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Research Article

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Comparative Analysis of Fermented Cow and Goat Milk with their Nutritional Content in Gusau, Nigeria

Anthonia M Oladokun* and Nasir Garba Anka

Department of Biochemistry, Federal University Gusau, Nigeria

***Corresponding Author**
Anthonia M Oladokun, Department of Biochemistry, Federal University Gusau, Nigeria.

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Abstract

The main source of a daily diet that includes high-quality foods with high biological potential that offer both nutritional and culinary benefits is typically regarded as milk. Humans and other mammalian species use milk secretion to feed their young because it is high in antibodies and contains considerable amounts of water, proteins, carbohydrates, minerals, organic acids, enzymes, vitamins, and calcium. One other definition of milk is "nature's most nearly perfect single food." This project's major objective is to identify the biochemical changes associated with the fermentation of cow and goat milk and its nutrient content. While coagulase catalase is found in cow milk, the biochemical enzyme activities of oxidase and catalase are significantly more prevalent in goat milk during fermentation than in cow milk. Cow milk has a higher moisture content (85.98%) than goat milk, while goat milk has a higher crude lipid content (15.36%) than cow milk. Goat milk has the highest energy value, at (78.93%). Goat milk contains the most cow milk overall, according to the results.

Keywords: Fermented Milk, Comparison Between Goat Milk and Cow Milk, Moisture Content, Kjeldahl Method, Crude Protein, Crude Lipid

1. Introduction

Milk and milk products are typically viewed as the main source of a daily meal combining high-quality foods with high biological potential that offer both nutritional and culinary advantages. [1]. Since milk includes considerable amounts of saturated fats, water, proteins, carbohydrates, minerals, organic acids, enzymes, vitamins, and calcium and is high in antibodies, humans and other mammalian species use it to feed their young [2]. One other definition of milk is "nature's most nearly perfect single food." It is the natural meal of newborn animals and the only source of nutrition during the first few hours and days following birth. According to Appiegate, milk is a secretion of the mammary glands in animals that nurse their young [3]. According to the Encyclopedia Britannica, milk is a fluid that female mammals' mammary glands secrete to feed their young. Milk is a wonderful fluid because it contains a wide variety of components that young animals need in a uniform composition [4]. Although it is not a perfect food, it is among the finest in terms of nutrition. Because milk is the only food consumed by young mammals for an extended length of time, its high nutritional value is highly beneficial to mammals [5, 6]. Every nutrient required by the human body is present in milk, which has an extremely complex nutritional makeup. Milk is a remarkably abundant source of protein; one gram of protein can be found in one cup of milk. Each fluid has a great biological value in stimulating the growth of mammalian young (both humans and animals), It is the best source of calcium in the diet and thus promotes healthy bone and tooth development. It has a significant biological benefit in fostering the development of young mammals, including both humans and animals. Because it is the best source of calcium in the diet, it promotes healthy bone and tooth formation.

Fresh milk comprises a water content of around 87%, in which different salts, proteins, carbohydrates, lipids, and vitamins are dissolved, as well as fat, globules, and casein [7]. Cow and goat milk are the most common raw ingredients for dairy products produced today. Gusau is the largest city in Zamfara state. Zamfara state is in the northwest of Nigeria. The people of Zamfara are nomads and rear mostly cows and goats. Most of the dairy milk consumed in Nigeria is from Zamfara state. The aim of this

research is to determine the comparative analysis of the nutritional composition of cow and goat milk.

2. Materials and Methods

The milk samples from Cow and Goat used in this work were obtained from the local Cow and Goat Fulani rearers in Gusau, Zamfara state, Nigeria, and were fermented for 72 hours. Kjeldahl catalyst (CUSO4 and Na2SO4), 4% Boric acid, Conc. H2SO4, 4% NaOH, N-Hexane, 1% phenolphthalein, and mixed indicator (bromocresol purple and bromocresol blue) are the reagents used. Weighing balance (Mettler Toledo AE50), Autoclave (Clarus 500 FID), Incubator (Memmert B40), Desiccator, pH Meter, Kjeldahl apparatus, Muffle furnace (Model SXL), Oven (GallenKamp Model). Before undertaking the experiment, the pH meter was calibrated first, and the pH probe was rinsed with deionized water. 5 ml of the milk sample was collected into a 20 ml beaker using a pipette. The pH probe was dipped into the beaker containing the sample.

The procedures described below were used to determine the moisture content of the samples. The AOAC air oven method was used in this analysis [9]. 5g of milk samples were weighed into a petri dish, the sample was heated in a drying oven for 24 hours and at a regulated temperature of 105 ±2ºc. It was removed, cooled in a desiccator, and weighed. The process of drying, cooling, and weighing continued until a constant weight was obtained. The moisture content is determined by comparing the weight of the samples before drying and after drying.

$$W_m = \frac{W_1 - W_2}{W_1} \times 100$$

Wm= Moisture content of the sample in %
M_1= Mass in grams of the test samples and petri dish before drying in grams.
M_2= Mass in grams of the test samples and petri dish after drying in grams.

These procedures described below were used to determine the ash content of the samples. The AOAC (2010) method was used in this analysis. 2g of the milk sample was weighed into a crucible and its content was charred on a Kjeldahl heater in a fume cupboard to drive off the smoke after ignition, the crucible and its content were transferred into a muffle furnace at 121 ºc for 3 hours or until white ash is observe. The crucible was removed and placed in a desiccator to cool and then reweighed. Then the percentage of ash and organic matter was calculated as.

$$W_a^* = \frac{W_1^* - W_2^*}{W_1^*} \times 100$$

W_a^*= Ash content of the sample in %
W_1^*= Weight of sample
W_2^*= Weight of sample after the process.

Kjeldahl method is used to determine crude protein in the fermented mils of cow and goat. (Kirk, 1950) To determine crude lipid using a Soxhlet extractor, a clean dried filter paper was weighed and 5g of milk sample was weighed into a filter paper. A clean dry receiver flask was weighed. The filter paper containing the sample was then placed in a thimble of the Soxhlet extractor. 250ml of N-Hexane (45ºc-50ºc) was filled into a Soxhlet by pouring it into a 250ml round bottom flask. The Soxhlet extractor apparatus containing filter paper with its content was filled into a flask and then placed on an electric heating mantle. The mantle was switched on and the heat was increased carefully and slowly until the content started boiling. This extraction was carried out for 6 hours without interruption, the thimble was removed with the content from the Soxhlet, and the solvent was distilled out using a simple distillation system to remove the N-Hexane used while the flask contained only crude fat. The crude fat was transferred into a 100ml beaker, and the containing content was dried in an oven at 100 ºc for 45 minutes. The beaker was allowed to cool at room temperature and weighed.
The percentage of crude lipid was calculated as:

$$\%\ of\ crude\ lipid = \frac{W_a - W_b}{W_a} \times 100$$

W_a= Weight of sample and flask before extraction
W_b= Weight of oil + flask after extraction
The total proportion of carbohydrates in the milk cannot be analyzed directly (Amicucci et al., 2019) but it can be obtained as estimated by a different method that is by subtracting all the other food nutrient values like % lipid fat, % crude protein, % ash, % and moisture from 100%. The remainder accounts for the total percentage (%) of carbohydrates in the milk sample.
Carbohydrate contents= 100 - (% protein + % lipid + % ash + % moisture content).

3. Results

Nutritional composition (%)	First value	Second value	Third value	Fourth value	Fifth value	Sixth value	Mean (%)	Standard deviation(%)
Moisture content	87.20	86.80	86.40	85.20	84.80	85.50	85.98	0.95
Ash content	3.00	3.00	2.40	2.82	2.75	2.68	2.77	0.22
Crude protein	2.90	2.46	2.46	2.75	2.65	2.50	2.62	0.17
Crude lipid	0.40	0.20	0.40	0.30	0.20	0.40	0.31	0.09
Total available carbohydrate	6.50	7.54	8.34	6.80	7.20	7.80	7.36	0.67
Energy value (Kcal/100g)	3.54	36.88	41.88	37.20	38.50	40.1	38.32	2.35

Table 1: The statistical analysis for the result of the biochemical changes associated with the fermentation of cow milk and its nutritional composition.

Nutritional composition(%)	First value	Second value	Third value	Fourth value	Fifth value	Sixth value	Mean (%)	Standard deviation (%)
Moisture content	**80.00**	**79.60**	**79.20**	**78.60**	**78.20**	**78.00**	**78.93**	**0.79**
Ash content	**2.00**	**3.00**	**3.00**	**2.60**	**2.70**	**2.80**	**2.68**	**0.37**
Crude protein	**9.38**	**9.60**	**9.38**	**9.40**	**9.25**	**9.30**	**9.38**	**0.11**
Crude lipid	**15.20**	**15.20**	**15.60**	**15.30**	**15.40**	**15.50**	**15.36**	**0.16**
Total available carbohydrate	**6.28**	**6.90**	**7.18**	**7.25**	**7.40**	**7.45**	**7.07**	**0.43**
Energy Value (Kcal/100g)	**181.72**	**185.6**	**187.88**	**188.2**	**188.5**	**189.00**	**186.82**	**2.76**

Table 2: The statistical analysis for the result of the biochemical changes associated with the fermentation of goat milk and its nutritional composition.

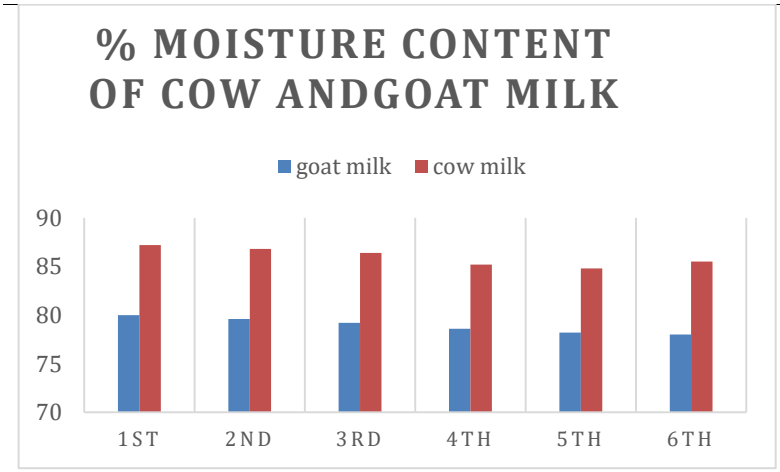

Figure 1: % Moisture Content of Goat Milk and Cow Milk

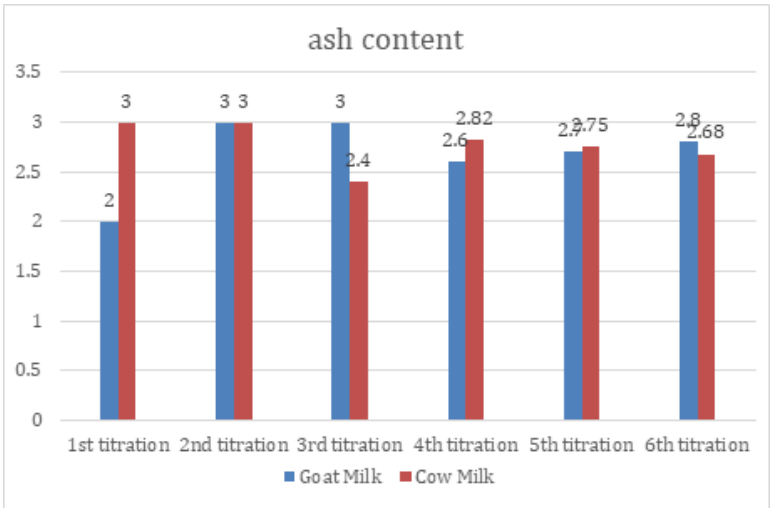

Figure 2: Ash Content of Goat Milk and Cow Milk

From the result obtained, each value was titrated at every 30 mins interval to the 6th value. It could be seen that milk shown in the table above, it could be seen that cow milk has the highest moisture content (85.98%) followed by goat milk moisture content (78.93%). This signifies that fresh cow milk has the highest moisture content compared to goat milk. These happen because of loss of water content. The value of the ash content shows that the value of cow milk is relatively (2.77%) followed by the ash content of goat milk (2.68%). This shows that the amount of organic material (mineral element) is higher in cow milk than in goat milk. The crude protein content of cow milk (2.62%) followed by goat milk (9.38%). This is a result of the presence of essential amino acids, especially the lysine content is higher in goat milk compared to cow milk. The crude lipid (fat) content of cow milk (0.31%) followed by goat milk (15.36%). These signify that cow milk has low crude lipid content which means that it has a low caloric value compared to goat milk.

The total available carbohydrates obtained shows that the cow milk content value (12.42%) followed by the fresh cow milk (85.25%) from the result of the sample in carbohydrate content shows that there is a significant difference between the two kinds of milk. The pH value of cow milk (is 6.38) which signifies that it is acidic, while the pH value of goat milk is 6.5 which indicates that it is slightly acidic.

4. Conclusion

To determine the nutritional composition for the study of the fermented milk from cow and goat milk was found to be determined by moisture, protein, ash, lipid, and carbohydrate respectively. From the above result, it was concluded that the moisture content of cow milk is the highest (85.98%), next is the crude lipid (0.31%) and the crude lipid content of goat milk has the highest value (15.36%), followed by crude protein of the goat milk (9.38%). The total available carbohydrate of the goat milk has a value of (38.32%), and the energy value of the goat milk is (186.82%).

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