An evaluation of colostrum quality of local goats in Libya

Mabruka Saleh Hamad
Department of Physiology and Biochemistry, Faculty of Veterinary Medicine, Omar Al-Mukhtar University, Al-Baida- Libya.
E-mail: mabruka_sitmo@hotmail.com

Abstract
Acquisition of high quality colostrum is an important factor influencing the neonatal health. The present study was conducted to evaluate the quality of colostrum based on immunoglobulin G (IgG) content in local goats and to examine the effects of parity and litter size on it. This study also provides an insight about the relationship between colostrum quality and neonatal kids mortality in local goats. Colostrum samples were collected from 39 goats and analyzed for IgG concentration throughout 12 hours post partum using Refractometry. The goats were divided into 3 groups based on their parity and the number of kids they carried: Group 1 included primiparous goats with a single kid (n = 11), Group 2 included multiparous goats with a single kid (n = 13), and Group 3 included multiparous goats with twin kids (n = 15). The study showed that the goat parity did not influence colostrum quality. Among the multiparous goats, the colostrum obtained from goats carrying twins showed better quality than that from those carrying a single kid ($P < 0.05$). The mortality rate in neonatal kids of primiparous goats was 25.64% , whereas was 15.38%, 33.33 in kids of multiparous goats with single kids and twins, respectively. The elevated mortality rate in neonatal twins may be related to the volume of colostrum they consumed.

Key words: local goats, colostrum quality, parity, neonates mortality rate,

Introduction

Libyan local goats (Mahali) represent more than 90% of total goat population and are concentrated along the coastal area of the country. Other breeds like Targhai and Tibawi breeds are limited mainly to the southern region. Damascus, Murciano-Grandina, French Alpine, and Saanen goats were imported for crossing with local goats in order to improve their productivity but these breeds have been intermixed in an unmanaged way with local goats. Mahali goat breed is kept mainly for meat production, milk left to kids and occasionally consumed by household. Production systems are based on rain-fed rangeland and

crop residues with supplemental feeding during summer or drought periods ***(Akraim, 2012).***

Colostrum, the initial secretion from the mammary gland after parturition, is an important source of immunity and nutrition for the neonate ***(Bielmann et al, 2010).*** The colostrum is produced after parturition for the first 3 days with adequate immunoglobulin levels and the concentration of the immunoglobulin decreases in the post kidding period ***(Keskin et al, 2007).*** Goat kids are a gammaglobulinemic at birth. Colostrum intake during the first 2 postpartum days reduces mortality, because it provides antibodies (immunoglobulins) to avoid possible diseases and infections; where, the survival of newborns is related to colostrum quality and the volume ingested ***(Romero et al, 2013).*** In ruminants, the placenta impedes the transfer of Ig from the dam to the fetus; consequently, the consumption of colostrum by the progeny of these species holds a fundamental role in the acquisition of immunity ***(Castro et al, 2005).*** Failure of transfer of passive immunity is a major cause of increased susceptibility to infectious agents in newborn kids. Feeding of high quality colostrum is the most effective way to obtain sufficient immunoglobulin ***(Rudovsky et al, 2008).***

The concentration of immunoglobulin in the colostrum will determine the quality of the colostrum, and it can be classified as high, medium or low quality colostrum ***(Fleenor and Stott, 1980).***

The Brix refractometer has been reported to be a useful instrument for the evaluation of colostrum immunoglobulin concentration. Unlike the colostrometer, the Brix refractometer is not sensitive to the temperature of the colostrum at the time of analysis ***(Bielmann et al, 2010).*** The refractometer measures the total protein in the colostrum, protein solutions refract light and refractometer use this property to estimate total protein in a solution ***(Chavatte et al, 1998).*** Since the most of the protein in colostrum is IgG, thus measuring total protein in colostrum provides a value that is highly correlated with IgG concentration. Although colostrum contains several types of immunoglobulins (IgG, IgA, IgM), IgG constitutes approximately 85% of the immunoglobulins in colostrum ***(Butler, 1983).*** The appropriate cut-off level to ensure good quality colostrum (≥ 50 g/L of IgG) is a refractometer Brix score of 22% or higher ***(Bielmann et al, 2010).***

Several researchers have concluded that parity is an important factor influencing colostral immunoglobulin content ***(Muller and Ellinger, 1981; Gulliksen et al, 2008)*** in dairy cattle. A few studies have investigated the effect of

parity and litter size on colostrum quality in goats ***(Romero et al, 2013 and Arguello. et al, 2006).***

The aim of the present study was to evaluate the local goat colostrum quality with respect to parity and litter size. Association between colostrum quality and neonatal kid mortality was also described.

Materials and methods

The study was conducted on 39 local goats from a herd in Jardas Jerrari which is a village at Al Jabal Al Akhdar District, northeastern of Libya, 674 meters above sea level and has a climatic condition. The experiment was performed during the kidding season, from December to February. All animals used were appeared clinically healthy, sprayed and drenched against external and internal parasites, and vaccinated against enterotoxemia and pasteurellosis 2 weeks before kidding.

The animals were allowed to graze and drink water freely during the day and kept in a pen in the night. A complementary diet consisting of barley (30%), wheat bran (30%), maize (20%), wheat (10%), Soybean (7%), calcium carbonate (2%), sodium chloride (1%) was provided to animals once a day as 0.5 kg per animal. Thirty nine goats were used. Of these, 11 were primiparous (all single births), and 28 were multiparous in second lactation or more (13 single births and 15 multiple births.

Colostrum samples were collected by hand-milking into clean and dry plastic test tubes within 12 h after parturition , transported directly to laboratory, and stored at -20 °C until required for analysis. Data regarding mortality rate of neonatal kids in relation to goat parity and litter size were recorded.

Colostrum samples were allowed to thaw at room temperature before analysis and well mixed. Colostrum quality was determined using refractomery technique, by caprylic acid fractionation method described by Morrill et al. (2012). Caprylic acid precipitates non-IgG proteins leaving the IgG in the colostrum supernatant. One milliliter of colostrum was added to a tube containing 1 ml of 0.06 M acetic acid and 0.75 µl of caprylic acid. Samples were thoroughly mixed by vortexing and allowed to react for 5 minutes. A sample of the supernatant was analyzed using a digital temperature-compensated refractometer (model RX-5000, Atago Co. LTD, Japan). Approximately 0.5 ml of the colostrum supernatant was used on the refractometer prism and the Brix readings (%) of the IgG-rich supernatant were recorded at 20°C. The refractometer was calibrated with distilled water at the start of each set of analyses.

The effects of parity and litter size on colostrum quality were analyzed using one-way analysis of variance. Minitab 15 for windows (Minitab

Inc. was used for statistical analysis).

Results and discussion

Only 28.2% (11/39) of the Brix scores of all colostrum samples examined met the standard cut off level of 22% for good colostrum quality. The mean Brix values of all samples examined was 19.22 ± 4.7 %. The Brix scores for colostrum samples from primiparous goats ranged from 12.5% to 32.0% with a mean value of 21.18 ± 4.6 %.

The Brix scores ranged from 13.5% to 30.0% and 12.6% to 32.0% for the multiparous goats carrying single kids and twins, respectively. The mean Brix values were 17.03 ± 4.2 % for goats with single kids and 19.68 ± 5.2% for goats with twins (Table 1).

The Brix values of colostrum below 22% corresponding to immunoglobulin G concentration below 50 g/l and is defined as poor quality colostrum and consequently a Failure of passive immunity transfer with increased susceptibility to diseases and subsequent death in neonatal kids.

Overall mortality rate in neonates was 25.64 % (10/39). The mortality rate in neonatal kids for the primiparous goats was 27.27 % (3/11), whereas the mortality rates in kids from multiparous goats were 15.38% (2/13) for goats with single kids and 33.33 % (5/15) for goats with twins (Table 2).

The effect of goat parity on the colostrum quality

The effect of goat parity on the colostrum quality was analyzed according to the data obtained from the goats in groups 1 and 2. There was no significant difference between the Brix values of colostrum samples taken from primiparous and multiparous goats, i.e. the content of IgG in colostrum from primiparous goats did not differ from that of multiparous goats. This finding is in agreement with a study conducted by ***Arguello et al (2006)*** and in contrast with a study by ***Romero et al (2013)*** who observed that primiparous goat colostrum is characterized by higher IgG content than that of multiparous goats. Other studies on colostrum of other species have reported controversial results; ***Pritchett et al (1991)*** found that lactation number did not influence colostrum content of IgG in dairy cows, whereas ***Gulliksen et al (2008)*** reported higher IgG concentration in colostrum from older cows than that from cows in first lactation. A study on ewe colostrum showed that the concentration of IgG in colostrum obtained from the primiparous ewes was higher than that from the multiparous ewes ***(Higaki et al, 2013).***

The effect of goat litter size on the colostrum quality

The effects of goat litter size on colostrum quality were analyzed using data from groups 2 and 3. The

difference between the Brix values for colostrum samples taken from goats with single kids and goats with twins was significant ($P<0.05$), i.e. the colostrum content of IgG of the goats carrying twins was higher than that from the goats carrying single kid. This finding supports a study conducted by ***Csapo et al (1994)*** in which colostrum of the twin-producing goats, ewes and cows contained significantly more immunoglobulin-G than that of mothers with single progeny. ***Romero et al (2013)*** also reported similar result on goats colostrum. In the present study the higher mortality rate in neonatal kids of the multiparous goats with twins compared to goats carrying single kid despite the higher content of IgG in their colostrum may be due to the insufficient quantity of IgG consumed by two neonates as the concentration of colostral IgG is also did not meet the desired content of 50g/L. The volume of goat colostrum was not recorded in this study.

Association between neonatal kid's mortality and colostrum quality

This study showed that the majority of goats examined (27/39) produce colostrum with an IgG content below 50 g/L. The relationship between absorption of colostral Ig by the neonatal kid and kid health is well established ***(Chen et al, 1999).*** The failure of passive transfer of immunoglobulins results in an increased morbidity and mortality in neonatal ruminants, as a result of an increased susceptibility to pathogens and subsequent disease ***(Bielmann et al, 2010).*** Primary factors that influence the acquisition of passive immunity include: the volume of maternal colostrum; immunoglobulin concentration and time elapsed postpartum prior to feeding ***(Rodriguez et al, 2009; Suraya and Yaakub, 2011).*** The high survival rate or mortality of the newborns is greatly dependent on the colostrum intake. The newborns will receive adequate amount of immunoglobulin if they are fed with adequate quantity of high quality colostrum immediately after birth. Artificially feeding colostrum to neonates can increase the likelihood of selecting colostrum with adequate IgG concentration ***(Pritchett et al, 1991).*** The low quality of colostrum and high mortality rate in goats in the present study may be attributed to management practices. Akraim (2012) reported that the mortality rate of neonatal kids in local goats is 5% and the main constraints in goat production are insufficient and fluctuating feed supply, and poor flock management. Prepartum diet has been reported to be one of the factors influencing colostrum quality ***(Donovan et al, 1986).*** An evaluation of colostrum by farmer prior kids feeding in the study area is not a common practice or may be dependent only on colostrum volume or appearance; an incorporation of on farm colostrum

evaluation using hand-held refractometer may assist as a rapid and accurate method for selecting of colostrum with adequate immunoglobuline G concentration. Feeding kids the correct amount of high-quality colostrum immediately after birth is one of the most important management practices in kid management ***(Bently, 2013).*** Transmitting of colostrum to neonatal kids in the study area is mostly done if the kid can not suckle because goat mother disease or any reason prevents the neonate from suckling. According to recommendation of neonates management researcher, having of good colostrum, fresh, refrigerated or frozen on hand from a healthy goat in the same herd is the best way for good artificial rearing management ***(Bently, 2013)*** and lowering of failure of passive transfer prevalence.

Prediction of goats colostrum quality status and passive transfer in neonatal kids will allow for development of colostrum and kids management practices which might assist in reducing neonatal kids morbidity and mortality in local goats.

Table 1. Mean ± SE of Brix scores (%) in primiparous and multiparous with single and multi births goats

Groups	Group 1	Group 2	Group 3	Overall
No.	11	13	15	39
Brix Scores %	21.18±4.6	17.03±4.2	19.68±5.2	19.22±4.7

Table 2. Mortality rate (%) in primiparous and multiparous goats

Groups	Group 1	Group 2	Group 3	Overall
No.	11	13	15	39
Mortality rate %	27.27 (3/11)	15.38 (2/13)	33.33 (5/15)	25.64 (10/39)

References

Akraim, F (2012): Goat production in libya: current state and production constraints. Krmiva 54:189-194.

Arguello, A., N. Castro, S. Alvarez, and J. Capote (2006): Effects of the number of lactations and litter size on chemical composition and physical characteristics of goat colostrum. Small Rumin. Res. 64:53–59, (Abstract).

Bentley, J. (2013): Colostrum Management for the Dairy Goat Kid. Iowa State University Extension and Outreach.

Bielmann, V., J. Gillan, N. R. Perkins, A. L. Skidmore, S. Godden, and K. E. Leslie (2010): An evaluation of Brix refractometry instruments for measurement of colostrum quality in dairy cattle. J. Dairy Sci. 93:3713–3721.

Butler, J. E. (1983): Bovine immunoglobulins: An augmented review. Vet. Immunol. Immunopathol. 4:43–152.

Castro, N., J. Capote, S. Alvarez, and A. Arguello (2005): Effects of lyophilized colostrum and different colostrum feeding regimens on passive transfer of immunoglobulin G in Majorera goat kids. J.Dairy Sci. 88:3650–3654.

Chavatte, P., F. Clement, R. Cash, and J. F. Grongnet (1998): Field determination of colostrum quality by using a novel, practical method. AAEP Proc. 44:206–209.

Chen, J. C., C. J. Chang, H. C. Peh, and S. Y. Chen (1999): Serum protein levels and neonatal growth rate of Nubian goat kids in Taiwan area. Small Rumin. Res. 32:153–160, (Abstract).

Csapó J., Z. Csapó-Kiss, T.G. Martin, J. Szentpeteri, G. Wolf (1994): Composition of colostrum from goats, ewes and cows producing twins. International Dairy Journal 4: 445–458, (Abstract).

Donovan G. A., L. Badinga, R. J. Collier, C. J. Wilcox, R. K. Braun (1986): Factors influencing passive transfer in dairy calves. *J. Dairy Sci.*, 69:754–759, (Abstract).

Fleenor, W.A., and G. H. Stott (1980): Hydrometer test for estimation of immunoglobulin concentration in bovine colostrum. J. Dairy Sci. 63: 973–977.

Gulliksen, S. M., K. I. Lie, L. Solverod, and O. Osteras (2008): Risk factors associated with colostrum quality in Norwegian dairy cows. J. Dairy Sci. 91:704–712.

Higaki, S., M. Nagano, S. Katagiri, Y. Takahashi (2013): Effects of parity and litter size on the energy contents and immunoglobulin G concentrations of Awassi ewe colostrums. Turk J Vet Anim Sci. 37: 109-112.

Keskin, M., Z. Guler, S. Gul, and O. Bicer (2007): Changes in gross chemical composition of ewe and goat colostrum during ten days postpartum. J. Appl. Res. 32:25–28, (Abstract).

Morrill, K. M., E. Conrad , J. Polo , A. Lago , J. Campbell , J. Quigley , and H. Tyler (2012): Estimation of colostral immunoglobulin G concentration using refractometry without or with caprylic acid fractionation. J. Dairy Sci. 95 :3987–3996.

Muller, L., and D. Ellinger (1981): Colostral immunoglobulin concentrations among breeds of dairy cattle. J. Dairy Sci. 64:1727–1730.

Pritchett, L. C., C. C. Gay, T. E. Besser, and D. D. Hancock

(1991): Management and production factors influencing immunoglobulin G1 concentration in colostrum from Holstein cows. J. Dairy Sci. 74:2336–2341.

Rodriguez, C., N. Castro , J. Capote , A. Morales-delaNuez , I. Moreno-Indias , D. Sanchez-Macias , and A. Argüello (2009): Effect of colostrum immunoglobulin concentration on immunity in Majorera goat kids. J. Dairy Sci. 92 :1696–1701.

Romero, T. , M. C. Beltrán , M. Rodríguez , A. Martí De Olives , and M. P. Molina (2013): *Short communication:* Goat colostrum quality: Litter size and lactation number effects. J. Dairy Sci. 96 :7526–7531.

Rudovsky , A., L. Locher, A. Zeyner, A. Sobiraj, T. Wittek (2008): Measurement of immunoglobulin concentration in goat colostrums. Small Ruminant Research 74: 265-269.

Yaakub, S. (2011): Effect of colostrum feeding on the serum immunoglobulin level in Saanen crossbred kids. Mal. J. Anim. Sci. 14:25-29.