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Effects of parity and litter size on the energy contents and immunoglobulin G concentrations of Awassi ewe colostrum

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Abstract: This study determined the energy content and immunoglobulin G (IgG) concentration of Awassi ewe colostrum and examined the effects of parity and litter size on them. Colostral samples were collected from 57 ewes from the 1st to 7th parities with a litter size of 1 or 2, within 12 h after lambing. Concentrations of colostral fat, lactose, and protein were measured as energy sources, and IgG was measured as representative of the immunoglobulin content of the colostrum. Mean values obtained from analyses of the ewe colostrum samples were 7.4 ± 2.1 kJ/g for the energy value and 60.9 ± 21.4 mg/mL for IgG. Ewe parity did not influence colostral energy content, whereas the IgG concentration of the colostrum obtained from the primiparous ewes was higher than that from the multiparous ewes ($P < 0.05$). Among the multiparous ewes, the colostrum obtained from ewes carrying twins showed higher energy content and IgG concentrations than that from those carrying a single lamb ($P < 0.05$).

Key words: Awassi sheep, colostrum, energy, immunoglobulin G

Awassi is a very popular fat-tailed sheep breed reared in Middle Eastern countries (1). Its lamb mortality rate reaches 5%–10% shortly after birth, even in favorable years (2). Adequate colostrum intake decreases the risk of starvation and health hazards in lambs by providing energy and immunoglobulins, hence decreasing the risk of mortality (3).

New technology based on the early weaning and artificial rearing of Awassi sheep lambs using a milk replacer has led to an increase in flock productivity by increasing milk production and body weight in lambs (4). In artificial rearing management practices, the lambs are separated from the dams as soon as possible after parturition to facilitate the acceptance of artificial teats by the lamb (4). Therefore, lambs should be artificially fed with colostrum, either fresh or preserved (5).

When preserving colostrum, it is important to know about colostrum quality and the factors affecting it. However, limited data are available in the literature about the energy content and immunoglobulin concentrations of Awassi ewe colostrum and the factors affecting them. Previous studies have examined the effect of parity and litter size on the colostral energy values and immunoglobulin G (IgG) concentrations in other ewe breeds; however, these studies reported controversial results (6,7). Thus, this preliminary study analyzed the composition (i.e. energy contents and IgG concentration) of Awassi ewe colostrum and the effects of parity and litter size on it.

Fifty-seven ewes, ranging from the 1st to 7th parities, were used. All of the primiparous ewes carried a single lamb. Due to this bias in sampling, the ewes were divided into 3 groups based on their parity and the number of lambs they carried: Group 1 included primiparous ewes with a single lamb (n = 21), Group 2 included parous ewes with a single lamb (n = 23), and Group 3 included parous ewes with twin lambs (n = 13).

The experiment was conducted at the Tel Hadya Research Station of the International Center for Agricultural Research in the Dry Areas (ICARDA), 30 km southwest of Aleppo in northwestern Syria. Four weeks prior to lambing, each ewe received 224 g/day of crude protein and 18.1 MJ of metabolizable energy/day. The

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ewes were vaccinated against foot and mouth disease and anthrax and sheep pox, and were sprayed and drenched against external and internal parasites. The ewes were vaccinated against enterotoxemia and pasteurellosis 2 weeks before lambing. The experiment was performed on the ICARDA farm in January during the lambing season (December–February).

Colostrum samples (approximately 50 mL from each half of the udder) were collected by hand-milking into plastic bottles within 12 h after parturition; we did not determine the suckling behavior of the lambs. An aliquot of the colostrum samples (approximately 5 mL) was transferred from the bottle into a plastic test tube and stored at -20 °C for measurements of IgG content at a later time. The remaining sample was added to 100 µg/mL of sodium azide (Merck, Darmstadt, Germany) and stored at 4 °C to measure the colostral fat, lactose, and protein concentrations.

The concentrations of colostral fat, lactose, and protein were measured as energy sources and analyzed in samples within 3 days of collection. The colostrum samples were diluted by one-half or one-third with distilled water, depending on their viscosity. The samples were warmed to room temperature and then analyzed for the concentrations of fat, lactose, and protein using an infrared milk analyzer (Milkoscan 133B; Foss Electric, Hillerød, Denmark). The energy content of the colostrum was calculated using the equation of Šebek and Everts (8): milk energy content (kJ/g) = $0.0419 \times F + 0.0214 \times L + 0.0159 \times P$, where F, L, and P are the concentrations of fat, lactose, and protein (in grams) per kilogram of milk, respectively.

Concentrations of colostral IgG were measured as representative of the immunoglobulin content of the colostrum and analyzed within 1 week of collection. The colostrum IgG concentrations were determined using the single-radial-immunodiffusion technique, using radial immunodiffusion plates and agents specific for ovine IgG purchased from the Ecos Institute (Miyagi, Japan). Five microliters of colostrum (1:100 diluted in distilled water) was added into each well of a radial immunodiffusion plate. IgG standards were included on each plate. Ring diameters were determined to the nearest 0.1 mm using the scale attached to the kit after a 72-h incubation at room temperature.

The effects of parity and litter size on the colostrum components were analyzed using an one-way analysis of variance. SPSS 12.0 for Windows (SPSS Inc., Chicago, IL, USA) was used for statistical analyses.

The colostrum compositions are shown in the Table. The energy content of the colostrum determined in the present study (7.4 kJ/g) was higher than the value in a previous study on the normal milk of Awassi sheep (3.4 kJ/g) (9). The composition of the energy sources in colostrum analyzed in the present study was also different from the findings in previous studies on the normal milk of Awassi sheep; the fat (10.1%) and protein (15.6%) concentrations in the colostrum in the present study were higher than those of the normal milk (6%–8% and 5%–6%, respectively) (9,10), whereas the lactose concentration (3.3%) in the colostrum analyzed in the present study was lower than that of the normal milk (4%–6%) (9,10). Similar trends were also observed in other ewe breeds (11,12).

The energy content (7.4 kJ/g) and IgG concentration (60.9 mg/mL) of the colostrum determined in the present study were similar to those reported in previous studies on other ewe breeds: 7–8 kJ/g of energy content (11,13,14)

Table. Composition of colostrum obtained from primiparous Awassi ewes carrying single lambs and multiparous Awassi ewes carrying single and twin lambs.

Category	Groups[a] (no. of ewes)			Total (57)
	1 (21)	2 (23)	3 (13)	
Fat (%)	10.0 ± 5.1	9.0 ± 4.1	12.3 ± 2.9†	10.1 ± 4.4
Lactose (%)	3.2 ± 0.8	3.5 ± 0.5	3.2 ± 0.7	3.3 ± 0.6
Protein (%)	17.4 ± 3.0*	13.2 ± 3.4	17.3 ± 3.7†	15.6 ± 3.9
Energy (kJ/g)	7.6 ± 2.3	6.6 ± 1.8	8.6 ± 1.5†	7.4 ± 2.1
IgG (mg/mL)	66.2 ± 23.2*	51.0 ± 20.9	70.0 ± 22.6†	60.9 ± 21.4

[a] Groups 1, 2, and 3 represent primiparous ewes carrying a single lamb, multiparous ewes carrying a single lamb, and multiparous ewes carrying twins, respectively.
* Marked values (mean ± SD) in Group 1 differ significantly from those of the same category in Group 2 (P < 0.05).
† Marked values (mean ± SD) in Group 3 differ significantly from those of the same category in Group 2 (P < 0.05).

and 45–80 mg/mL IgG concentration (6,7,15). The mean concentrations of fat (10.1%), lactose (3.3%), and protein (15.6%) determined in the present study were also similar to those reported in previous studies of other breeds: 8%–11%, 2%–4%, and 10%–18% of fat, lactose, and protein concentrations, respectively (11,12).

The effects of ewe parity on the colostral composition were analyzed using data obtained from the ewes in Groups 1 and 2. The colostral protein and IgG concentrations of the ewes in Group 1 were higher than those of the ewes in Group 2 ($P < 0.05$). The volume of colostrum was not estimated, although multiparous ewes produce larger volumes of colostrum than primiparous ewes (11). Thus, the higher concentrations of protein and IgG in the colostrum of the primiparous ewes were possibly caused by a similar mass of protein and IgG concentrated in a smaller volume of colostrum, as described in a previous study on other ewe breeds (6).

The effects of ewe litter size on colostral composition were analyzed using data from Groups 2 and 3. Colostral fat, protein, and IgG concentrations and the energy content in the colostrum from the ewes in Group 3 were higher than those of the ewes in Group 2 ($P < 0.05$). Due to the higher concentrations of colostral fat and protein in the ewes carrying twins, the energy content of the colostrum obtained from the ewes carrying twins was higher than that of the ewes carrying a single lamb. Some studies also detected such a trend in colostral energy content (16) and fat concentrations (7,16). The reasons for a higher colostral protein concentration in the ewes carrying twins than in those carrying a single lamb are unknown, but the higher colostral fat concentrations in the ewes carrying twin lambs may be due to increased body fat mobilization under a strong negative energy balance. Ewes carrying twin fetuses require approximately 1.4 times more energy for fetal development than ewes carrying a single fetus (17).

The higher IgG concentration in the colostrum of the multiparous ewes carrying twins indicates increased transportation of the immunoglobulin from the ewe's serum to the colostrum. This could be evidence of a signal from the fetus(es) to the dam to increase the quantity of available immunoglobulin for multiple-birth lambs. Because IgG is actively transported from the ewe's serum to the colostrum during late gestation, the number of fetuses present may directly affect the rate of transport. Gilbert et al. (6) also observed evidence of this relationship in other ewe breeds.

In conclusion, the colostrum of Awassi ewes contained 7.4 ± 2.1 kJ/g of energy and 60.9 ± 21.4 mg/mL of IgG. These values were similar to the findings in previous studies on other ewe breeds: 7–8 kJ/g of energy content (11,13,14) and 45–80 mg/mL IgG concentration (6,7,15). Ewe parity did not influence the colostral energy content, whereas the IgG concentration of the colostrum obtained from primiparous ewes was higher than that of multiparous ewes ($P < 0.05$). Among the multiparous ewes, the colostrum obtained from ewes carrying twins showed higher energy content and IgG concentrations than that from ewes carrying a single lamb ($P < 0.05$). Further studies are needed to examine the colostrum yield and to clarify the volumes of colostrum that a lamb needs to prevent starvation and infectious diseases in Awassi sheep.

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