FREEZING POINT DEPRESSION OF RAW GOAT'S MILK FROM THE REGION OF GOIÂNIA, BRAZIL

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Summary

Studies at freezing point depression (FPD) for goat milk are described in this paper. The 432 samples of raw goat milk collected in a period of two years and analysed by the use of an eletronic cryoscope gave a mean value of FPD: -0.565 ± 0.01℃. Statistical significant differences were found between the morning and evening milk. The evening milk showed better quality considering the lactose and others dissolved solutes. Among the Brown, Saanen and Anglo-nubian goats, the greatest increase in FPD, occured in the Anglo-nubian breed. The statistical analysis revealed a significant breed difference ($p < 0.05$), when climate variation was observed. The superior and inferior values found to the FPD of the caprine milk (-0.545 to -0.585℃), is important in establishing regional rules, to improve the quality control criteria and legal interpretation of standards found in the pertinent legislation. The results are also important to improve herd management so that one can increase the animal production which will affect the technological composition, and the nutritional characteristics of the resultant products.

(**Key Words**: Goat's Milk, Freezing Point Depression, Quality Control, Breed, Climate, Lactation Time)

Introduction

Considering the increasing importance of goat raising activity, particularly, in the State of Goiás, Brazil, and the increase of the number of projects aimed at increasing the production of goat milk, it became necessary to adopt standard values for freezing point depression according to regional criteria, instead of using data collected in foreign countries. It is possible to manage the milk production from each animal in such a way that the nutritional value of the lactic products can be improved. The main objective of this paper was to analyse the influence of animal breed, time of lactation, milking interval and the regional climate conditions on the freezing point depression of raw goat milk. This publication also shows the average values and the normal intervals, as well as the frequency distribution for the freezing point depression. This paper supplies enough technical data to determine better conditions for managing the herd. It defines norms for the improvement of the quality control measurements.

Materials and Methods

1. Material

The production of 16 pure goats from Brown, Saanen and Anglonubian breeds was used. They were between two and four years old, beloging to the veterinary School of the Goiás Federal University. Were firstly identified by numbers so that a better control could be made. The milk samples were collected from 1988 to 1990 and the goats were fed: soy bran, cotton bran, Guandú triturated hay. This kind of ration was given once a day, according to the requirements established for maintaince and production. Mineral salt and water were given "*ad libitum*". The pasture had the following grasses: A gayanos, Braquiaria ruzizienses Stapf, Braquiária humidícula. The goats were vaccinated against aphtose fever and received vermifuge during the beginning of the experiment. After that procedure vermifuge was given every sixty days. The milk samples were collected, once a week, in the morning and in the evening, for about 18 months. In this way, 432 samples were collected. At each milking data

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were obtained concerning lactation time, breed, milking period and temperature-humidity conditions of the air. The samples were put inside sterilized glass tubes, which were maintained under refrigeration within insulated boxes with crushed ice. They were transport to the Physiology and Pharmacology Department of the biological Science Institute of the Goiás Federal University. At this place, the samples were always analysed on the same day. The goats had access to the pasture during the evening, staying in collective stalls with a wooden suspensed floor. The installations characteristics used in this research, were listed at table 1.

TABLE 1. INSTALLATIONS CHARACTERISTICS USED TO SAMPLING

Location	Mato grosso goiano
South latitude	16° 40' 22"
Longitude	49° 15' 29"
Altitude (m)	730
Average temperature (℃),	21
Humidity (%)	71.5
Precipitation (mm)	1,487.2
Insolation/hours/year	2,645.7
Climate	sub tropical
Soil/fertility	silica/average

2. Acidity determination

The method used to determine acidity, was the Dornic's degree which consists of 10 ml of milk mixed with NaOH 0.9 N (Houbraken, A. 1976).

3. Freezing point determination

The FPD was determined using an thermistor cryoscope calibrated with standard solution of potassium biphtalate: 0.424; 0.530; and 0.621℃. The instrumental precision expressed as standard deviation was 0.0007, resulting in a variation coefficient of 0.13%. The respective values for the accuracy of the measurements were sd = 0.0008 and cv = 0.15%. The equipment showed a perfectly linearized temperature readout for the range −0.173℃ to −1.635℃. The carry over effect was found to be 0.6% of the absolute difference between freezing point of succeding samples; this implied a mean determination error less than 0.002℃ (Pombo, W. 1983).

4. Statistical analysis

The data were submitted to ANOVA, using the experimental delineation of accidental entire blocks. The significance level used was 5% (Delio, 1975).

Results

1. Average values and morning, evening and total variation intervals.

Table 2 presents the average values and the variation intervals of acidity and FPD of milk collected during the morning, evening and combined (morning + evening). The value are not related to animal breed, lactation time and weather.

2. Frequency distribution

Figure 1, was made to show the frequency distribution of the FPD's values from raw milk. The analysis used data from 216 morning samples and 216 corresponding evening samples. Figure 1 also shows the frequency distributions, considering the combined samples (morning + evening). It was important to note that the highest frequency interval, was the same for both morning and evening periods. The higher frequency of FPD's values, estimated on 52% to morning period and 39% to evening, occured in the class interval, from −0.530 to −0.563℃.

3. Weather variations of FPD

Figure 2, made to analyse the weather variations shows a general fact in the rainy months (october-march) and the dry period (april-september). FPD showed superior average values, during the dry period, with a significant statistical difference, at a 5% level ($p < 0.05$), when compared to those obtained in the rainy period. The lowest limits, appeared in August. These results were obtained from 160 samples (40 a month) from each rainy periods. Five pure animals were used from Brown breed (40-160 days of lactation time) and they were submitted to the same type of feeding and handling.

4. Effect of breed upon FPD

240 samples obtained from 16 pure animals were analyzed whose breeds were: Brown, Saanen and Anglo-nubian. They were submitted to same handling and feeding. The caprines had lactation

TABLE 2. AVERAGE VALUES AND VARIATION INTERVALS OF ACIDITY AND FPD

Variables Milking period	Acidity (°D)	FPD (°C)
Morning (n = 216)		
X	15	−0.560
SD	2.45	0.01
MM	10-20	−0.540~ −0.560
Afternoon (n = 216)		
X	16	−0.569
SD	2.51	0.01
MM	11-21	−0.549~ 0.589
(Morning + afternoon)		
X	16	−0.565
SD	2.49	0.01
MM	11-21	−0.545~ −0.585

X = average, SD = standard deviation, MM = maximum and minimum values, n = number of samples.

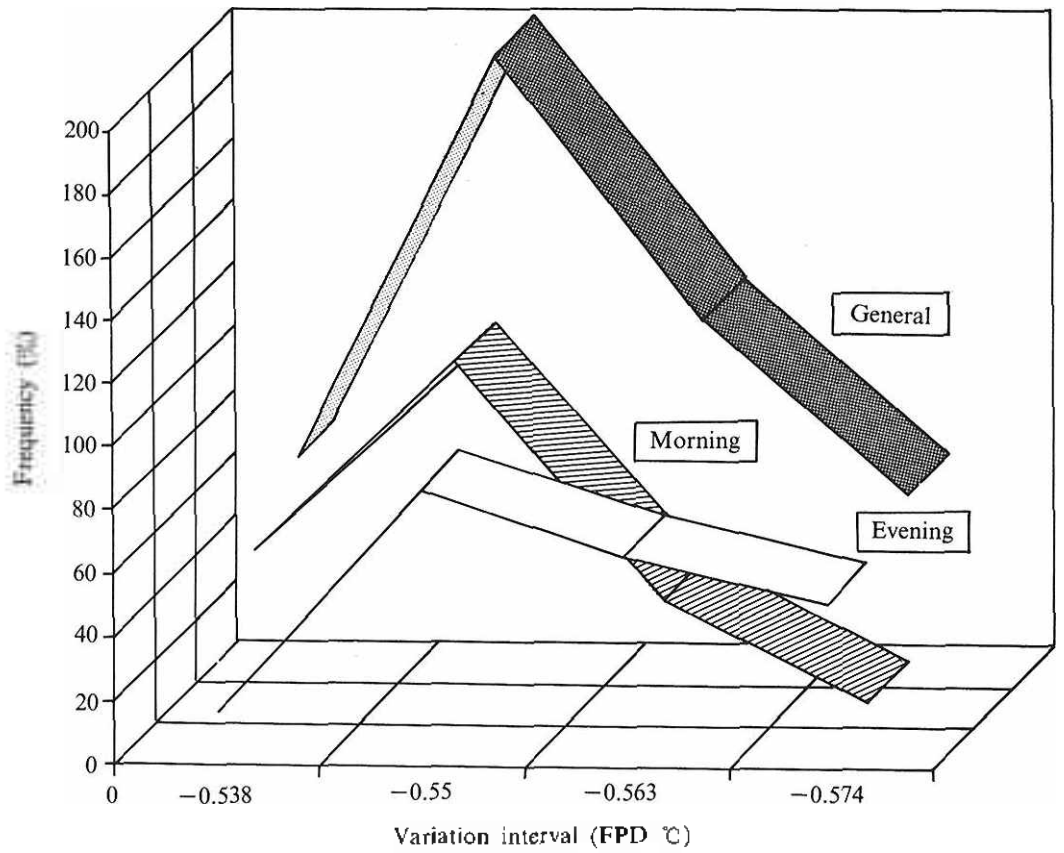

Figure 1. Frequency distribution of the FPD's values.

time between 40-160 days living in the dry period. 80 samples from each one of the above mentioned breeds were studied. In figure 3, it is shown that the Brown breed, produces a better quality of raw material than the Anglo-nubian breed ($p < 0.05$). Saanen and Anglo-nubian did not show differences regarding FPD.

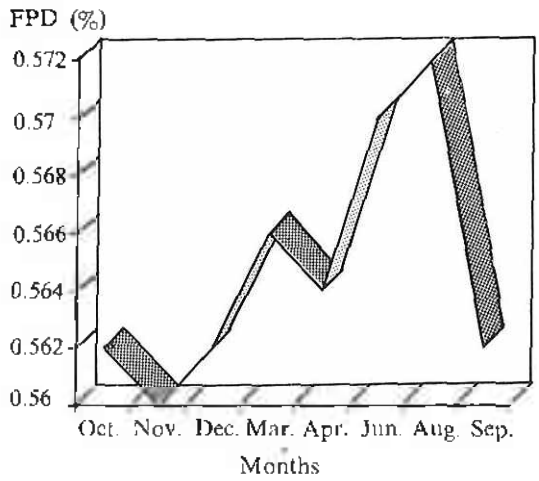

Figure 2. Weather variations of the FPD's values.

5. *Effect of lactation time on FPD*

Table 3. ilustrates the FPD values of 60 samples (for each lactation time), produced by six goats from the Brown breed. It was observed that, as lactation time increased, the average values of FPD are lower, until half of the lactation.

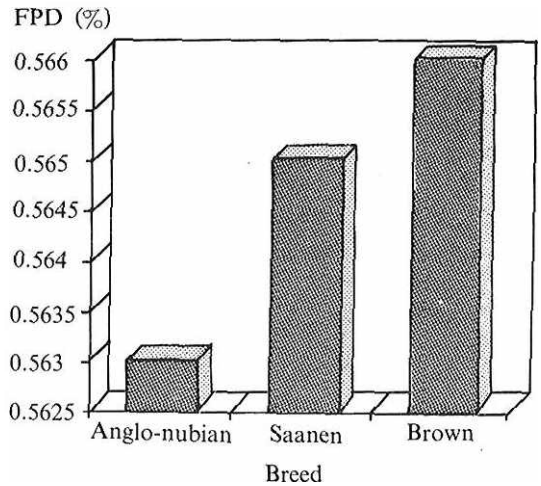

Figure 3. Breed effect on the FPD's values.

TABLE 3. LACTATION TIME AND MILK FPD FROM BROWN BREED (DAYS)

Lactation time / values	7-40	41-80	81-120	121-160	more than 160
X	−0.567	−0.572	−0.584	−0.572	−0.560
SD	0.01	0.01	0.01	0.01	0.01

X = average, SD = standard deviation.

Discussion

The results obtained in this investigation are usefull as regional standards, when caprine fluid milk is considered. They contribute to the quality control measurements, of the product in powder and to the improvement of the pertinent legislation of the fluid raw material. Based on the general average of FPD and on the dispersion found followed by two standard-deviation values, we calculated the variation interval for the 432 samples. From this calculation, the superior limit was established, with the value of: −0.545℃. The average value obtained was: −0.565℃. Based on this value, it was observed that the number of digits which decreases the cryoscope reading, when 1% of water is added to the milk is: 0.01 × 565 = 5.65; which means a FPD of approximately −0.559℃. A cryoscopic reading of −0.539℃ would therefore, indicate 565-539/5.65 = 4.6% of added water. So, it is easily possible to determine the amount of water added, according to the result shown in the equipment. In this paper, it was established two standard-deviation tolerance above the average, to compensate for the occurence of natural variations of the milk or for the equipment used. By getting a value equal or minor than −0.545℃, one can affirm with 95% of security, that the product is free from added water.

Many authors certify not having detected any difference among the samples collected during evening and morning periods (Shipe, 1959), while others (Devendra, 1987), affirm that the phy-

sical-chemical composition of the caprine milk is fairly variable due to the milking interval. Sampaio, J.M.C. (1984), found that morning milk is less concentrated in fat than the correspondent evening milk. Considering table 2, which gives the results of the analyses, obtained during a long period of time, a statistical significant difference, at a 5% level, to FPD, could be observed, the evening milk being more concentrated in solutes. These results have application because the yield in the production of raw material derivatives, like cheese for example, is directly proportional to the milk solutes (Furtado & Wolfschoon-Pombo, 1978). Because this, the industry that uses the evening milk to industrialization, will have a better yield on the technological process, with greater margin of profit. In order to explain such differences there are many factors such as feeding habit and water ingestion. Some authors affirm that elevated values of humidity and air temperature, and related to variation in the milk composition. The elevated temperature from the evening period, stresses the animal, which decreases, the milk production and may provoke physiological changes such as an increase of the pulmonary ventilation, blood volume elevation, decreases in heart rate, adrenal and thyroid activity (Islabão, 1984). Such factors probably contribute to the observed differences.

In order to differentiate authentic milk, from adulterated milk and to make practical work easier, figure 1, shows the frequency distribution obtained in this study. Reveals a curve similar to the Gaus curve, but none of them showed symmetry. The way the values were distributed, is not independent from factors that affect the results, as animals breed, region climate, and others.

Figure 2 allows to say that for industrialization, the milk collected during the winter is recommended that is, from april to september. French (1970), showed more elevated concentrations to fat and non-fat solids, in the rainy period. Parkash and Jenness (1968), revealed superior concentration of lactose and total solids in spring and higher values of protein and ash, during the winter. Therefore this analysis shows the necessity of regionals studies, and one should not depend in establish national standards, mainly in big countries like Brazil. About the animal breed, the values published here for the Anglo-nubian breed, are similar to those found by Jenness, R. (1980) in Trinidad, and those published here, for the Saanen breed, are higher than those published by the same author (Saanen breed) in Nigeria. The observations made on the lactation time, indicates that the raw material, produced in the interval 81-120 days, is of better quality. However, the FPD's average values, increased in the end of lactation, approaching those revealed in the begining of lactation.

Conclusions

Factors like milking period, animal breed and region climate, affect the solutes concentration which are dissolved in the caprine milk. The influence of these variables change the conditions to manage the herd and therefore, industries and producers can obtain higher margin of profit. The mean, maximum and minimum values of FPD, obtained in this investigation, are usefull as subsidies to establish norms that aim the quality control of the product.

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