# Relationship between freezing point and chemical composition of individual Comisana ewe milk

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## SUMMARY
The aim of the study was to evaluate the freezing point trend and the relationship between chemical composition and physical properties of ewe milk.
We determined, on 150 individual milk, the freezing point, fat, protein, casein, lactose, urea, pH, tritable acidity and chloride.
Significant relation coefficients (r = Pearson) have been recorded as follow showing freezing point and the following parameters: lactose (r = -0,21; P<0,01), protein (r = -0,36; P<0,001), casein (r = -0,40; P<0,001), urea (r = -0,39; P<0,001).

## 1 INTRODUCTION
Freezing point of sheep milk is still not ruled as a law limit in Italian legislation and studies related to that are insufficient. As a consequence frequent contrasts are observed between farmers and milk product manufacturers about such trait. It is therefore important to know the range of freezing point during the lactation period on individual and bulk milk, surely safe of any adulteration, in order to determine a reference value.

## 2 MATERIAL AND METHODS
A total of 150 individual milk samples were monthly collected in the morning milking from February to June 2006 using one flock. The samples were obtained from 30 multiparous Comisana ewes.
The ewes were pastured and housed over night; they were fed with hay and 0.4Kg of barley and pea corn per head per day.
In June ewes were fed only with straw and 0.15Kg of barley and pea corn per head per day.
Milk samples were collected by milk meter to record milk yield.
We determined the freezing point by thermistor cryoscope; fat, protein, casein, lactose and urea by Fourier Transformed Infrared analysis (MilkoScan FT600); pH; tritable acidity (Soxelet-Henkel) and chloride by silver nitrate titration (Mettler DL50) .
The statistical analysis has been performed by BMDP new system software.

## 3 RESULTS AND DISCUSSION
In the considered period ewe milk show on average freezing point –0.563°C±0.008, fat 6.44%±1.90, protein 6.03%±0.84, casein 4.8% ±0.72, lactose 4.77%±0.34, pH 6.63±0.58, titrable acidity 9.89 °SH±2.25, urea 39.2mg/dl±6.5 and chloride 1.00g/l ±0.16.
The average monthly freezing point trend increased from February (-0.567°C) to June (-0.556°C) (Tab.1).
The 50.4% of the samples show a freezing point ranging between –0.556°C and –0.565°C (Tab.2).
41% of total milk samples showed a freezing point >-0.560°C. Amongst those samples 41% have been collected in June where we observed higher medium value of this trait and the lowest medium value of protein and lactose.
In detail the medium value of lactose decrease from 4.75% in May to 4.43% in June (Tab.1).
In the same month of June an increase of freezing point has been observed also from other Authors (Di Antonio E. et al.; Cannas A. et al.).
Averages of fat content increased from March to June while the yield, protein, casein and lactose decreased (Tab.1).
Tritable acidity had a little variation during the considered period except in March where we recorded the minimum value (9.29°SH). The values of pH show variations with the minimum in February and the maximum in April (Tab.1).
Significant relation coefficients (r = Pearson) have been recorded as follow showing freezing point and the following parameters: lactose (r = -0,21 (P<0,01) observed also from Pavic V. et al.; protein (r = -0,36; P<0,001), casein (r = -0,40; P<0,001), urea (r = -0,39; P<0,001) (Tab.3).

## 4 CONCLUSION
In this study the traits mainly related to the freezing point were protein, lactose and urea. The most evident freezing point on monthly basis variation, was observed at the end of the lactation, to coincide with low content of lactose and protein in milk.
More studies are needed to verify the influence of season on variation of milk freezing point.
Further investigations, especially on bulk milk, are under way.

**References**

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**Pavic V., Antunac N., Mioc B., Ivankovic A., Havranek J.L., 2002.** Influence of stage of lactation on the chemical composition and physical properties of sheep milk. Czech J. Anim. Sci., 47, (2):80-84.

Table 1: Monthly averages and standard deviations of the traits

| | Feb. | March | April | May | June |
|---|---|---|---|---|---|
| Freezing point | -0.567±0.008 | -0.564±0.006 | -0.563±0.008 | -0.564±0.007 | -0.556±0.006 |
| Production (g) | 410±180 | 483±139 | 422±205 | 400±134 | 352±101 |
| Fat (%) | 6.27±2.09 | 5.00±1.41 | 5.86±1.48 | 7.25±1.60 | 7.84±1.49 |
| Protein (%) | 6.29±1.01 | 6.10±0.73 | 6.17±0.75 | 5.83±0.75 | 5.76±0.88 |
| Casein (%) | 5.01±0.78 | 4.86±0.61 | 4.93±0.61 | 4.66±0.65 | 4.56±0.87 |
| Lactose (%) | 4.89±0.29 | 4.95±0.33 | 4.86±0.28 | 4.75±0.26 | 4.43±0.27 |
| Urea (mg/dl) | 45.20±8.25 | 38.01±4.76 | 35.75±3.58 | 40.67±4.70 | 36.44±5.34 |
| pH | 6.49±0.16 | 6.79±0.08 | 6.77±0.09 | 6.60±0.23 | 6.63±0.25 |
| Trit. acidity (°SH) | 10.31±3.27 | 9.29±1.72 | 10.01±2.33 | 10.10±1.93 | 10.02±1.23 |
| Chloride ($Cl^-$) (g/l) | 0.95±0.12 | 1.02±0.16 | 1.01±0.16 | 1.04±0.12 | 1.03±0.11 |

Table 2 : Frequencies (%) of freezing point samples by classes (°C)

| >-0.551 | -0.551 / -0.555 | -0.556 / -0.560 | -0.561 / -0.565 | -0.566 / -0.570 | -0.571 / -0.575 | <-0.575 |
|---|---|---|---|---|---|---|
| 4.1% | 13.1% | 24.5% | 25.9% | 16.6% | 11.0% | 4.8% |

Table 3: Coefficients of correlation (r_ Pearson)

| | Fat | Protein | Casein | Lactose | Urea | pH | Tritable acidity | Chloride | Freezing point |
|---|---|---|---|---|---|---|---|---|---|
| Production | -0.65*** | -0.29*** | -0.26** | 0.53*** | 0.059 | 0.25** | -0.05 | -0.19* | 0.15 |
| Fat | | 0.29*** | 0.26** | -0.65*** | -0.02 | -0.41*** | 0.13 | 0.13 | -0.029 |
| Protein | | | 0.96*** | -0.14 | 0.18* | -0.19* | 0.08 | -0.06 | -0.36*** |
| Casein | | | | -0.04 | 0.25** | -0.23** | 0.09 | -0.14 | -0.40*** |
| Lactose | | | | | 0.25** | 0.21* | -0.09 | -0.48 | -0.21** |
| Urea | | | | | | -0.39*** | 0.16 | -0.24** | -0.39*** |
| pH | | | | | | | -0.16 | 0.03 | 0.11 |
| Trit. acidity | | | | | | | | -0.05 | -0.08 |
| Chloride | | | | | | | | | 0.07 |

*P<0.05; **P<0.01; ***P<0.001