Quality of donkey milk: correlations between electric conductivity, freezing point and composition parameters

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Abstract

The results obtained in this study verified the usefulness of electric conductivity (EC) and freezing point (FP) to evaluate their practical application to the assessment of physical and chemical donkey milk quality. Statistic correlations was performed between EC, FP and some physical and chemical parameters in donkey milk samples from two farms. Some interesting correlations are showed and some related considerations are reported. In conclusion FP would be considered as an important qualitative indicator more than EC, especially for its practical application.

Introduction

The electric conductivity (EC) was considered one of the most important parameters of milk with the aim to evaluate its chemical and physical characteristics (Redaelli et al., 1984) and for a fast evaluation of milk acceptance. Some studies concern the EC application for the evaluation of fat and total nitrogen contents in bovine milk and its derivatives and for ovine and goat milk (Lawton and Pethig, 1993). The EC is mainly considered a useful marker in cases of mastitis diagnosis (Redaelli et al., 1984).

This parameter can be influenced by milk composition, in particular for the presence of its ions. Furthermore, EC values could have a variation in relation to animal species, season, feeding, lactation stage, because these factors have an influence on the distribution between milk colloidal and solution phases, therefore, EC has an influence on the amount of free conductor ions in the milk (Prentice, 1962). An experimental study on bovine milk showed the significant correlations between the effects on EC values, lactation stage and mastitis. Furthermore, CE values for milk taken by healthy udders ranged between 5.3 mS/cm (35 days after birth) and 5.9 mS/cm (at the end of lactation). Milk from udders affected by mastitis had EC values that ranged between 5.4 mS/cm, at 25 gg. Postpartum; and 6.1 mS/cm at the end of lactation (Sheldrake et al., 1983). Pautzke et Schulz (2007) referred a significant correlation between plate count and mastitis indicators, somatic cell count, EC and lactose contents in bovine milk (9).

The impedometric method allow to verify the modifications of metabolic processes, allowing to evaluate lactic acid contents, as a lactose metabolite. EC measurement could be used to show milk bacterial spoilage, with a reduction of pH values. The metabolites produced by bacteria increase milk EC values (Pesta et al., 2007). FP is a parameter that is subject to limited variations of its values; for this reason it is indicated to show the cheat of water addition to milk. FP values could be influenced by the so called “natural” factors: animal breed and stage of lactation, feeding, number and time of milking, cow health status (Sotgiu et al., 1996). Seasonal and climatic differences would be strongly related to these factors (Casali et al., 1988). “Technological factors” influence the FP, as for example, the type of milking, milk storage at farm level (Conte, 2005), water deriving from milking equipments and from bulk tank milk (Slaughhuis, 2001), milk treatments at plants level (the so called “technological dilution” of milk) (Dillier-Zulauf, 1985).

In milk, as for every watery system, FP values depend from the concentration of components in the milk, including fatty acids, minerals, proteins, lactose and other components. Thus, FP is a sensitive parameter to detect the addition of water, as for example, in cases of water contamination of milk (Sotgiu et al., 1996).
solution. Lactose and chloride, as other salts, would be the main factors that cause a FP reduction; lactose would be the principal component of milk that is responsible for this effect (Lawton and Pethig, 1993; Shipe, 1959; Slaghuis, 2001; Conte, 2005). As regard EC of donkey milk, Conte et al. (2008) showed some experimental data, together with further observations, could be useful to define the physiological indices for EC also for equids milk. It would be supposed the practical application of this parameter to an indirect evaluation of the product quality. The authors considered that EC would be useful for early diagnosis of mastitis because this pathology are very rare in donkey or they are in subclinical and cannot be diagnosed (Conte et al., 2003). Conte (2005) referred further results of a research carried out during one year on FP in donkey milk; lactose amount evaluation was also measured, because this disaccharide has a high percentage in this milk; it was choose as a target parameter to verify if it would have a certain influence on FP values, such as for cow milk was verified (Slaghuis, 2001). The results revealed mean values that were similar to bovine milk FP. A repeated relationship between FP and lactose was showed. Lactose could have a strong influence on the donkey milk FP.

Freezing point (FP) could acquired a great importance as an useful parameter to verify donkey milk authenticity; its price (Conte, 2005) is elevated because it is used for infants intolerance to some bovine milk proteins or to multiple intolerance (Carroccio et al., 2000). On the basis of the above and in view of lack researches on this topic for donkey milk, the present work has the objective to verify the statistic correlations between EC, FP and some principal components of this milk, with the aim to evaluate the practical application of this two parameters for the assessment of physical and chemical milk quality.

**Materials and Methods**

Milk samples was taken from donkeys in two farms in Sicily. In the first farm (A) n.20 samples were collected; in the second farm (B) n. 10 samples were taken. The animals were manually drawn. All samples were put in a chilled cooler box and transferred to the laboratory. The samples were analysed for the measurement of the following indices: pH (potentiometric method; pHMeter 330i/ set, WTW); electric conductivity (EC) (CON6/TDS meter, Eutech Instr./Oakton Instr.); somatic cell count (SCC) ((Milko Scan, FOSS Italy); lactose (LTS), fat (GRS), total nitrogen (TN) and dry matter (DM) percentages; freezing point ( Lactostar; Funke Gerber, Germany). The statistical analysis of data were performed by Spearman’s rho correlation coefficient (P<0.01).

**Results and Discussion**

Table 1 and Table 2 show the results of analysis for donkey milk in farm A and farm B, respectively. This data were used for the statistical elaboration. In the farm A the statistical analysis of data showed the following correlations (Table 3): a highly significant negative correlation between pH and FP; between TN and FP and between DM and FP (P<0.01), a highly significant between pH and LTS, TN and DM; between LTS and pH, TN and DM and between TN and LTS, DM (P<0.01) and a significant correlation between LTS and FP, DM.

Some considerations arose after the observation of these results. The correlation between FP and LTS could be justified by milk acidification during storage, when the lactose splits and lactic acid is formed; this phenomenon had a certain influence on freezing point values. The acidification explained also the relation between pH value and lactose. Furthermore, DM was affected by total nitrogen and lactose percentage. A negative correlation between pH and FC was explained with a probable increase of some ions during milk refrigeration, with particular reference to the acid groups derived from lactose splitting. The negative correlation between TN and FP was not in agreement with the hypothesis of Dillier-Zulauf (1985) on the absence of a quantifiable effect of fat and of soluble protein on freezing point. The negative correlation between PC and DM would be due to the effect of milk components that contribute to the dry matter percentage.

With reference to farm B, the following correlations were showed (Table 4): a significant negative correlation (P<0.05) between EC and FP, significant was the correlation (P<0.05) between EC and lactose; the latter had a highly significant negative correlation (P<0.01) with FP; the same correlation was between FP and pH, lactose, fat, TN and DM, a highly significant correlation (P<0.01) was observed between lactose and pH, TN and DM.

These correlations gave the opportunity to formulate some considerations. The negative correlation between EC and FP does not find a practical confirmation; these parameters are usually influenced by the presence of some ions in the milk; therefore it would have hypothesized a direct correlation between the parameters. The correlation between EC and lactose could be explained by the potential acidifying effect of lactose, causing ions formation that would
have an influence on conductance values. Lactose relationship with pH, TN and DM was stackable with the same results obtained from farm A; the same was observed for the negative correlation between FR and pH, lactose, fat, TN and DM.
References


