UDDER HEALTH INDICATORS OF SERRANA GOATS BREED USED FOR MILK PRODUCTION OF THE "TRANSMONTANO GOAT CHEESE"

INDICADORES DE SAÚDE DO ÚBERE DE CABRAS DA RAÇA SERRANA USADAS PARA PRODUÇÃO DE LEITE DO "QUEIJO DE CABRA TRANSMONTANO"

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ABSTRACT

"Transmontano goat cheese" is a traditional Portuguese protected designation of origin cheese produced with raw milk from goats of different herds in the region of Trás-os-Montes. Maintaining high quality standard is essential and depends mainly on the health of the herd and milk quality. Intramammary infections are the main cause for milk composition changes, decrease in milk quality and quantity, leading to high economic losses. In order to make a first approach of the udder health status and make management improvements, somatic cells count from the bulk tank of each farm was evaluated along with other parameters such as fat content, protein and lactose, and total bacterial count to determinate their relationship. High somatic cells count (SCC) were observed. The percentage of fat content and lactose was negatively correlated with log10 SCC and indicated severe udder health problems. The negative correlation value of the total bacterial count in the present model suggests environmental contamination and cooling problems in milk storage. Results show the need for continued investigation and udder health control programs in Serrana goat herds.

RESUMO

O queijo de cabra transmontano é um queijo de denominação de origem protegida produzido com leite cru de cabra de diferentes explorações na região de Trás-os-Montes. Manter os padrões de elevada qualidade é essencial e depende em grande parte da saúde do rebanho e da qualidade do leite. As infeções intramamárias são a principal causa para mudanças na composição do leite, diminuição da qualidade e quantidade, levando a elevadas perdas económicas. A fim de realizar uma primeira aproximação ao estado sanitário do úbere e melhorar o maneio, procedeu-se à contagem de células somáticas do tanque de cada exploração juntamente com os parâmetros teor butiroso, proteína e lactose, e número de microrganismos totais para se entender a relação existente entre eles. Foram encontradas elevadas contagens de células somáticas (CCS), percentagem do teor butiroso e de lactose negativamente correlacionados com o log10 CCS indicaram significativos problemas de saúde do úbere nos rebanhos em estudo. O valor negativo do número de microrganismos totais presente neste modelo sugere a contaminação ambiental e problemas de refrigeração no armazenamento do leite. Os resultados mostram a necessidade de prossecução de investigação e instauração de programas de controlo da saúde do úbere nos nossos efetivos caprinos da raça Serrana.

INTRODUCTION

The "Transmontano goat cheese" is traditionally produced with raw milk and coagulated via animal rennet from Serrana goats in the region of Trás-os-Montes, Portugal. It plays a major role for the economy and as also in feeding habits of the population (Freitas & Malcata, 2000). Leicras Lda. (Mirandela) is the company responsible for collecting the milk of different herds, processing into cheese and for selling it.

"Transmontano goat cheese" is a typical Portuguese protected designation of origin cheese, protected under the European Union standards. Its growing appreciation and consumption led to greater concern for consumers who demand quality and product safety.

Therefore, obtaining milk that meets the appropriate hygienic conditions to get a high microbiological and physico-chemical quality final product is essential. Milk quality depends largely on the health of the herd and intramammary infections represent a huge concern being the main cause for milk composition changes, decreasing quality and quantity, causing high economical losses (Contreras *et al.*, 2007). The milk from animals with mastitis presents increased somatic cells count, decreased lactose, casein and fat content that interfere negatively in the technological milk process which contributes to the devaluation of the cheese (Stuhr & Aulrich, 2010). The measurement of total bacteria count and somatic cells count, represent the main parameters to evaluate animal health status and milk quality. Bulk milk somatic cells count (SCC) can be used to evaluate the udder health status of a herd being helpful in improving udder health control programs and herd management. Many described factors have influence in bulk milk SCC in goats, like month of lactation, seasonal variation, hygiene-sanitary management conditions and others needing further investigation like the management herd factors, such as milking techniques, housing conditions, drying-of strategies, disease prevalence and breed effects (Koop *et al.*, 2009).

With this study, our goal was 1) to evaluate the SCC from the bulk tank of Serrana goat herds, and; 2) to determine its relationship with other parameters, such as fat, protein and lactose contents, and total bacterial count, in order to understand the extent to which microbiological contamination and consequent increase of SCC interference in milk composition and cheese manufacture.

MATERIAL AND METHODS

Between January and July 2015, a total of 806 milk samples were periodically collected, and immediately refrigerated, from the same bulk tank of 40 Serrana goat herds, i.e., repeated samples were taken from the same farms. In each herd, approximately 45 ml of milk from bulk tank was weekly or monthly collected, after milk homogenization, to a sterile container with up to 4 drops (160 uL) of sodium azide (Azidiol) as preservative (Barcina *et al.*, 1987). These samples were delivered to laboratory (ALIP - Associação Interprofissional do Leite e Lacticínios) until 24 hours after collection.

Bulk milk somatic cells count was determined by flow cytometry (Fossomatic™ FC; Foss Instruments) (Sánchez *et al.*, 2005). To determinate milk compounds, fat (%), protein (%) and lactose (%) were measured with Milkoscan 6000 instrument (Foss, Hillerød, Denmark) by mid-infra-red spectroscopy (Sánchez *et al.*, 2007) with mathematical evaluation of the whole IR spectrum by means of Fourier's transformations (Romero *et al.*, 2017). The total bacterial count was also processed by flow cytometry (Bactoscan™ FC; Foss Instruments) (Blowey & Edmondson, 2010). The freezing point was also evaluated in all milk samples in order to detect milk adulteration with water.

Descriptive analysis of data was used for means and quantiles determinations. After Log 10 SCC transformation, a model using a multiple correlation was made. The JMP10 package (SAS, 2012) was used.

RESULTS AND DISCUSSION

The geometric mean of SCC was $2196 * 10^3$ cells per ml. The quantile distribution was reported in table I.

Table I. Quantiles of Bulk milk somatic cells count (SCC) (*Percentis da contagem de células somáticas no tanque de leite (SCC)*).

Quantil	Minimum	Q2.5	Q10	Q25	Average	Q75	Q99	Q99.5	Maximum
SCC (x103/ml)	353	703	1108	1558	2275	3151	4074	7014	17060

The total bacterial count was $807.7 * 10^3$/ml with a confidence interval of 95% between $717.5 * 10^3$/ml and $897.9 * 10^3$/ml. The quantile distribution was reported in table II.

It was observed a correlation coefficient of $r = 0.43$ and an adjusted regression coefficient $R^2 = 0.18$ ($P < 0.001$) for the multiple correlation equation log10 SCC = 7.54 -0.8 * fat content + 0.33* protein – 0.42 * lactose -3 * 10^{-5} * total bacterial count.

Table II. Quantiles of total bacterial count (TBC) (*Percentis da contagem total de bactérias (TBC)*).

Quantil	Minimum	Q2.5	Q10	Q25	Average	Q75	Q99	Q99.5	Maximum
TBC (x103/ml)	3	23	42	80	220	800	2929	4707	4707

The high SCC observed in a large number of milk samples of the present study may be influenced by several physiological factors and should be investigated. In goats, parity, lactation stage, breed, seasonality, milk production, numbers of lambs or kids, milking frequency, machine or hand milking and estrus, as well as management practices are important non-infectious factors to contribute for the SCC variation (Souza *et al*., 2011). In fact, although the multiple correlation between log10 SCC and remaining variables were highly significant presenting a correlation coefficient $r = 0.43$, the low regression coefficient ($R^2 = 0.18$) indicated that those milk components doesn't explain, alone, the SCC variation. However, this model can help to understand the role of milk components as milk quality indicators and indirectly give the udder sanitary state of the herd.

In addition to the high SCC, the percentage of fat content and lactose negatively correlated with log10 SCC indicates severe udder health problems in the studied herds. It is known that intramammary infections damage the blood-udder barrier by the action of the microbial toxins and metabolic products, interfering in the regulation between the blood and the parenchyma, altering milk composition. In healthy udders, lactose is synthetized from glucose and galactose in the gland cells and is compromised during intramammary infections leading to lower percentage of lactose found in milk and indicates chronic udder health problems in herds (Stuhr & Aulrich, 2010).

The positive correlation between SCC and protein content can be explained by the increasing permeability of blood constituents due to loosen connections between cells during mammary infections. Although most of the proteins present in milk are synthesized in the mammary gland and their milk synthesis is decreased, some immunoglobulins and albumins are transferred from the blood. Therefore, milk proteins synthesized in the mammary gland (caseins, beta-lactoglobulin and alpha-lactalbumin) decrease whereas blood serum proteins (whey proteins) increase, altering milk composition but not total protein content (Linn, 1988).

Finally, the negative value of the total bacterial count present in the regression equation suggests environmental contamination and cooling problems in the milk storage in own herds.

CONCLUSIONS

Even considering that physiological factors, such as the apocrine excretion of milk, number of lactations and time of lactation curve, may influence the SCC in goats, these preliminary results show the need for continued investigation and udder health control programs in our goat herds of Serrana breed. Understand breed effects and know the disease prevalence as well the non-infectious risks factors in the herd is essential to improve bulk milk SCC control as also understand its relationship with traditional management aspects that may compromise udder health.

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