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Short communication: Goat colostrum quality: Litter size and lactation number effects

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ABSTRACT

The quality of colostrum of Murciano-Granadina goats was studied to establish the transition period and the time when milk can be marketed. Forty-three dairy goats were used: 19 primiparous (15 single births; 4 multiple births) and 24 multiparous (10 single births; 14 multiple births). Samples were collected every 12 h during the first week postpartum. Physicochemical parameters and somatic cell count were determined. Analysis of variance with repeated measures was used to study the effect of different factors: postpartum time, litter size, lactation number, their interactions, and production level on colostrum. Postpartum time had a significant effect on all parameters studied, which decreased along the first week of lactation, whereas lactose, pH, and conductivity increased. Based on these results, colostrum secretion takes place until 36 h postpartum (hpp). In relation to other factors of variation studied, the lactation number influenced most colostrum components, whereas the litter size only affected the pH value, protein and lactose content. The production level influenced only the protein and dry matter contents, with an inverse relationship. Milk produced during the period between 36 and 96 hpp is considered transition milk, which should not be commercialized. Milk collected after 4 d postpartum (96 hpp) could be marketed, ensuring that its composition does not present a risk in the dairy industry.
Key words: colostrum, physicochemical parameter, Murciano-Granadina goat

Short Communication

Feeding goat kids colostrum is a very important livestock practice within artificial goat-raising systems and it is used mainly in intensive farming. This system minimizes or annuls the mother-kid link, which is established along the first hours postpartum (**hpp**; Ramírez et al., 1997), thus helping artificial nipples to be accepted. Newborns are hypogammaglobulinemic at birth (Rodríguez et al., 2009); colostrum intake during the first 2 postpartum days reduces mortality, because it provides antibodies (immunoglobulins) to avoid possible diseases and infections; the survival of newborns is related to colostrum quality and the volume ingested (Argüello et al., 2004; Keskin et al., 2007).

Different studies have evaluated goat colostrum composition (Argüello et al., 2006; Yang et al., 2009; Moreno-Indias et al., 2012). Colostrum is characterized by high fat as well as protein and mineral contents compared with milk. It also presents some interesting components from a biological viewpoint, such as protective substances (immunoglobulins, lactoferrin, and lysozymes, among others) and growth factors (vitamins and amino acids), among others. The physicochemical characteristics and production period of colostrum may vary according to different factors such as production, feeding, breed, length of the dry period, season of the year, and animal health status (Csapó et al., 1998; Caja et al., 2006).

From a practical point of view, suitably delimiting the colostrum production period is interesting for farmers, as they can offer good-quality colostrum to feed goat kids. On the other hand, it would also be useful for producers to know from what time milk can be commercialized because, according to the legislation of many countries, milk intended for human consumption may not contain colostrum [Commission Regulation, European Commission (EC) 1662/2006; European Commission, 2006]. Also, for the dairy industry it is important that milk does not contain colostrum, because the presence of a large amount of soluble proteins can negatively affect the production and standardization of some milk products (Raynal-Ljutovac et al., 2005).

Murciano-Granadina is the most common Spanish goat breed, being well adapted to the Mediterranean livestock system. Some authors have studied different aspects of Murciano-Granadina goat milk production and composition (Díaz et al., 2012; León et al., 2012).

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Nonetheless, information about Murciano-Granadina goat colostrum quality is rather limited (Quiles et al., 1991; Caja et al., 2006).

Therefore, this study aims to establish the physicochemical characteristics of Murciano-Granadina goat colostrum by evaluating the influence of hours postpartum, litter size, lactation number, and the animal's production level; in addition, the period of transition from colostrum to milk is determined, establishing the time when goat milk can be marketed.

Experimental animal procedures were approved by the Ethics Committee of Universitat Politècnica de València (UPV, València, Spain). Forty-three dairy goats of the Murciano-Granadina breed belonging to the experimental flock of the Animal Science and Technology Institute of UPV were used. Of these, 19 were primiparous (15 single births and 4 multiple births); and 24 were multiparous (10 single births and 14 multiple births), divided as follows: 3 in second lactation, 10 in third lactation, and 11 in fourth lactation or more. The mean gestation length for the experimental goats was 151 ± 10 d, and the length of dry period was approximately 103 d. The animals presented a suitable health status and were fed the same ration [alfalfa hay (1,050 g), barley straw (330 g), orange pulp (1,615 g), barley (520 g), beet pulp (205 g), soybean (275 g), treacle (40 g), and a vitamin-mineral corrector], using a mixer-feeder wagon, which covers lactation requirements according to the Institut National de la Recherche Agronomique (INRA, 2007).

After birth, goat kids were separated from their mothers and were raised artificially. Machine milking (high line; CASSE 2 × 12 × 6; Alfa Laval, Lund, Sweden) was performed every 12 h (0800 and 2000 h) during the first week of lactation. To obtain colostrum and milk samples (300 mL), a complete milking was carried out, measuring the total volume with milk-recording jars (3.5 L, Sneder; Industrias Berango S.L., Vizcaya, Spain). The samples were stored at 4°C until their subsequent analysis, and 3 aliquots of 1.5 mL were frozen (−40°C) for IgG quantification.

The physicochemical parameters were analyzed in triplicate on the same day of sampling, and the pH value was determined using a portable pH meter (model Basic 20; Crison Instruments SA, Barcelona, Spain). Colostrum density was determined applying a densimeter [ranging between 1,000 and 1,100 kg/m^3 (Proton 20°C; GAB Sistemática Analitica S.L., Barcelona, Spain)]. Electrical conductivity was measured using a conductivity meter (model Basic 30; Crison Instruments SA), and the results were expressed in millisiemens per centimeter at 25°C (mS/cm). To determine titratable acidity (AOAC International, 2000), 1 mL of phenolphthalein indicator (1%) was added to 10 mL of milk, and the mixture was titrated with 0.111 *M* Dornic NaOH (Suministros Químicos Arroyo S.L., Santander, Spain) to a permanent light pink color. Titratable acidity was expressed as °Dornic using the relation 1 °D = 0.1 mL of Dornic NaOH (1°D is equivalent to a 0.01% lactic acid concentration). The freezing point was measured with a thermistor cryoscope (CryoStar l; Funke-Dr. N. Gerber Labortechnik GmbH, Berlin, Germany).

Gross composition analysis (fat, protein, lactose, and DM) and SCC were analyzed at the Interprofessional Milking Laboratory of the Valencian Community (LICOVAL; Spain). Composition was determined by infrared spectrophotometry equipment (MilkoScan FT120; Foss Electric A/S, Hillerød, Denmark; IDF, 2000), using a specific calibration for goat milk; SCC was determined according to the electronic fluoro-opto method (IDF, 2006), using a Fossomatic 5000 somatic cell counter (Foss Electric A/S).

Immunoglobulin G analyses were done using the Calokit-Cabra (Zeu-Inmunotec S.L., Zaragoza, Spain), a direct ELISA sandwich-type immunoenzymatic assay, permitting IgG quantification (mg/mL), with a range of 0.01 to 50 mg/mL. The kit is supplied with a microtiter plate for 96 tests, together with reagents. Colostrum and milk samples were analyzed in duplicate following the manufacturer's instructions.

Statistical analyses were performed using SAS (version 9.2, 2001; SAS Institute Inc., Cary, NC). The SAS PROC MIXED for repeated measurements was used to determine the colostrum production period during the first lactation week. The statistical model included the effect of hours postpartum:

$$Y_{ij} = \mu + HPP_i + G_j + \varepsilon_{ij},$$

where Y_{ij} = dependent variable, μ = mean, HPP_i = hours postpartum (i = 1–14 h), G_j = goat (j = 1–43 goats), and ε_{ij} = residual error. The MIXED procedure of SAS was used to evaluate the effect of different variation factors on colostrum quality characteristics:

$$Y_{ijkl} = \mu + HPP_i + LN_j + LS_k + G_l\,(LN_jLS_k) + COV + \varepsilon_{ijkl},$$

where Y_{ijkl} = dependent variable, μ = mean, HPP_i = hours postpartum (i = 1–14 h), LN_j = lactation number [j = 0 (first lactation); j = 1 (≥second lactation)], LS_k = litter size [k = 0 (single); k = 1 (multiple)], G_l (Ln-$_jLS_k$) = l (1–43) goats nested to LN_j and LS_k; COV = covariate (mean production), and ε_{ijkl} = residual error.

Table 1 provides the physicochemical characteristics of colostrum and milk of Murciano-Granadina goats along the first 156 hpp. All parameters decreased along