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Milk production traits of indigenous Black and Meriz goats raised under farm production system

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Abstract

To study the milking performance of indigenous goats, a total of 397 test day milk yield observations (TDMY) of 25 Black and Meriz does raised in Farm 1, and 18 local Black does raised in Farm 2 were used. The examined milking performance traits were total milk yield (TMY), peak milk yield (PMY), time to peak milk yield (TPMY) and lactation period (LP). Milk was recorded at monthly intervals starting one month post kidding till the does were dried off. The overall means of TDMY, TMY, PMY, TPMY and LP were 755.84 ± 25.31 ml, 132.38 ± 6.90 L, 1309.56 ± 68.44 ml, 36.52 ± 2.40 days and 172.73 ± 3.83 days, respectively. Within flock Black does yielded significantly (P<0.01) higher TDMY, TMY, PMY and longer LP than did Meriz. Black does raised in Farm 2 yielded significantly (P<0.01) higher TDMY, TMY and PMY compared to those raised in Farm 1. The highest TDMY was attained during the first test and declined significantly (P<0.01) toward the lowest value at the 7th month of lactation. The results revealed that 5 years and older does produced significantly (P<0.01) more TDMY, TMY and PMY than younger does. It can be concluded that a large variations in milk production performance existed between different breeds within the same flocks and between the same breed in different flocks.

Key words: Milk traits, Black goat, Meriz, flock

Introduction

Local breeds of small ruminants are widely recognized as a key resource within the frame of future international agriculture policies (Macciotta et al., 2005) . Their good adaptation to specific environments allows for the exploitation of low-potential rural areas and wastelands providing rural societies with typical products of animal origin (Boyazoglu and Morand-fehr, 2001; Haenlein, 2001). Also, it is reported that local goat genotypes which are suited to environmental conditions produce satisfactory milk and support kid growth without supplementary feeding (Cabiddu et al., 1999; Sangare and Pandey, 2000). Furthermore, the native goats are important species in Iraq; they can play an important role for the provision of meat and milk production, particularly under the agricultural systems prevailing in the country (Alkass and Juma, 2005).

The main goal of dairy goat production is to improve traits related to milk performance. It is possible to apply better selection in goats than in dairy cows due to higher fertility and shorter generation interval (Ciappesoni et al., 2004). Test-day milk yield is currently used in commercial flocks of sheep and goats (Barillet et al., 1992; and Sanna et al., 1994), which fit into fairly simple formulas that give accurate and consistent lactation records (Vanraden, 1997). Since information on milk production of goats raised under farm condition in general and Meriz goats in particular is limited. This study aimed to compare milk traits of local Black and Meriz using test-day method, together with some factors affecting these traits.

Materials and Methods

A total of 397 observations of test day milk yield (TDMY) of 25 local Black and Meriz does aged 2-6 years raised in one flock (Farm 1), and 18 local Black goat raised in the second herd (Farm 2) were used in this study during kidding season 2010.

In the first flock, after kidding the does were allowed to graze in a mountainous natural pasture during the day (early morning to sunset). The kids were allowed to suck their dams after retained back till the

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next morning. In addition, the kids had an access to pasture separately. Usually does of the first flock were milked after suckling in the afternoon, as well as in the morning before leaving to the pasture. In the second flock, (Farm 2) the does were allowed to graze in natural pasture in the plain from morning till mid-day and enclosed during afternoon. Usually does of the second flock were milked 10 days post kidding at morning only. The kids were weaned at 3 months old in both flocks.

In the current experiment, milk was recorded at monthly interval starting one month post kidding till the does were dried off (less than 100 ml) according to ICAR (2007). On the day of the test, the kids were separated from their mothers at 8.00 p.m. On the following morning, does were hand milked at 8.00 a.m., and the quantity of milk was recorded using a graduated cylinder. Daily milk yield was obtained by multiplying test-day yield by 2. The milking traits were measured as follows: peak milk yield (PMY) as the yield with the highest milk production, time to peak milk yield (TPMY) as the time from the kidding to highest milk production and lactation period as period throughout the entire lactation (LP).

Statistical analysis

General Linear Model was used to estimate Best Linear Unbiased effects (SAS, 2002) of breed, age of doe, type of birth and stage of lactation on test day milk yield (TDMY), assuming the following model:

$Y_{ijklmn} = \mu + B_i + AD_j + T_k + P_l + AN_m + e_{ijklmn}$

Where:

Y_{ijklmn} = observational value of animal,
μ = overall mean,
B_i = Effect of i^{th} breed (i = Black goat, Meriz),
AD_j = Effect of j^{th} age of doe (j = 2, 3, 4, 5 and over),
T_k = Effect of k^{th} type of birth (k = single, twin),
P_l = Effect of l^{th} month of lactation (l = 1^{st}, 2^{nd}, 3^{rd}, 4^{th}, 5^{th}, 6^{th}, 7^{th}),
AN_m = Effect of m^{th} individual animal
e_{ijklmn} = Random error associated with each observation assumed to be NID with zero mean and $\sigma^2 e$ variance.

Duncan's multiple range test (Duncan, 1955) SAS (2002) was used to detect differences among least square means within each factor.

The month of lactation was excluded from the above model when used for analysis of TMY, PMY, TPMY and LP.

Results and Discussion

The overall mean of TDMY and TMY for both breeds was 755.84 ± 25.31 ml/day and 132.38± 6.90 L, respectively (Table 1). The value of TDMY recorded herein was higher than TDMY obtained by Hermiz, et al. (2004) for native goats and their crosses with Damascus and Saanen goats raised in central Iraq. Moreover, the average TMY noticed for Black goat in both farms was higher than those recorded earlier for native goat in Iraq by Hermiz et al. (1998), Salih and Maarof (2004) and Maarof et al (2009). Such differences among studies could be attributed to the differences in genetic make-up, management and feeding practices in each flock.

In the present study, breed comparison within flock revealed that Black does yielded significantly (P<0.01) more TDMY (685.29 vs. 566.87 ml/d) and consequently more TMY (127.46 vs. 95.91 L) (Table 1) than did Meriz. Such difference between the two breeds might be due to the differences in genetic make-up. Also, the larger size of the former breed and consequently a higher nutrient intake (Prasad et al., 2005) could be contributed for such differences (Agnihotri and Rajkumar, 2007; Guler et al., 2007; Mioc et al., 2008; Norris et al., 2011). Furthermore, Black does raised in farm 1 produced significantly (P<0.01) lower TDMY (685.29 ml/d) and TMY (127.46L) compared to those raised in farm 2 for TMY (1127.92 ml/d) and TMY (189.86L) (Table 1). Such difference between farms may be attributed mainly to variation in feeding and management practices followed in each farm and to some extent to differences in the genetic make-up (Akpa et al., 2002, Macciotta et al., 2005; Konyali et al., 2010).

It appears from the results presented in Table 1 that age of doe had a significant effect (P<0.01) on both TDMY and TMY, which showed an almost steady growing trend from two years old toward those aged 5 years and older. The effect of parity on milk yield might be due to the proportion of mammary alveoli from the previous lactation. Those alveoli would then be added to alveoli that developed in subsequent lactations. This continuity was interrupted as the age of the goats increased (Knight and Peaker, 1982). In addition, as the goats got older, the increase in body weight and digestive system developed (Rathore, 1970), dry matter intake increased and as a consequence, milk yield was increased (Randy et al., 1988). Also it is worth noting that the does aged 5 years and older had larger udder size in terms of circumference, width, length and distance between teats (Merkhan and Alkass, 2011). Such results were in accordance with findings of Jawasreh (2003), Macciotta et al. (2008) and Hamed et al. (2009).

Although does reared twin kids yielded more TDMY (765.03 ml) than those reared singles (749.95 ml) (Table 1), however, the differences between them were not significant. It is generally agreed that does sucked by twin or triplet produce significantly higher milk than those sucked by singles (Sangare and Pandey, 2000; Jawasreh, 2003; Skapetas et al., 2008; Zahraddeen et al., 2009) due to the role of both the

Table 1: Least-square means ± standard errors of test day milk yield and total milk yield as affected by the examined factors

Factors	No.	Test day milk yield (ml)	Total milk production (l)
Overall mean	397	755.84 ± 25.31	132.38 ± 6.90
Farm1- Black goat	155	685.29 ± 32.43^{b}	127.46 ± 5.30^{b}
Farm1-Meriz	141	566.87 ± 26.99^{c}	95.91 ± 6.37^{c}
Farm2- Black goat	101	1127.92 ± 64.09^{a}	189.86 ± 16.44^{a}
Age of does (years)			
2	54	634.81 ± 45.24^{b}	114.26 ±10.82^{b}
3	91	628.35 ± 37.46^{b}	114.36 ± 9.19^{b}
4	113	706.90 ± 42.40^{b}	126.12 ± 8.76^{ab}
5 & more	139	926.11 ± 53.10^{a}	154.47 ±15.49^{a}
Type of birth			
Single	242	749.95 ± 34.62^{a}	132.79 ± 9.95^{a}
Twin	155	765.03 ± 35.93^{a}	131.755 ± 8.83^{a}
Month of lactation			
1st	68	1258.53 ± 71.54^{a}	
2nd	68	950.0 ± 62.28^{b}	
3rd	68	854.11 ± 36.96^{b}	
4th	68	663.52 ± 40.63^{c}	
5th	64	458.12 ± 32.57^{d}	
6th	43	332.79 ± 25.28^{d}	
7th	18	170.0 ± 15.29^{e}	

Means with different letters within each column are significantly different (P<0.05)

suckling reflex and the physiological mechanism during pregnancy that prepare the udder to produce more milk for does carrying multiple fetuses (Goonewardene et al., 1999). Moreover, Al-Shaikh et al. (1999) and Mourad, (1992) found that the effect of litter size on milk yield was confined to the pre-weaning milk yield and did not extend to the post-weaning milk yield. Several authors also observed that type of birth had no significant effect on milk yield (Akpa et al., 2002; Jawasreh, 2003; Zahraddeen et al., 2009; El-Abid and Abu Nikhaila, 2010).

It appears from Table (1) that there was a significant (P<0.01) decrease in TDMY as lactation progressed; yet the highest TDMY was attained during the first test (1258.53 ml/d) and decreased gradually toward the lowest value at the 7th month of lactation (170.0 ml/d). It has been accepted that in ruminant, after completing development of tissue prior to parturition, the acquisition of a milk synthesis potential expressed at peak lactation is largely due to the increase in cellular activity (Boutinaud et al., 2004) . Indeed, it has been shown in goats and cows that the number of mammary cells, estimated by the total quantity of DNA in the udder, rises markedly between the final days of gestation and the first days of lactation (Schmidt, 1970). The increase in DNA levels continues during the first weeks of lactation (Knight and Peaker, 1984). Similarly, Prasad and Sengar (2002), Prasad et al. (2005), Mioc et al. (2008) and Norris et al. (2011) demonstrated that the highest yield (P<0.01) was obtained during early lactation, followed by mid lactation with the lowest values recorded during late lactation.

The overall means of peak milk yield (PMY), time to peak milk yield (TPMY) and lactation period were shown in Table (2). The difference between Black goats and Meriz for peak milk yield (Table 2) was highly significant (P<0.01). The PMY for Black goat was higher than that recorded by Hermiz et al. (1998) for native goats (1.012 kg) raised in central Iraq. On the other hand, this value is lower than the values of 1811.9 g/day and 1.90 kg/day found by Maarof et al. (2009) and Salih and Maarof (2004), respectively for Black goat raised in Kurdistan region. Such difference could be attributed to differences in genetic make-up as well as other environmental factors and feeding in particular.

In farm 1, both Black goats and Meriz attained their PMY almost at 33 days (Table 2). However, Hermiz et al. (1998) and Salih and Maarof (2004) reported that native Black goats attained their PMY at 8 and 9 weeks, respectively.It was reported that PMY was attained at two weeks for Red Sokoto (Ehoche and Buvanendran, 1983), at 3 weeks for Red Sokoto, Sahel and West African Dwarf does (Zahraddeen et al., 2009), and at 4 weeks for Alpine goats (Zeng et al., 1997) and Sudanese Nubian goats (Mohammed et al., 2007).

Lactation period was significantly (P<0.05) longer for Black goats compared to Meriz (Table 2). The values obtained in the current study were longer than those recorded by Akpa et al. (2002), Salih and Maarof (2004), Agnihotri and Rajkumar (2007) and

Table 2: Least-square means ± standard errors of Peak yield (PMY), time to peak yield (TPMY) and lactation period (LP) as affected by the examined factors.

Factors	No.	PMY (ml)	TPMY (days)	LP (days)
Overall mean	68	1309.56 ± 68.44	36.52 ± 2.40	172.73 ± 3.83
Farm1-Black goat	25	1295.60 ± 61.45^{b}	33.36 ± 3.35^{a}	183.72 ± 5.92^{a}
Farm1-Meriz	25	964.80 ± 65.12^{c}	33.72 ± 3.43^{a}	161.52 ± 7.25^{b}
Farm2-Black goat	18	1807.78 ± 172.30^{a}	44.83 ± 5.94^{a}	173.05 ± 5.22^{ab}
Age of does (year)				
2	9	1072.22 ± 89.09^{b}	43.11 ± 10.19^{a}	178.22 ± 11.92^{a}
3	15	1114.67 ± 86.81^{b}	28.13 ± 2.21^{a}	175.26 ± 9.69^{a}
4	19	1311.05 ± 95.43^{ab}	35.10 ± 3.53^{a}	175.42 ± 6.96^{a}
5 & more	25	1510.80 ± 152.65^{a}	40.28 ± 4.42^{a}	167.20 ± 5.66^{a}
Type of birth				
Single	41	1295.61 ± 102.42^{a}	37.39 ± 3.14^{a}	174.95 ± 5.07^{a}
Twin	27	1330.74 ± 76.58^{a}	35.22 ± 3.79^{a}	169.37 ± 5.89^{a}

Means with different letters within each column differed significantly (P<0.05)

Zahraddeen et al. (2009). Such longer period of lactation is indicative that does used herein were more persistant for milk production compared to the previous studies.

Does raised in farm 1 had significantly (P<0.01) lower PMY (1295.60 vs. 1807.78 ml) and attained PMY numerically earlier (33.36 vs. 44.83 days) than those raised in farm 2 (Table 2). Such difference between farms may be attributed to variation in feeding and management practices as well as, to some extent to differences in the genetic make-up (Akpa et al., 2002).

It is clear from the results presented in Table (2) that the effect of age of does was highly significant (P<0.01) on PMY only. Similarly, Hermiz *et al.* (1998) found that the age of the does had a significant effect on PMY in native goats. Mohammed et al. (2007) also noticed the same results in terms of PMY and TPMY. However, Goonewardene et al. (1999) and Guney et al. (2006) observed a non significant effect of the age of does on lactation period.

The peak milk yield, TPMY and LP were not influenced by type of birth (Table 2) such results were in accordance with the findings of Hermiz et al. (1998) and Mohammed et al. (2007). However, Salih and Maarof (2004) noticed that type of birth and rearing had no significant effect on TPMY and LP, while significantly affected PMY.

Conclusion

From the present results it can be concluded that large variation in milk production exist between breeds within flocks and within breed between flocks and the possibility of improving this trait genetically is feasible.

References

Agnihotri, M.K. and Rajkumar, V. 2007. Effect of breed, parity and stage of lactation on milk composition of western region goats of India. *International Journal of Dairy Science*, 2(2):172-177.

Akpa, G.N., Asiribo, O.E., Oni, O.O., Alawa, J.P., Dim, N.I. and Osinowo, O.A. 2002. Milk production by agropastoral Red Sokoto goats in Nigeria. *Tropical Animal Health and Production*, 34:525-533.

Alkass, J.E. and Juma, K.H. 2005. Small Ruminant Breeds of Iraq. In: Characterization of Small Ruminant Breeds in West Asia and North Africa (Ed. Luis Iniqueze). Vol. I. West Asia. International Center for Agriculture Research in the Dry Areas (ICARDA); Alepo, Syria. Pp: 63-101.

Al-Shaikh, M.A., Al-Mufarrej, S.I. and Mogawer, H.H. 1999. Effect of fenugreek seeds (Trigonella foenumgraecum L.) on lactational performance of dairy goat. *Journal of Applied Animal Research*, 16(2): 177 -183.

Barillet, F. Biochard, D., Barbat, A., Astrue, J.M. and Bonaitli, B. 1992. Use of an animal model for genetic evaluation of the Lacaune dairy sheep. *Livestock Production Science*, 31:287-299.

Boutinaud, M., Guinard-Flament, J. and Jammes, H. 2004. The number and activity of mammary epithelial cells, determining factors for milk production. *Reproduction Nutrition Development*, 44: 499–508.

Boyazoglu, J. and Morand-Fehr, P. 2001. Mediterranean dairy sheep and goat products and their quality. A critical review. *Small Ruminant Research*, 40:1–11.

Cabiddu, A., Branca, A., Decandia, M., Pes, A., Santucci, P.M., Masoero, F. and Calamari, L. 1999. Relationship between body condition score, metabolic profile, milk yield and milk composition in goats browsing a mediterranean shrubland. *Livestock Production Science*, 61: 267–273.

Ciappesoni, G., Pribyl, J., MiLerski, M. and Vares, V. 2004. Factors affecting goat milk yield and its

composition. *Czech Journal of Animal Science*, 49:465-473.

Duncan, D.B. 1955. Multiple range and Multiple test. *Biometric*, 11:16.

Ehoche, O.W. and Buvanendran, V. 1983. The yield and composition of milk and preweaning growth rate of Red Sokoto goats in Nigeria. *World Review of Animal Production*, 19: 19-24.

El-Abid, K.E. and Abu Nikhaila, A.M.A. 2010. A study on some Non-genetic factors and their impact on milk yield and lactation length of Sudanese Nubian goats. *Australian Journal of Basic and Applied Science*, 4(5):735-739.

Goonewardene L.A., Okinea E., Patrick N. and Scheer H.D. 1999. The relationship between multiple birth and milk yields in non-suckled intensively managed dairy goats. *Small Ruminant Research*, 32: 181-185.

Guler, Z., Keskin, M., Masatcioglu, T., Gul, S. and Bicer, O. 2007. Effects of breed and lactation period on some characteristics and free fatty acid composition of raw milk from Damascus goats and German Fawn X Hair goat B_1 crossbreds. *Turkish Journal of Veterinary and Animal Science*, 31(5): 347-354.

Guney, O., Torun, O., Ozuyanik, O. and Darcan, N. 2006. Milk production, reproductive and growth performances of Damascus goats under northern Cyprus conditions. *Small Ruminant Research*, 65: 176-179.

Haenlein, G.F.W. 2001. Past, present and future perspectives of small ruminant dairy research. *Journal of Dairy Science*, 84:2097–2115.

Hamed, A., Mabrouk, M.M., Shaat, I. and Bata, S. 2009. Estimation of genetic parameters and some non-genetic factors for litter size at birth and weaning and milk yield traits in Zaraibi goats. *Egyptian Journal of Sheep and Goat Science*, 4(2):55-64.

Hermiz, H.N., Asofi, M.K. and AlRawi, A.A. 1998. Some genetic and non-genetic causes of variation in milk traits of Iraqi local goat. 6th world congress on genetics applied to livestock production. 12-16, Jan. Armidale, NSW Australia. 24: 212-215.

Hermiz, H.N., Singh, M., Al-Rawi, A.A. and Alkass, J.E. 2004. Genetic and non genetic parameters for milk traits in Iraqi local goat and their crosses. *Dirasat Agricultural science*, 31(2): 223-228.

ICAR. 2007. International Committee for Animal Recording. Recording guidelines. ICAR Guidelines, approved by the General Assembly held in Kuopio, Finland on 9 June 2006. ICAR online. Available in: http://www.waap.it/sheep_enquiry/documents/sheep_enquiry_example. Accessed 15/06/2008.

Jawasreh, K.I. 2003. Genetic evaluation of Damascus Goats in Jordan. MSc. Dissertation University of Bagdad.

Knight, C.H. and Peaker, M. 1984. Mammary development and regression during lactation in goats in relation to milk secretion. *Qatar Journal of Experimental Physiology*, 69:331-338.

Knight, C.H. and Peaker, M. 1982. Development of the mammary gland. *Journal of Reproduction and Fertility*, 65: 621-626.

Konyali, A., Ayag, B.S. and Yurdadabak, S. 2010. Effect of estrus synchronization on dairy goat milk composition. *African Journal of Agriculture Research*, 5(8):681-684.

Maarof, N.N., Hermiz, H., Salih, N.G. and Alkass, J.E. 2009. Prediction of total milk yield from partial monthly yield in native Black goats. *Journal Zankoy Sulaimani*, 12(1): 1-5.

Macciotta, N.P.P., Dimauro, C., Steri, R. and Cappio-Borlino, A. 2008. Dairy goats feeding and nutrition (Book). Cannas, A. and Pulina, G. (Eds.) CAB International.

Macciotta, N.PP., Fresi, P., Usai, G. and Cappio-Borlino, A. 2005. Lactation Curves of Sarda breed goats estimated with test day models. *Journal of Dairy Research*, 72:470-475.

Merkhan, K. Y. and Alkass, E.J. 2011. Relationship among udder and teat size characteristics with milk yield in local Black and Meriz goats. *Research Opinions in Animal & Veterinary Sciences*, 1(9): 601-605.

Mioc, B., Prpic, Z., Vnuce, I., Baeac, Z., Susic, V., Samarzija, D. and Pavic, V. 2008. Factors affecting goat milk yield and composition. *Mljekarstvo*, 58:305-313.

Mohammed S.A., Sulieman, A.h., Mohammed, M.E. and Siddg, F.S. E. 2007. A study on the milk yield and compositional characteristics in the Sudanese Nubian Goat under farm condition. *Journal of Animal and Veterinary Advances*, 6:328-334.

Mourad, M. 1992. Productive and reproductive performance of Alpine goats. *Small Ruminant Research*, 8(1-2): 41-46.

Norris, D., Ngambi, J.W., Benyi, K. and Mbajiorgu, C.A. 2011. Milk production of three exotic dairy goat genotypes in Limpopo province, South Africa. *Asian Journal of Animal and Veterinary Advances*, 6(3):274-281.

Prasad, H. and Sengar, O.P.S. 2002. Milk yield and composition of the Barbari goat breed and its crosses with Jamunapari, Beetal and Black Bengal. *Small Ruminant Research*, 45, 79–83.

Prasad, H., Tewari, H.A. and Sengar, O.P.S. 2005. Milk yield and composition of the beetal breed and their crosses with Jamunapari, Barbari and Black Bengal

breeds of goat. *Small Ruminant Research*, 58: 195-199.

Randy, H.A., Sniffen, C.J. and Heintz, J.F. 1988. Effect of age and stage of lactation on dry matter intake and milk production in Alpine does. *Small Ruminant Research*, 1:145.

Rathore, A.K. 1970. Goats milk production and the effect of age on milk quality. *Australian Goat World*, 22:1.

Salih, N.G. and Maarof, N.N. 2004. Studies of some milk production and body weight traits of Black mountainous goat in Sulaimani governorate, Iraqi Kurdistan Region. *Kurdistan Academic Journal*, 3(1)A: 51-57.

Sangare, M. and Pandey, V.S. 2000. Food intake, milk production and growth of kids of local, multipurpose goats grazing on dry season natural Sahelian rangeland in Mali. *Animal Science,* 71, 165–173.

Sanna, S.R., Carta, A., Causu, S., Pilla, A.M. and Pagnacco, G. 1994. Valutazione genetic razza ovina Sarda. 3. Indici e andamenti genetici. ed ambientali. *Zootecnica e Nattrizionae Animale*, 20:313-318.

SAS/STAT. 2002. User Guide for Personal Computers. Release 6.12 SAS. Institute Inc., Cary, NC. U.S.A.

Schmidt, G.H. 1970. Biology of Lactation. San Francisco; W. H. Freeman.

Skapetas, B., Katanos, J., Laga, V., Sinapis, E. and Ziminaoglou, I. 2008. Vacuum level for opening the teat sphincter and the change in the teat end wall thickness in response to the machine milking of indigenous Greece goats. *Czech Journal of Animal Science*, 53(3):112-118.

Vanraden P.M. 1997. Lactation yields and accuracies computed from test day yields and (Co) variances by best prediction. *Journal of Dairy Science*, 80:3015-3022.

Zahraddeen D., Butswat I.S.R. and Mbap S.T. 2009. A note on factors influencing milk yield of local goats under semi-intensive system in Sudan Savannah ecological Zone of Nigeria. *Livestock research for Rural Development*, 21(3).

Zeng S.S., Escobar E.N. and Popham T. 1997. Daily variations in somatic cell count, composition, and production of Alpine goat milk. *Small Ruminant Research*, 26: 253–260.