You've GOaT to Try This Milk!

MEET THE AUTHOR CHRISTINE HA

Image 1. Christine Ha

I am an undergraduate student from McGill University in Canada majoring in Global Nutrition with a minor in Field Studies that has brought me to Barbados. The focus of my studies has always been centered around food security, thus I found it important to further my knowledge on a bovine milk alternative. There are several stark differences that can be observed when comparing the nutrient content between milk samples collected from goats and cows, due to the physiological differences between animal species (Yang et al., 2013). This is of interest to study in Barbados and in many developing countries, as goats are one of the primary milk producers in these regions (Gateneh, 2016). In partnership with the Ministry of Agriculture's Greenland Livestock Research Station, I designed a project to study the macronutrient composition of the goat milk collected from different breeds and at different stages of lactation.

Image 2. Milk Parlor at the Greenland Livestock Research Station

INTRODUCTION

Barbados is facing very intense pressure from imports. Between 1991 and 2012, Barbados faced a drop in national milk output from 14 to 7 million kg due to increased competition from low-priced fresh and powdered milk imports. Thus, whether goat milk, which is less expensive to produce in the tropics can replace the less sustainable and expensive production of cow (bovine) milk is of interest. This brings us to the need for research to compare the differences between goat and cow milk in Barbados. Goat milk is currently available for purchase at major grocery outlets, and directly from many goat farms, mostly located in the north of Barbados. The milk being sold is currently unpasteurized, however new legislation will require all milk to be pasteurized within the upcoming months. Although the best source of dairy is still uncertain, research that compares the health benefits of goat to cow milk will give us a better understanding of their relative health properties, and how to better provide recommendations on their consumption.

PROJECT OBJECTIVES

1. The primary purpose of this study was to gain more insight on how the composition of goat and cow milk may affect human health.

2. The factors examined are listed in Figs. 1 and 2

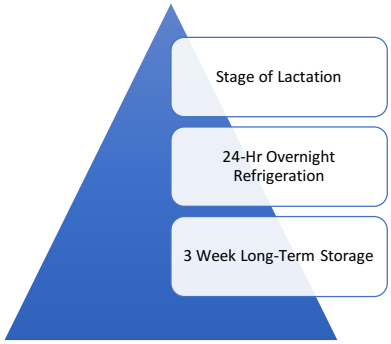

Fig.1 Factors affecting the composition of milk being studied

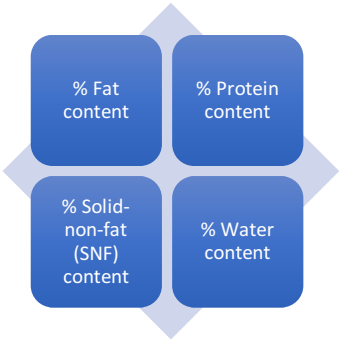

Fig.2 Milk Constituents Evaluated

Image 3. LactiCheck milk analyzer (RapiRead modelX, Page & Pedersen Int.)

MATERIALS & METHODS

The three breeds of goat studied were Alpine, Saanen, and Toggenburg goats, and Holstein cows from a local farm. Given that all the goats and cows were fed the same feed and exposed to the same environmental conditions, it allowed us to compare the difference in the nutrient composition of the milk produced by these animals. The differences in lactation period were taken into consideration by sampling milk from both mature and yearling goats for each respective breed.

Breed of Goat	Stage of Lactation: Yearling	Stage of Lactation: Mature	Total # of Samples Analyzed per Breed of Goat
Toggenburg	x3	x3	6
Alpine	x3	x3	6
Saanen	x3	x3	6
Total # of Samples Analyzed per Lactation Stage	9	9	

Table 1. Triplicate Samples by Goat Breed

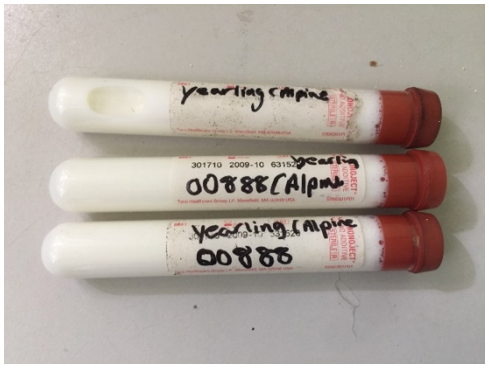

Image 4. Triplicate Sample of Yearling Alpine Milk

It was important to take triplicate samples of milk from each goat as shown in image 4, as it helped to identify if there were any measurement errors that were outliers falling outside the expected range. It was also important that the milk samples were immediately analyzed after collection from the animals to avoid the oxidation of fat content in the samples.

All the sample collection, analysis and refrigeration of the goat milk took place over a 5-week period. Cow milk samples were also collected weekly from a local farm and analyzed using the LactiCheck instrument for the constituents of milk.

Image 5. Young Saanen Goat

After each sample was analyzed, it was immediately refrigerated at 4°C to be re-analyzed the next day to see if there were any observable changes. While the goat and cow samples by breed and stage of lactation were only analyzed fresh and after a 24-hr refrigeration, the pooled filtered and unfiltered goat milk samples were refrigerated and re-analyzed at 1-week, 2-week, a 3-week time points.

RESULTS

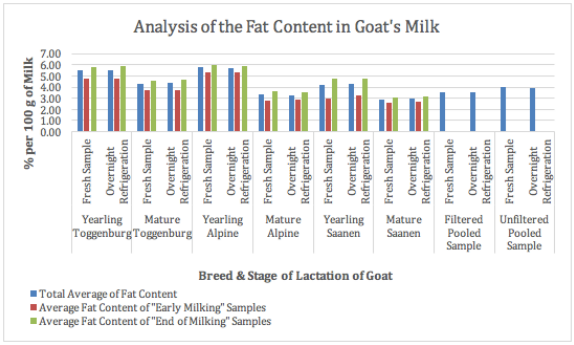

Fig.3 Analysis of the Fat Content in Goat's Milk

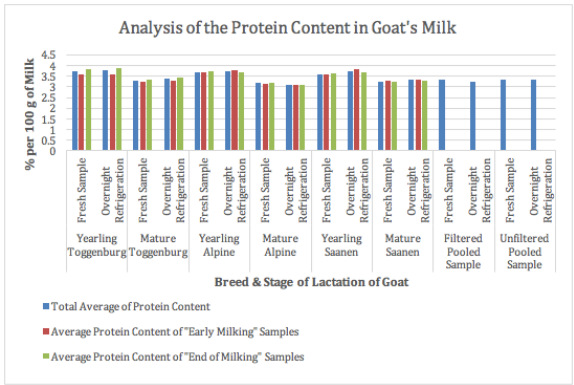

Fig.4 Analysis of the Protein Content in Goat's Milk

The data in Fig. 3 illustrates that the yearling Alpine goat milk had the highest % fat content, and the mature Saanen goat milk ranked the lowest. As for the milk % protein content, the yearling Toggenburg goat milk had the highest, and the mature Alpine goat milk had the lowest content. There was an interesting inverse relationship between the % solid-non-fat (SNF) and % H_20 content. While the yearling Toggenburg goat milk had the highest % SNF content, it also had the lowest % H_20 content. The milk that ranked lowest in % SNF coupled with the highest % H_20 content was milk from mature Alpine goats. Overall, milk from yearling goats had higher % fat, protein and SNF content than mature goat milk across all 3 breeds studied. Despite these disparities among goat milk at different stages of lactation, when the % fat and protein content between pooled goat and bovine milk were compared, no significant differences were found. Nor were there any significant decrease in % fat and protein content in goat milk after overnight refrigeration or long-term storage up to 3-weeks.

CONCLUSION & FUTURE DIRECTION

Depending on the desired functional properties of the goat milk, the breed and stage of lactation of the goats must be taken into consideration. Milk from yearling goats across the Toggenburg, Saanen and Alpine breeds of goat have the highest % fat, protein and SNF content than their mature counterparts. The highest producer of % fat content in milk is the Yearling Alpine goats, and the highest % protein content is found in milk produced by Yearling Toggenburg goats. As for the stability of the goat milk constituents, protein and fat remained relatively stable throughout the 2-week recommended shelf-life with small decreases over time.

In addition to the similar macronutrient compositions between the goat and bovine milk studied, goat milk is less expensive and more sustainable to produce in the tropics. The economic factors are in favor of goat milk, but it is not just a matter of cost and nutrition. Taste is also an important factor to consider as some dairy products may be more suited for development using goat milk. While some people prefer drinking bovine milk due to goat milk's strong taste, they may enjoy goat milk based cheeses.

If Barbados was looking to import more goats to expand the market for goat milk, I'd recommend the importation of Alpine and Toggenburg goats for their nutritionally favorable macronutrient composition compared to Saanen goats. It would also be fascinating to study the outcome of the milk produced by interbreeding the goats available at Greenland, and compare the total milk yields by breed and interbred goats. A major factor to consider when importing new breeds or interbreeding goats will be their acclimatization and ability to endure heat stress in a tropical climate. Research has consistently shown negative correlations between increased heat stress and a decrease in total milk yield (Mabjeesh et al., 2007; Silva et al., 2007), and decreases in fat and lactose content (Bhatta et al., 2015; Salari et al., 2016; Kijajevic et al., 2018). This study found that mature goats across all 3 breeds produced milk with the lowest % protein, fat and SNF content compared to yearling goats. Follow-up studies should evaluate whether this decrease in physico-chemical characteristics is related to mature goats being more susceptible to heat stress, or due to increased nutritional needs. Perhaps mature goats can benefit from protein-rich grass higher in nitrogen levels. As well as the supplementation of concentrates higher in fat content to counter the changes in nutrient composition of the milk when the goats are experiencing heat stress.

It would also be beneficial to study samples of milk from both the morning and evening milking periods on each day of data collection from both the goats and cows. This would serve to reinforce whether the data collected from each animal is representation of the constituents of their milk samples for the given day, or inform us that there are variations depending on the time of day of the milking. Although in refrigerated milk, the protein and fat tapers off at 2 weeks with minimal change at week 3, a study on the microbial growth in the milk would help to determine the safety of the milk's consumption. An analysis of the pH between the milk samples from different breeds of goat, stage of lactation, before and after filtration and change in pH over time during the recommended refrigeration period for goat's milk may also be of interest. Furthering our knowledge on all these factors affecting the composition of goat milk will allow dairy farmers to make informed decisions.

ACKNOWLEDGMENTS

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REFERENCES CITED

Bhatta, M., Das, D., & Ghosh, R., 2015. Influence of Seasonal Variation in the General Composition of Black Bengal Goat (Capra Aegagrus Hircus) Milk. Journal of Dairy, Veterinary & Animal Research 2, 148-152. doi:10.15406/jdvar .2015.02.00046.

Getaneh, G., Mebrat, A., Wuble, A., & Kendie, H., 2016. Review on goat milk composition and its nutritive value. Journal of Nutrition and Health Sciences 3. https://doi.org/10.15744/2393-9060.3.401

Kljajevic, N. V., Tomasevic, I. B., Miloradovic, Z. N., Nedeljkovic, A., Miocinovic, J. B., & Jovanovic, S. T., 2018. Seasonal variations of Saanen goat milk composition and the impact of climatic conditions. Journal of Food Science and Technology 55, 299-303. http://doi.org/10.1007/s13197-017-29384

Mabjeesh, S. J., Gal-Garber, O., & Shamay, A., 2007. Effect of photoperiod in the third trimester of gestation on milk production and circulating hormones in dairy goats. Journal of Dairy Science 90, 699-705. https://doi.org/10.3168/jd s.S0022-0302(07)71553-9

Salari, F., Altomonte, I., Ribeiro, N. L., Ribeiro, M. N., Bozzi, R., & Martini, M., 2016. Effects of season on the quality of Garfagnina goat milk. Italian Journal of Animal Science 15, 568-575. http://doi.org/10.1080/1828051 x.2016.1247658

Silva, F., Brito, L., Torres, R., Júnior, J. R., Oliveira, H., Caetano, G., & Rodrigues, M., 2013. Factors that influence the test day milk yield and composition. Genetics and Molecular Research 12, 1522-1532. http://doi.org/10.4238/2013.13.5

Yang, Y., Bu, D., Zhao, X., Sun, P., Wang, J., & Zhou, L., 2013. Proteomic analysis of cow, yak, buffalo, goat and camel milk whey proteins: quantitative differential expression patterns. Journal of Proteome Research 12, 1660–1667. https://doi.org/10.1021/pr301001m