of n/NOAH used x 100/ weight of milk samples.

Ph

The ph of the milk was determined using Hanna instrument hi 98107 phep ph tester, with +/-0.1 accuracy.

Specific gravity

The specific gravity of milk was determined using the mass and volume of the milk as described by [4]. Milk collected was weighed using electronic weighing scale to determine the mass of the milk yield and measuring cylinder to determine the volume of the milk for each of milk samples.

Calculation of the specific gravity of the milk:

Density of milk = Mass of milk yield (G) Volume of milk yield (Cm^3)

Specific gravity of milk Density of milkDensity of water

Culture media used for the study

The culture media include mannitol salt agar, nutrient agar, plate count agar, salmonella shigella agar, MacConkey agar, sim agar. they were constituted according to manufacturer's instruction.

Determination Of Total Bacterial Count

Total bacterial count was determined by standard plate count method as described by [48].

Identification Of Isolates

Bacterial isolates were identified as described by [7] using bergey›s manual of systematic bacteriology.

Results and Discussion

Effects of storage methods on milk composition

The results on tables 1 and 2 showed that milk compositions vary in percentages with different storage methods. the protein, lactose, solid-not-fat, moisture content, casein, total solid and ph percentages of the bulked goat milk were significantly ($p < 0.05$) affected by storage methods table 1 and 2. storage method did not influence fat, ash, energy, titratable acidity and specific gravity percentages of the bulked milk table 1 and 2. The protein, moisture content, casein and ph had higher percentages with refrigeration method more than freezing method. freezing method significantly ($p < 0.05$ influenced lactose, solid non-fat and total solids percentage contents of the milk more than refrigeration method. The observation that storage method significantly influenced changes in protein content of bulked milk from wad goats could be as a result of the presence of proteolytic enzymes secreted by bacteria or enzymes from somatic cells which degrade protein in milk during cold storage [53]. This study is in line with the findings of [31] who reported that storage method had influence on milk protein content at refrigeration temperatures. However, the result of this study was not similar with work of [20] who reported that milk stored at 4^0c did not significantly affect protein content of milk from goats. The higher mean value of lactose under freezing over refrigeration could be due to the temperature gradient between freezing and refrigeration. This study does not corroborate the findings of [20] who reported that lactose content of milk preserved for up to 5 days at 4°c was not significantly affected. The higher percentage of solid non-fat content of milk observed during freezing could be as a result of expanding water crystals which caused mechanical damage to fat globules and make them accumulate [32]. Higher percentage of solid-not-fat observed with freezing could be as a result of higher lipolysis which will lead to further break down of milk particles [13]. Refrigeration influenced the moisture content of milk more and this could be as a result of decrease in total solids content of milk, this happened more significantly in milk preserved at temperature slightly above 5°c [12]. The result from this study does not corroborate the findings of [20] who stated that refrigerated method did not influence moisture content. Refrigeration method influenced casein content of milk more than freezing could be as a result of casein micelles losing their stability and precipitating. [23] reported a significant proteolytic activity in milk stored at 4°C. the report of this study is not in line with the findings of [40] who detected no effect of temperature on casein content in bulk tank milk. Total solids content of milk from wad goats was influenced by the storage method with more percentage in frozen milk, this could be due to less growth of psychotrophic which increased the activities of degradative enzymes present in milk. This study corroborates the report of [41] who reported that milk stored at 2°c had less impact on total solids compared to milk stored at 4°c. The report of this study differed from the findings of [17] who reported that cooling and freezing did not affect the total solids content. It was observed from this study that refrigeration had more percentage of milk ph than freezing method and this could be as a result of high activity of lactic acid present in milk which leads to fermentation thereby altering milk ph. [34] reported a change in ph at low temperatures known as post acidification. the result of this study is not in line with the study of [38] who reported that storage method did not affect milk Ph.

Factor		Protein (%)	Fat (%)	Lactose (%)	Solid Non-Fat (%)	Ash (%)	Moisture Content (%)
Storage Method							
Refrigeration	32	2.34 ± 0.09 ^{A}	3.27 ± 0.22	8.28 ± 0.32^{b}	11.38 ± 0.34^{b}	0.76± 0.08	85.35 ± 0.31^{a}
Freezing	32	1.93 ± 0.09^{b}	3.38 ± 0.22	9.47 ± 0.32^{a}	12.33 ± 0.34^{a}	0.93 ± 0.08	84.28 ± 0.31^{b}
Storage Duration							
0	8	3.66 ± 0.19^{a}	3.75 ± 0.43	6.96 ± 0.64^{c}	11.55 ± 0.69^{abc}	0.93 ± 0.15	84.70 ± 0.61^{bcd}
24	8	1.49 ± 0.19^{c}	3.21 ± 0.43	9.03 ± 0.64^{abc}	11.16 ± 0.69^{bc}	0.64 ± 0.15	85.63 ± 0.61^{ab}
48	8	1.99 ±0.19^{bc}	2.78 ± 0.43	11.45 ± 0.64^{a}	14.01 ± 0.69^{a}	0.56 ± 0.15	83.21 ± 0.61^{d}
72	8	1.75 ± 0.19^{bc}	3.73 ± 0.43	6.99 ± 0.64^{c}	9.42 ± 0.69^{c}	0.67 ± 0.15	86.85 ± 0.61^{a}
96	8	2.07 ± 0.19^{bc}	3.46 ± 0.43	9.79 ± 0.64^{ab}	12.73 ± 0.69^{ab}	0.87 ± 0.15	83.80 ± 0.61^{ab}
120	8	1.77 ± 0.19^{bc}	3.20 ± 0.43	9.03 ± 0.64^{abc}	11.95 ± 0.69^{abc}	1.16 ± 0.15	84.85 ± 0.61^{cd}
144	8	2.34 ± 0.19^{b}	3.66 ± 0.43	8.64 ± 0.64^{bc}	11.86 ± 0.69^{abc}	0.88 ± 0.15	84.48 ± 0.61^{bcd}
168	8	1.99 ± 0.19^{bc}	2.83 ± 0.43	9.0 9± 0.64^{abc}	12.15 ± 0.69^{abc}	1.07 ± 0.15	85.02 ± 0.61^{bc}

Table 1: Means showing effects of storage method and duration on protein, fat, lactose, solid non-fat, ash and moisture contents of bulked milk from west African dwarf goats.

$^{A-D}$ Means in the same column with different superscript differ significantly ($p < 0.05$).

Factor		Casein (%)	Energy (%)	Total solids (%)	Titratable acidity (%)	Ph (%)	Specific gravity (%)
Storage method							
Refrigeration	32	1.90 ± 0.08^{a}	71.92 ± 1.85	14.65 ± 0.31^{b}	0.27 ± 0.09	7.55 ± 0.02^{a}	1.09 ± 0.02
Freezing	32	1.57 ± 0.08^{b}	76.04 ± 1.85	15.72 ± 0.31^{a}	0.25 ± 0.09	7.46 ±0 .02^{b}	1.04 ± 0.02
Storage duration							
0	8	2.97 ± 0.15^{a}	76.24 ± 3.69	15.31 ± 0.61^{ab}	0.22 ± 0.02^{c}	7.63 ± 0.04^{a}	1.06 ± 0.04
24	8	1.21 ± 0.15^{c}	70.95 ± 3.69	15.31 ± 0.61^{ab}	0.23 ± 0.02^{bc}	7.60 ± 0.04^{ab}	1.20 ± 0.04
48	8	1.62 ± 0.15^{bc}	78.79 ± 3.69	16.79 ± 0.61^{a}	0.26 ± 0.02^{abc}	7.20 ± 0.04^{d}	1.05 ± 0.04
72	8	1.43 ± 0.15^{bc}	68.54 ± 3.69	13.15 ± 0.61^{b}	0.30 ± 0.02^{ab}	7.53 ± 0.04^{abc}	1.01 ± 0.04
96	8	1.68 ± 0.15^{bc}	78.61 ± 3.69	16.20 ± 0.61^{a}	0.26 ± 0.02^{abc}	7.58 ± 0.04^{abc}	1.06 ± 0.04
120	8	1.43 ± 0.15^{bc}	71.97 ± 3.69	15.15 ± 0.61^{ab}	0.25 ± 0.02^{abc}	7.45 ± 0.04^{c}	1.08 ± 0.04
144	8	1.90 ± 0.15^{b}	76.86 ± 3.69	15.52 ± 0.61^{ab}	0.31 ± 0.02^{a}	7.47 ± 0.04^{bc}	1.04 ± 0.04
168	8	1.62 ± 0.15^{bc}	69.81 ± 3.69	14.98 ± 0.61^{ab}	0.24 ± 0.02^{abc}	7.52 ± 0.04^{abc}	1.04 ± 0.04

Table 2: Means showing effect of storage method and storage duration on casein, energy, total solids, titratable acidity, Ph, and specific gravity content of bulked milk from west African dwarf goats.

$^{A-D}$ Means in the same column with different superscript differ significantly ($P < 0.05$).

Effects of storage duration on milk composition

Storage durations affected ($p > 0.05$) percentage milk compositions of protein, lactose, solid-not-fat, moisture content, casein, total solid, titratable acidity and ph of the bulked wad milk table 1 and 2. Storage durations had no effects on fat, ash, energy and specific gravity percentages of the bulked milk. The protein percentage was highest at 0 hour followed by protein percentage at 144 hours, with lowest percentage at 24 hours. The storage durations of 48, 72, 96, 120 and 168 hours of storage durations had similar protein percentage content. table 1 showed that the lactose percentage was highest at 48 hours milk storage duration and lowest at 0, 72 hours storage duration. There were similarities in lactose percentage at 24-, 120-, and 168-hours storage duration. The percentage of solid-not-fat was highest at 48 hours and lowest at 72 hours and had similarities percentages at 0-, 120-, 144- and 168-hours storage duration. The moisture content percentage was highest at 72 hours and differed ($p > 0.05$) from moisture content percentage at 48 hours but similar to 24, 96 hours storage duration. Table 2 showed that storage duration significantly affected casein, total solids, titratable acidity and ph of the bulked wad milk. The percentage of casein was highest at 0, followed by 144 and lowest at 24 hours respectively. There were similarities in the percentage of

Factors	N	Total Bacteria Count (Cfu/Ml)
Storage Method		
Refrigeration	16	$23.2 \times 10^5 \pm 5.54 \times 10^5$
Freezing	16	$23.8 \times 10^5 \pm 5.54 \times 10^5$
Storage Duration		
0 Hour	24	$19.5 \times 10^5 \pm 4.18 \times 10^5$
24 Hours	8	$27.6 \times 10^5 \pm 7.25 \times 10^5$
48 Hours	-	-

Table 3: Means showing the effects of storage method and duration on total bacteria count of milk from wad goats.

Probable Organism	Gr	Mp	Mt	In	H_2s	Ur	Ct
Bacteria							
Salmonella Enterica	-Ve	Rod	+Ve	-Ve	+Ve	-Ve	-Ve
Escherichia Coli	-Ve	Rod	+Ve	-Ve	-Ve	-Ve	-Ve
Acinetobacter Baumannii	-Ve	Rod	+Ve	-Ve	-Ve	-Ve	+Ve
Staphylococcus Aureus	-Ve	Cocci	-Ve	-Ve	-Ve	+Ve	+Ve
Staphylococcus Epidermis	+Ve	Cocci	-Ve	-Ve	-Ve	+Ve	-Ve

Table 4: Reaction, morphology and biochemical test of microorganisms isolated from 0-hour (fresh) wad goats milk preserved under different storage conditions.

Gr: Gram Reaction; Mp: Morphology; Mt: Motility; In: Indole, H_2s: Hydrogen Sulphide; Ur: Urease Test; Ct: Citrate Test

Probable Organism	Gr	Mp	Mt	In	H_2s	Ur	Ct
Bacteria							
Salmonella Enterica	-Ve	Rod	+Ve	-Ve	+Ve	-Ve	-Ve
Pseudomonas Aeruginosa	-Ve	Rod	+Ve	-Ve	+Ve	-Ve	+Ve
Staphylococcus Epidermis	+Ve	Cocci	-Ve	-Ve	-Ve	+Ve	-Ve
Staphylococcus Aureus	-Ve	Cocci	-Ve	-Ve	-Ve	+Ve	+Ve
Shigella Spp	+Ve	-Ve	Rod	-Ve	-Ve	+Ve	-Ve

Table 5: Reaction, morphology and biochemical test of microorganisms isolated after 24 hours from wad goats milk preserved under different storage conditions.

Gr: Gram Reaction; Mp: Morphology; Mt: Motility; In: Indole; H_2s: Hydrogen Sulphide; Ur: Urease Test; Ct: Citrate Test

casein in the milk for 48,72,96 and 168 hours storage durations. The percentage of total solid for storage duration of 48 and 96 hours were same but differed significantly ($p > 0.05$) from storage duration of 72 hours and similar to the percentage at 0, 24, 96, 120, 144 and 168 hours of storage duration. Titrtable acidity percentage observed at 144-hour storage duration was highest and lowest at 0 hour storage duration. There were similarities in the percentages of titratable acidity at 24,48,72,96,120 and 168 hours storage duration. The percentage of ph was highest at 0 hour, followed by 120 hours and lowest at 48-hour storage duration. The percentage of ph at 0 hour was similar to 24 hours storage duration. The storage duration at 72, 96 and 168 hours had same percentage of ph. the percentage of protein at 0-hour storage duration was more and this could be as a result of less degradation of protein in fresh milk by proteolytic enzymes. The less protein percentages observed as storage duration increased could be attributed to increase in levels of total bacteria and psychrotrophic bacteria activities [39]. The production of microbial proteases with storage duration will contribute to increased proteolytic activity [2] this will further reduce protein percentage. There were inconsistencies in milk protein

percentages with storage duration and this could be as a result of the proteolytic activity of enzymes naturally present in stored milk which increases over time during long term storage [28]. This observation varies from the report of [29] who reported that storage duration did not affect protein content of milk from goats. Storage duration influences lactose percentage of the wad goat milk and was highest at 48 hours. The main source of dietary carbohydrate for microbes in milk is lactose, it maybe that the degradation of lactose in milk to release glucose occur more at 48 hours storage duration. This report is in agreement with the findings of [43] who stated that storage duration influenced milk lactose. However, this does not corroborate with the findings of [35,18] who reported that there was no significant effect on milk lactose when preserved from 24 hours to 120 hours at 4^{o}c. Storage duration influenced the solid non-fat content of milk and this could be due to the physical damage to milk fat globule membrane in raw milk which initiates lipolysis. This agrees with the report of [53] who stated that low temperature storage conditions had influence on solid non-fat content of milk when preserved over long periods. Reports from this study corroborates the findings of [43] who reported that cow's milk preserved for up to 24 hours was affected by storage duration as an increase in mean value was observed between 0 to 24 hours. moisture content of milk from wad goats was influenced by the storage duration and this could be due to solubilization of protein and total solids components of milk during long term storage thereby leading to an increase in the moisture content. However, this study does not corroborate the findings of [41] who reported that storage duration did not affect the moisture content of milk. In this study, storage duration had effect on casein content with highest value obtained at 0 hour and decreased as duration of storage extends. This suggested less proteolysis at 0-hour storage durations and it agrees with work of [23] who reported a reduction in casein with increased proteolytic activities in milk stored for 6 days. [40] Also reported that over time the casein content of bulk tank milk increased from 3.19 to 3.22% between 0 and 48 hours and then decreased to 3.18% between 48 and 96 hours. The decrease in casein as storage extend could also be as a result of degradation of casein micelles by microbial proteases which leads to a reduction in calcium phosphate causing instability in milk components [23]. The observation that the total solids content of milk from wad goats was influenced by the storage duration may be due to degradation of total protein and decrease in fat content during storage period. [24] Stated that a decrease in total solids content was mainly due to degradation of total protein and fat content during storage period. This study varied from the work of [16] who reported increasing total solids content with the advancement of storage period. Titratable acidity was shown to be affected by storage duration and could be due to fermentation process, acidic coagulation which occurs in milk during long storage and also the action of predominating lactic acid bacterial degradation of lactose and other sugars when stored for a long period of time [26]. This observation is in line with the findings of [11] who reported an increase in milk titratable acidity from 24 hours to 48 hours' duration and [27] who reported that titratable acidity increased with the advancement of fermentation period up to 16 days. The ph of the milk was affect by storage duration as can be linked to the high activity of lactic acid during storage which leads to fermentation thereby altering milk Ph. [33] Stated that increase in titratable acidity during storage is as a result of proliferation of lactic acid bacteria. [47] Study on milk stored for 5 d at 5.5°c, the titratable acidity increased from 0.15 to 0.17%, and was linked to increased microbial population within the storage period from 560 to 120,000 cfu/ml.

Effects of storage methods and storage duration on total bacterial count

Storage method and storage duration had no significant ($p > 0.05$) effect on total bacterial count (tbc) of the bulked milk from wad goats table 3. However, there were variations in the number of total bacterial Present in all storage methods and durations. Gram negative organisms' *salmonella enterica, Escherichia coli, Acinetobacter Bahmani* and gram-positive organisms *staphylococcus aureus* and *staphylococcus epidermis* were isolated at 0-hour (fresh) bulked milk of wad as shown in table 4. The bacterial isolated at 24 Hours Storage Were *Pseudomonas Aeruginosa, Staphylococcus Epidermidis, Staphylococcus Aureus* and *Escherichia Coli* Table 5. At 48 hours no visible growth of bacterial was detected. storage method and duration did not significantly influence the total bacterial count of bulked milk from west African dwarf goats. However, an increase in total bacterial count was observed in bulked wad goats milk preserved under different storage durations due to presence of dominant psychotropic and psychrophilic bacteria capable of surviving under cold temperatures. This result agrees with the findings of [37] who reported that bacteria can grow at a relatively rapid rate below 8^{0}c and are capable of forming visible colonies on incubated plates. [8] Also reported that spoilage bacteria such as proteolytic and lipolytic bacteria can also grow in milk during cold storage and alter the quality and shelf life of the milk. the isolated bacterial in this study at 0 and 24 hours were in line with the work of [37] who stated that *Shigella, Pseudomonas Aeruginosa, Esherichia Coli*, *Staphylococcus Aureus, Staphylococcus Epidermis, Salmonella Enterica* species of bacteria have the ability to grow at temperatures just above freezing point. The study concluded that bulked milk of wad goats can retain its nutrient content by refrigerating and freezing up to 48 hours.

Conclusion

The study concluded that bulked milk of wad goats can retain its nutrient content by refrigerating and freezing up to 48 hours. storage method and duration did not significantly affect the total bacteria count; however, it ameliorated the growth of microorganisms in milk from west African dwarf goats.

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Bibliography

1. Addis MF., *et al.* "The bovine milk microbiota: insights and perspectives from-omics studies". *Molecular Biosystems* 12 (2016): 2359-2372.

2. Albert C., *et al.* "Effect of microorganisms on free amino acid and free d-amino acid contents of various dairy products". Acta Universitatis Sapientiae, Alimentaria 2 (2009): 45-53.

3. Alganesh T., *et al.* "Microbial quality and chemical composition of raw whole milk from horror cattle in east wollega, ethiopia". *The Ethiopian Journal of Education and Sciences* (2008).

4. Aree ST. "Density and specific gravity: specific gravity bottle method". Faculty of Engineering, School of Petroleum and Chemical Engineering, Koya University (2013): 1-3.

5. Association of Official Analytical Chemists. 1990. "Official Methods of Analysis Chemists, 15th Edition. Aoac, Usa, Virginia, Arlington (1990).

6. Association of Official Analytical Chemists. 1993. "Methods and Determination of Moisture". The Aoac Referee 17 (1993): 5-9.

7. Bergey DH., *et al.* "Bergey's manual of systematic bacteriology". Baltimore, Md: Williams and Wilkins (1984).

8. Celestino ELM., *et al.* "The effects of refrigerated storage on the quality of raw milk". *Australian Journal of Dairy Technology* 51 (1984): 59-63.

9. Chouinard PY and Girard CL. "Nutritional Interest of Milk and Dairy Products: Some Scientific Data to Fuel the Debate". *Animal Frontiers* 4 (2014): 4-6.

10. Clark JL., *et al.* "Direct Oven Drying Method for Determination of Total Solids Content of Milk and (Direct Oven-Ether Extraction) Method for Determination of Solid-Not-Fat Content of Milk". *Journal of Association of Analytical Chemist* 72 (1984): 712-718.

11. Da Silva FD., *et al.* "Effect of Commercial Grape Extracts on the Cheese-Making Properties of Milk". *Journal of Dairy Science* (2015): 98.

12. Datta N., *et al.* "Ultra- High-Temperature (Uht) Treatment of Milk: Comparison of Direct and Indirect Modes of Heating". *Australian Journal of Dairy Technology* 57 (2002): 211-257.

13. Deeth HC. "Lipoprotein Lipase and Lipolysis in Milk". *International Dairy Journal* 16 (2006): 555-562.

14. Devendra C and Mcleroy GB. "Goat and Sheep Production in the Tropics". 7th Edition, Payne, W.J.A and Longman (Ed.), London and New York Publishers (1996): 1-55.

15. Economides S. "Comparative Studies of Sheep and Goats: Milk Yield and Composition and Growth Rate of Lambs and Kids". *Journal of Agricultural Science* 106 (1986): 477-484.

16. El Owni AOO and Hamid IAO. "Effect of Storage Period on Weight Loss, Chemical Composition, Microiological and Sensory Characteristics of Sudanese White Milk (Gibnabayda)". *Pakistan Journal of Nutrition* 7 (2008): 75-80.

17. Fava LW., *et al.* "Evaluation of Physico-Chemical Characteristics of Fresh, Refrigerated and Frozen Lacaune Ewe's Milk". *Brazilian Journal of Veterinary and Animal Science* 66 (2014): 1924-1930.

18. Fekadu B., *et al.* "Changes in Goat Milk Composition During Lactation and their Effect on Yield and Quality of Hard and Semi Hard Cheeses". *Small Ruminant Research* 59 (2005): 55-63.

19. Foley YJ., *et al.* "Commercial Testing and Product Control in the Dairy Industry". University College, Cork (1974).

20. Fonseca CR., *et al.* "Storage of Refrigerated Raw Goats Milk Affecting the Quality of Whole Milk Powder". *Journal of Dairy Science* 96 (2013): 4716-4724.

21. Food and Agriculture Organization of the United Nations (FAO). 2019 Food and Agriculture Organization of the United Nations Statistical Databases (2019).

22. Google Earth (2013).

23. Guinot-Thomas P., *et al.* "Effects of Storage Conditions on the Composition of Raw Milk". *International Dairy Journal* 5 (1995): 211-223.

24. Hayaloglu A., *et al.* "Influence of Starters on Chemical, Biochemical and Sensory Changes in Turkish, White-Brined Cheese During Ripening". *Journal of Dairy Science* 88 (2005): 3460-3474.

25. Herreid EO. "The Babcock Test. A Review of the Literature". *Journal of Dairy Science* 25.4 (2003): 324-343.

26. Hussain I., *et al.* "Quality Comparison of Probiotic and Natural Yogurt". *Pakistan Journal of Nutrition* 8 (2009): 9-12.

27. Joshi VK and Sharma S. "Lactic Acid Fermentation of Radish for Shelf Stability and Pickling". *National Product Radiance* 8 (2009): 19-24.

28. Kaylegian KE., *et al.* "Lipolysis and Proteolysis of Modified and Producer Milks Used for Calibration of Mid-Infrared Milk Analyzers". *Journal of Dairy Science* 90 (2007): 602-615.

29. Kondyli E., *et al.* "Chemical Composition and Microbiological Quality of Ewe and Goat Milk of Native Greek Breeds". *Small Ruminant Research* 103 (2012): 194-199.

30. Lafarge V., *et al.* "Raw Cow Milk Bacterial Population Shifts Attributable to Refrigeration". *Applied and Environmental Microbiology* 70 (2004): 5644-5650.

31. Lizandra P., *et al.* "Evaluating the Effect of Storage Conditions on Milk Microbiological Quality and Composition". *Irish Journal of Agricultural and Food Research* 57 (2018): 52-62.

32. Loesner MJ and Golden DA. "Modern Food Micobiology".7th Edition, Springer Science and Business Media, Incorporation, New York (2005): 101-115.

33. Lu M., *et al.* "Milk spoilage: Methods and practices of detecting milk quality". *Food and Nutrition Science* 4 (2013): 113-123.

34. Lucas A., *et al.* "Effect of Milk Base and Starter Culture on Acidification, Texture, and Probiotic Cell Counts in Fermented Milk Processing". *Journal of Dairy Science* 85 (2004): 2479-2488.

35. Millogo V., *et al.* "Effect of Storage Time and Temperature on Raw Milk Composition of Dairy Cattle in Tropical Conditions". *African Journal of Dairy Farming and Milk Production* (2014): 104-108.

36. Millogo V., *et al.* "Effect of Different Handmilking Techniques on Milk Production and Teat Treatment in Zebu Dairy Cattle". *Tropical Animal Health and Production* 44 (2012): 1017-1025.

37. Muir DD. "The shelf-life of dairy products: 1. Factors influencing raw milk and fresh products". *International Journal of Dairy Technology* 49 (1996): 24-32.

38. Naceur M., *et al.* "The Effect of Storage Temperature and Duration on the Composition and Bacteriological Quality of Raw Milk". *Journal of Agriculture and Allied Sciences* 7 (2018): 81-85.

39. O'connell A., *et al.* "The Effect of Storage Temperature and Duration on the Microbial Quality of Bulk Tank Milk". *Journal of Dairy Science* 99 (2016): 3367-3374.

40. O'connell A., *et al.* "The Effect of Storage Conditions on the Composition and Functional Properties of Blended Bulk Tank Milk". *Journal of Dairy Science* 100 (2017): 991-1003.

41. Paludetti LF., *et al.* "Evaluating the Effect of Storage Conditions on Milk Microbiological Quality and Composition". *Irish Journal of Agricultural and Food Research* 57 (2018): 52-62.

42. Park WY., *et al.* "Effects of Different Storage Time and Temperature on Physicochemical Properties and Fatty Acid Profiles of Commercial Powder Goat Milk Products". *Journal of Advanced Dairy Research* 5 (2017): 4-6.

43. Peter Z., *et al.* "Effects of Storage on the Major Constituents of Raw Milk". *Scientific Journal for Food Industry* 1 (2015): 375-381.

44. Pyne GT. "The Determination of Milk-Protein by Formaldehyde Titration: National Centre". *Biochemical Journal* 26.4 (1932): 1006-1014.

45. For Biotechnology Information, USA. "National Library of Medicine 8600 Rockville Pike, Bethesda Md, 20894 USA". *Journal Of Biochemistry* 26 (1932): 1006-1014.

46. Ribeiro AC and Ribeiro SDA. "Specialty Products Made from Goat Milk". Small Rumininant Research 89 (2010): 225-233.

47. Schmidt KA., *et al.* "Factors affecting titratable acidity in raw milk (1996).

48. Shah NP. "Functional Cultures and Health Benefits". *International Dairy Journal* 17 (2007): 1262-1277.

49. Taylor RA., *et al.* "Standard Plate Count: A Comparison of Pour Plate and Spread Plate Methods". *Journal of American Water Works Association* 75 (1983): 35-37.

50. Ufoegbune GC And Fabiyi S. "Identification of Land Areas Suitable for Fadama Farming at Federal University of Agriculture, Abeokuta, Nigeria Using Gis". Department of Water Resources and Agrometrology. Federal University of Agriculture, Abeokuta". *Journal of Applied Science and Environmental Management* 20 (2016): 1027-1032.

51. Verdi R and Barbano DM. "Properties of Proteases from Milk Somatic Cells and Blood Leukocytes". *Journal of Dairy Science* 74 (1991): 2077-2081.

52. Wouters JTM., *et al.* "Microbes from Raw Milk for Fermented Dairy Products". *International Dairy Journal* 12 (2002): 91-109.

53. Zajac P., *et al.* "Effects of Storage on the Major Constituents of Raw Milk". *Scientific Journal for Food Industry* 1 (2015): 375-381.