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Quantitative Determination of Casein and Lactose in Processed and Unprocessed Milk Samples from Ogwashi-Uku, Delta State

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Abstract

Milk is one of the most important nutritional constituent of our diet because it is largely composed of proteins and along with vitamins and minerals. This present study was based on determining the amount of casein and lactose present in processed (Dano cool cow and Peak milk) and unprocessed milk (Cow and Goat milk) samples collected from Ogwashi-uku, Delta State. The casein content was analyzed using Kjeldahl method and lactose content was analyzed using Benedict's Method. Results from this study shows that cow milk sample; an unprocessed form of milk has more lactose content (40.298%) than other forms of milk while Dano cool cow milk, a processed milk has more casein (23.93%) as compared to all other milk. High concentration of casein is more beneficial to health and high percentage of lactose do not poses no threat as it can be digested easily.

Keywords: *Casein, Lactose, unprocessed milk, processed milk, composition*

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1. Introduction

Milk is important part of human diet. It is an opaque liquid product from the mammary glands of farm mammals (example: cow, buffalo, sheep, goat etc) to feed their young ones with pH ranging from 4.6 to 6. It is generally viewed as nutritious food. Milk is a complex food containing basic nutrients (e.g. proteins, lipids, vitamins) with positive health benefits [1, 2]. The proteins have some biological activities – acting as growth factors, hormones, enzymes, antibodies and immune stimulants [3, 4].

The exact components of milk vary from species to species but all comprises of significant amount of saturated fats, protein, calcium and vitamins [5]. It is versatile ingredient used for the production of many dairy products like cheese, yoghurt, butter, creams and ice-cream. Milk can be in different form like raw milk, condensed milk, ultra-heat treatment (UHT) milk, evaporated milk, dried milk, skinned milk, flavored milk [6].
The casein is proved to be the major constituent of the milk and it is almost found 80% of total milk protein [7]. The casein is suspended in milk but in a complex form called *micelle*. The casein micelles that are being precipitated at isoelectric pH 4.6 contains αS1casein, αS2 casein, β casein and κ casein. While the casein is composed of all the essential amino acids like Leucine, Isoleucine, Lysine, Valine, Phenylalanine, Threonine, Methionine and Tryptophan. The various functional peptides from protein casein have many beneficial roles in human health; e.g. antimicrobial peptides help in immune system and antithrombotic peptides works in cardiovascular system [8]. The contents of various food supplements might be seen playing key role in maintaining net protein and amino acid balance of body.

Lactose is the main carbohydrate of milk. It is formed by the union of one molecule of D-galactose (engaged by its semiacetyl function) and one molecule of D-glucose (committed by its hydroxyl 4 position). It has a β-galactoside 1,4 bond (which is hydrolyzed by a β-galactosidase) and is a 4-Dglucopyranosyl-β-D-galactopyranose. Although lactose is a sugar, it does not have a sweet flavor. Its concentration varies slightly in milk (4.5 to 5.2 g / 100 g) contrary to the concentration of fat that of lactose cannot be easily modified by feeding and true step of a dairy race to another [9].

This study aimed at determining the percentage of lactose, and casein in different breeds of domesticated dairy animals (cow and goat) milk samples and also in different branded packs of milk samples (Dano cool cow milk and Peak milk).

2. Materials and Methods

2.1 Sample Collection and Preservation

Two different samples each for processed and unprocessed milk samples were collected from different locations. The unprocessed milk samples (cow and goat milk) were collected

from cattle ranch using sterilized bottles while the processed milk (Dano cool cow and Peak milk) were purchased from different store outlets. The unprocessed milk samples were preserved with an iced cold cooler after which all the samples were transported immediately to the laboratory for proper analysis.

2.3 Sample Preparation and Analysis

Determination of Lactose

Percentage of Lactose in the milk samples was done using Benedict's Method.

Principle:

The test principle is based on the quantification of reducing sugars, primarily lactose, in a milk sample through the reduction of copper ions in an alkaline solution, resulting in a color change during titration.

Procedure:

Five milliliter (5ml) of the milk sample was carefully transferred into a 50ml volumetric flask, to which 2.5ml of sodium tungstate (10%) was added with continuous mixing. The flask was then topped up with distilled water until reaching the 50ml mark. After allowing the mixture to sit for 10 minutes, it was filtered, with lactose typically dissolving in the water and separating from the filtrate, resulting in a clear solution. Subsequently, the filtrate was transferred to a beaker. In a separate beaker, 25ml of Benedict's reagent was combined with 30ml of distilled water, along with 2gm of anhydrous sodium carbonate to increase alkalinity. This mixture was thoroughly mixed and then heated until the solution became clear while boiling. The titration process followed, commencing rapidly with 2ml increments until the first shade of reduction was observed, and then proceeding with slow, drop-wise titration until the light blue color was completely reduced. The volume of the filtrate exhausted during the titration was recorded as part of the analysis.

Calculation: Every 25ml of Benedict solution is reduced by 0.0678gm of lactose.

$$\% \text{ Lactose} = 0.0678 \times 10 \times 100 = 67.8?\%$$

Determination of Casein

The AOAC procedure was used [10].

Principle:

This method is based on the digestion of sample with hot concentrated sulphuric acid in the presence of a metallic catalyst. Organic nitrogen in the sample is reduced to ammonia. This is retained in the solution as ammonium sulphate. The solution is made alkaline, and then distilled to release the ammonia. The ammonia is trapped in dilute acid and then titrated.

Procedures:

First, exactly 1g of the sample was accurately weighed and gently placed into a 30ml Kjeldahl flask, ensuring that the sample did not touch the walls of the flask. The flask was then stoppered, and a thorough shaking of the contents was performed. Subsequently, 1g of the Kjeldahl catalyst mixture was added to the flask. This mixture was cautiously heated on a digestion rack over an open flame until a clear solution was achieved. After the solution became clear, it was allowed to stand undisturbed for 30 minutes and allowed to cool. Approximately 100ml of distilled water was then added to prevent caking, and the solution was transferred to the Kjeldahl digestion apparatus. In preparation for distillation, a 500ml receiver flask containing 5ml of Boric acid indicator was positioned beneath a condenser of the distillation apparatus, with the tap placed about 20cm inside the solution. To the digested sample in the apparatus, 10ml of 40% sodium hydroxide was added, initiating immediate distillation. The distillation process continued until it reached the 35ml mark in the receiver flask.

Upon reaching the desired distillation volume, the contents of the receiver flask were titrated to a pink color using 0.01N hydrochloric acid, completing the analysis.

Calculations: % Nitrogen = Titre value x 0.01 x atomic mass of nitrogen x 4

Where 0.01 = normality of the acid.

Casein = % Nitrogen *6.38

3. Results and Discussion

Results obtained from the analysis of processed (Dano cool cow Milk and Peak Milk) and unprocessed (Goat Milk and Cow Milk) milk samples were presented in table 1 while figure 1 shows the graphical presentation of the values obtained from the analysis.

Table 1: Percentage values obtained for lactose and casein determination.

Sample description	Unprocessed milk		Processed milk	
	Cow Milk	***Goat milk***	***Dano cool cow***	***Peak milk***
Lactose %	40.298	28.600	24.112	29.099
Casein %	22.509	23.223	23.938	22.131

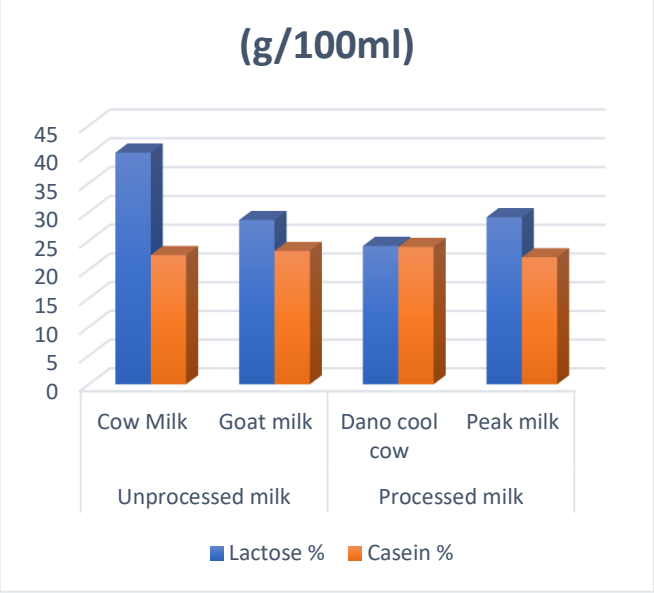

Figure 1: Percentage of casein and lactose content in processed and unprocessed milk samples

The results of this comprehensive study provide valuable insights into the nutritional composition of various milk samples, shedding light on the differences in lactose and casein content and their potential health implications.

Lactose, a natural sugar found in milk, is an essential component of dairy products and serves as a source of energy for the human body [11, 12, 13]. In this study, we examined the lactose content in different milk samples, including unprocessed cow milk, goat milk, and processed milk products like Peak milk and Dano Cool Cow milk.

Unprocessed cow milk, a staple in many households, was found to contain a relatively high lactose content of 40.298%. In contrast, goat milk, another unprocessed alternative, had a lower lactose content of 28.600%. This findings is in line with that of Stergiadis *et al*. [14] who reported high content of lactose in cow milk than in goat milk. This disparity in lactose levels between cow and goat milk can be attributed to the inherent differences in the composition of these two types of milk. While both cow and goat milk serve as excellent sources of nutrients, individuals who are lactose intolerant may find goat milk to be a more tolerable option due to its lower lactose content.

Interestingly, when examining processed milk products, Peak milk, a popular choice among consumers, exhibited a higher lactose content of 29.099% compared to Dano Cool Cow milk, which contained 24.112% lactose. This finding challenges the common assumption that processed milk products contain less lactose. It is essential to consider that the processing methods used in the production of these milk variants can influence their lactose content. These results emphasize the importance of understanding the nutritional content of various milk products, especially for individuals with dietary restrictions or lactose intolerance.

Beyond lactose, the study also explored the casein content of these milk samples. Casein is a type of protein found in milk, and its concentration can vary among different milk sources and processing methods [12].

Surprisingly, Dano Cool Cow milk, a processed milk product, exhibited a higher casein content at 23.93% when compared to Peak milk, which contained 22.131% casein. This finding challenges the notion that processed milk inherently has lower protein content. The higher casein content in Dano Cool Cow milk may make it a preferred choice for those seeking additional protein in their diet.

Conversely, goat milk, an unprocessed and less commonly consumed milk type, demonstrated a higher casein content of 23.223% compared to cow milk, which contained 22.509% casein. This findings is not conformity with that of Stergiadis *et al*. [14] who reported low composition of casein in cow milk than in goat milk This result suggests that goat milk, despite being unprocessed, can offer a higher concentration of casein, which is known for its potential health benefits.

Existing literature supports the idea that milk with a higher casein concentration may be more beneficial in terms of promoting satiety and muscle growth. Casein is a slow-digesting protein that provides a steady release of amino acids into the bloodstream, making it an excellent choice for those looking to maintain or build muscle mass.

In conclusion, the findings of this study underscore the importance of understanding the nutritional profiles of different milk sources and products. The variations in lactose and casein content among cow milk, goat milk, and processed milk products such as Peak milk and Dano Cool Cow milk provide consumers with a broader range of options to suit their dietary needs and preferences. Moreover, the unexpected results challenge some common assumptions about the nutritional content of processed versus unprocessed milk. Further research and consumer education on these topics can help individuals make informed choices about their dairy consumption, taking into account their nutritional goals and dietary restrictions.

4. Conclusion

This study clearly indicated that the amount of casein in Dano cool cow milk (unprocessed milk) was higher than that of the other milk samples. Thus, the Dano cool cow milk is suitable for the best muscle growth and basic body building achievements. It was found that peak milk contains the small amount of casein protein. All milk has lots of casein but there are different types of casein and for someone who has casein sensitivity, peak milk may provide an alternative to which they do not react. According to the research findings, all the milk samples contain some lactose but less was found in Dano cool cow milk, so they may be easier to digest for people with lactose sensitivity and cow milk contains the highest amount of lactose.

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