GIDA (2007) 32 (5) : 235-240 *Research Article (Araştırma Makalesi)*

CHANGES IN INORGANIC SUBSTANCES AND COLOUR VALUES OF AWASSİ SHEEP COLOSTRUM DURING TEN DAYS AFTER PARTURITION

DOĞUM SONRASI ON GÜN SÜRECİNDE AVASİ KOYUN KOLOSTRUMUNDA INORGANİK MADDELER VE RENK DEĞERLERİNDEKİ DEĞİŞİMLER

Zehra GÜLER*, Hasan ŞANAL
Department of Food Engineering, Faculty of Agriculture, University of Mustafa Kemal, Antakya

Geliş Tarihi: 02.03.2007

ÖZET: In the present study, the determination of the concentration of twenty elements in sheep colostrum has been successfully carried out by ICP-OES. Element contents and colour values of sheep colostrum varied significantly during 10 days after parturition ($P \leq 0.05$, $P \leq 0.01$, $P \leq 0.001$). Of macro elements Ca had the highest mean concentration at the end of experimental period, which followed by P, K, Na, S and Mg elements. Of minor elements, B was highest, followed by Si, Zn, Se, Fe, Cu, Al, Sr, Ni, Ba, Mo, Co, Mn, Cd. When lightness index (*L*-value) of samples increased throughout postpartum period, greenness (*-a* value) and yellowness (*b* value) decreased. As a result, the amount of inorganic substances and colour values were nearly constant at days 9 to 10 postpartum. Therefore, sheep colostrum may be converted to mature milk at day 9 after parturition.

Key Words: Awassi sheep, colostrum, inorganic substances, colour values

ABSTRACT: Bu çalışmada, Avasi koyum kolostrumundaki 20 elementin konsantrasyonunun belirlenmesi, ICP-OES kullanılarak başarıyla gerçekleştirilmiştir. Koyun kolostrumunun element içerikleri ve renk değerleri doğum sonrası 10 gün süresince önemli bir şekilde değişmiştir ($P \leq 0.05$, $P \leq 0.01$, $P \leq 0.001$). Deneme süresi sonunda makro elementlerden Ca en yüksek ortalama konsantrasyona sahip olmuştur. Bu elementi P, K, Na, S ve Mg izlemiştir. Minör elementlerden B, Si, Zn, Se, Fe, Cu ve Al kolostrumda en fazla belirlenmiştir. Doğum sonrası periyotda kolostrumun beyazlık indeksi (L-değeri) artarken, yeşillik (-a değeri) ve sarılık (b-değeri) azalmıştır. Sonuçta koyun kolostrumunun element içeriği ve renk değerleri doğum sonrası 9. ve 10. günlerde hemen hemen sabit olmuştur. Bundan dolayı kolostrum doğum sonrası 9. günde normal süte dönüşmüş olabilir.

Anahtar Kelimeler: Avasi koyun, kolostrum, inorganik maddeler, renk değerleri

INTRODUCTION

The first drawn secretion after parturition differs greatly from normal milk and is called as 'colostrum' or 'beestings'. Colostrum contains not only nutrients but also biologically active substances that are essential for proper lamb nutrition and health. Colostrum provides nutrients, energy substrates, growth factors and antibodies to give immunological protection against infections for the newborn (1).

In the first hours postpartum the colostrum contains at high levels protein substances and, especially, immunoglobulins, lactoferrin, fat and minerals, especially Cu and Fe (2,3). Colostrum is the main source of minerals for newborn lambs. The composition of colostrum like milk can be affected by nutrition and non-nutritional factors, breeds and species such as cow, sheep and goat (2, 4-5). The concentrations of elements

* E-posta: zguler@mku.edu.tr

such as Ca, Mg, Na, P, Zn, Cu, Fe and Mn in crossbred sheep colostrum were the highest at the parturition and decreased with time postpartum (6). Concerning on the period of changing of colostrum into normal milk, there is inconsistent data in literature. Researchers reported that it was about the first three days (2, 6), the first 24 h postpartum (7) and five days or seven days after parturition (8, 9). Therefore, there is a need for information on the colostrum period of sheep. Previous studies on sheep colostrum report only the measurement of gross chemical constituents and some minerals (3, 6-7). No data is available literature on changes in colour values of colostrum. Therefore, the objectives of this work were to obtain information on the major and minor elements, and the changes in colour values of Awassi sheep colostrum during ten days after parturition, and also to determine period of changing of colostrum to normal milk.

METARIAL AND METHODS

Material

This study was carried out with 10 heads of Awassi sheep at Research and Training Farm of Mustafa Kemal University (Hatay). The births occurred on the last week of the February. After parturition, experimental sheeps randomly chose from 3 years old animals. The animals were fed 500 g per day concentrate (16% crude protein and 2500 kcal metabolisable energy in kg dry matter) as addition to pasture during the study. The concentrate consisted substantially of 25% cottonseed cake, 28% bran, 35% barley, %10 hay, %1 NaCl and 1% feed additive.

The first colostral samples (500 ml) were taken after confinement before suckling. The sample collection was repeated at intervals of 24-h during 10 days postpartum. Refrigerated samples (500 ml) were tempered at 20ºC for determination of inorganic substances and colour values.

Methods

The analysis of inorganic substances was carried out as reported by Güler (10). A Mars 5 model microwave labstation with computer–controlled easywave software (CEM, Matthews, NC, USA) to digest of samples and a Varian Vista-MPX Simultaneous inductively coupled plasma optical emission spectrometer (ICP-OES) (Australia) to quantification used. The colour of samples was measured by the Minolta Chroma Meter CR-400 (Minolta Co., Ltd, Japan). This is known as the CIELAB system with parameters *L, a, b*. The *L*-value is a measure of lightness and it ranges between 0 and 100. Positive and negative increases of *a*-value correspond to increases in red or green colour proportions, respectively. The *b*-value represents colour ranging from yellow (+) to blue (-).

The results were statistically evaluated using analysis of variance (one-way ANOVA) and Duncan multiple comparison test in SPSS program (11).

RESULT AND DISCUSSION

Levels of 20 elements in sheep colostrum during 10 days postpartum are presented in Tables 1 and 2. The concentrations of elements except for K and Mn varied significantly ($P \leq 0.05$, $P \leq 0.01$, $P \leq 0.001$) with days postpartum. Calcium, Phosphorus, Sulfur, Magnesium, Bor, Iron, Zinc and Copper were the highest at day 1 postpartum. Potassium and Selenium were the highest at day 2 postpartum.

Statistical analysis showed that the days postpartum had a significant effect on colour values of colostrum ($P \leq 0.05$) (Table 3). The mean *L*-value of colostrum samples, that is, lightness was the lowest at the first day after parturition thereafter it increased to a value of 50.13 and unchanged significantly until day 6. At day 6 it again increased to 52.50 and unchanged until the end of experimental period. As shown in Table 3., the highest *a* value which is an indicator of green colour was on day 1. Greenness values of samples did not change between days 6 and 10 postpartum. In general, changes of *L*-values showed a similar trend to those of *–a*

Table 1. Changes in contents of major elements in sheep colostrum during ten days after parturition (mg/100g). Values given are means ± SD.

Days	Ca	P	K	S	Mg	Na
1	231.0±6.3^{ab}	141.1±2.3^{d}	121.1±27.5	115.1±13.3^{f}	74.7±2.3^{d}	46.5±4.4^{a}
2	223.9±10.4^{b}	132.6±2.2^{d}	132.3±25.3	98.8±4.6^{df}	66.9±2.6^{cd}	52.6±2.4^{ab}
3	218.1±13.0^{ab}	125.9±0.9^{c}	113.3±25.4	90.5±5.6^{cd}	66.0±2.5^{c}	62.4±4.8^{bc}
4	189.5±9.9^{ab}	107.5±0.7^{b}	101.2±25.4	86.2±3.6^{bcd}	54.6±1.1^{b}	96.3±7.3^{d}
5	182.3±8.8^{a}	109.0±0.6^{b}	102.7±25.2	64.3±4.7^{a}	49.7±2.5^{a}	100.3±4.8^{d}
6	176.7±12.5^{a}	92.3±0.3^{a}	81.2±26.8	63.2±1.6^{a}	42.4±2.7^{a}	156.5±5.7^{g}
7	202.2±25.9^{ab}	106.1±1.4^{b}	107.2±23.9	70.5±2.8^{abc}	53.1±2.5^{b}	128.1±15.4^{e}
8	179.7±19.7^{a}	96.8±1.7^{a}	111.6±26.6	71.6±1.0^{abc}	67.4±2.5^{cd}	139.6±14.1^{ef}
9	199.5±3.9^{ab}	127.8±0.3^{c}	110.5±24.7	83.9±6.5^{bcd}	53.3±2.4^{b}	75.8±7.2^{cd}
10	220.4±9.2^{ab}	131.7±3.1^{d}	110.9±25.0	79.8±3.7^{bcd}	57.0±2.6^{b}	65.7±5.4^{bc}
P	*	***	NS	**	***	***

a,b,c Means with different superscript within the same column are significantly different from each other (*P≤ 0.05, *P≤ 0.01, *P≤ 0.001). NS: Non significant. P: Significant level.

values. With respect to lightness and greenness, the most marked change in samples occured at day 6 postpartum. Yellowness (b-value) index of colostrum was highest at day 1 postpartum and then it decreased up to day 8 thereafter, it was constant by a value of 3.70.

Changes in inorganic substance contents of sheep colostrum were similar to those observed by Kracmar et al. (6) for 3 days after parturition. During experimental period Ca levels showed a similar tendency as the P levels; the concentrations decreased slowly until day 6, thereafter a period of slight increases and decreases was seen (Table 1). Kume and Tanabe (12) found that the change in the level of P for cow colostrum was similar to that of Ca element. Ca and P elements by a ratio of 1.5 ranged from 231.04 and 141 mg/100g to 176.65 and 92 mg/100g, from day 1 to day 6 postpartum, respectively. The decrease ratio (1.8) in S element in this period was similar to that in Mg. Potassium values showed an increasing and decreasing, i.e. sinusoidal tendency during the whole experimental period. The lowest K, Ca, P, S and Mg values were recorded at day 6 postpartum. Wheares an opposite tendency was recorded Na concentration. Na increased from day 1 up to day 6 postpartum (from 46.53 to 156.46 mg/100g) and then decreased (from 156.46 to 65.69 mg/100g) up to the end of the experimental period. Concentrations of these major elements showed fluctuations as increase and decrease between days 7 and 8, thereafter the concentrations did not change statistically. Of major elements Ca showed the highest mean concentration at the end of experimental period, which followed by P, K, Na, S and Mg. This trend, except for S, agreed with some researchers (13, 14). For S element, no data was found in the available literature.

From micro elements Zn decreased drastically from day 1 to day 4 postpartum. Zn showed a decrease ratio of 3.79, which followed by Fe (2.42) and Cu (1.54) elements. Interestingly, protein and fat contents in sheep colostrum during the same period decreased significantly (in other study, unpublished). This could be attributed to a direct correlation between Zn, Cu, Fe and protein and fat content in milk (15,16). The changes in concentrations of Fe, Mn, Se, Zn and Cu in colostrum during 3 days after parturition were similar to those

Table 2. Changes in contents of minor elements in sheep colostrum during ten days after parturition (mg/100g). Values given are means ± SD

	Essential minor elements						
Days	**Zn**	**Fe**	**Se**	**Cu**	**Mo**	**Co**	**Mn**
1	29.0±0.7^{e}	20.4±0.1^{j}	10.2±0.3^{d}	6.8±0.5^{c}	1.36±0.3c	1.3±0.1^{ef}	1.0±0.1
2	16.7±0.5^{d}	11.4±0.1^{h}	15.1±0.4^{g}	6.7±0.5^{c}	0.93±0.2b	1.1±0.1^{cd}	1.2±0.1
3	11.4±0.4^{c}	12.3±0.1^{i}	12.9±0.1^{f}	4.7±0.4^{ab}	1.24±0.3c	1.0±0.1^{cd}	1.1±0.1
4	8.0±0.4^{b}	9.1±0.1^{g}	8.8±0.1b^{c}	3.9±0.4^{a}	0.6±0.2a	0.9±0.1^{b}	1.0±0.0
5	7.0±0.5^{b}	8.6±0.1^{f}	10.9±0.0^{f}	4.6±0.4^{ab}	1.7±0.3f	1.0±0.1^{cd}	1.0±0.0
6	7.7±0.5^{b}	8.4±0.1^{e}	11.2±0.1^{e}	4.4±0.4^{ab}	1.26±0.3c	1.1±0.1^{cd}	1.1±0.1
7	7.11±0.5^{b}	7.3±0.1^{d}	8.6±0.1^{bc}	4.5±0.5^{ab}	0.95±0.3b	1.0±0.0^{c}	0.9±0.1
8	8.0±0.9^{b}	5.8±0.1^{c}	6.9±0.0^{a}	4.8±0.5^{ab}	0.82±0.2b	0.7±0.1^{a}	1.1±0.1
9	4.0±0.9^{a}	5.5±0.1^{b}	8.4±0.1^{b}	5.6±0.4^{bc}	1.00±0.3b	1.2±0.0^{cd}	1.0±0.0
10	4.4±0.5^{a}	4.1±0.1^{a}	9.1±0.1^{c}	5.6±0.4^{bc}	0.92±0.2b	1.3±0.1^{ef}	1.1±0.1
P	***	***	***	**	***	***	NS
	Non-essential minor elements						
	B	Si	Al	Sr	Ba	Ni	Cd
1	17.2±0.1^{g}	10.3±0.1^{b}	4.9±0.1^{b}	2.2±0.7^{a}	1.4±0.1^{cd}	1.2±0.2^{a}	1.1±0.1^{c}
2	15.3±0.0^{e}	10.3±0.1^{b}	4.7±0.1^{b}	2.9±0.1^{ab}	1.6±0.2^{ed}	1.9±0.2^{ab}	0.7±0.3^{a}
3	15.6±0.1^{f}	7.6±0.1^{a}	3.5±0.1^{a}	3.0±0.0^{bc}	1.4±0.4^{cd}	2.1±0.2^{bc}	1.3±0.4^{d}
4	14.3±0.2^{d}	6.0±0.0^{a}	3.1±0.1^{a}	2.8±0.0^{ab}	1.2±0.1^{a}	2.5±0.2^{c}	1.1±0.2^{c}
5	14.1±0.5^{c}	5.7±0.1^{a}	3.5±0.1^{a}	2.9±0.0^{b}	1.8±0.5^{f}	1.7±0.2^{ab}	1.2±0.3^{cd}
6	14.3±0.4^{d}	12.6±0.0^{c}	3.6±0.1^{a}	3.0±0.1^{bc}	1.6±0.5^{e}	1.1±0.1^{a}	0.9±0.4^{b}
7	13.9±0.1^{c}	11.3±0.0^{b}	3.1±0.1^{a}	3.7±0.1^{c}	1.4±0.2^{cd}	1.5±0.5^{a}	0.8±0.1^{a}
8	13.3±0.1^{b}	10.5±0.0^{b}	4.5±0.0^{b}	3.2±0.0^{bc}	1.6±0.1^{ed}	1.7±0.1^{b}	0.8±0.1^{a}
9	13.1±0.1^{b}	14.3±0.1^{d}	5.4±0.1^{c}	3.1±0.0^{bc}	1.2±0.2^{ab}	1.4±0.3^{a}	1.3±0.1^{d}
10	12.8±0.1^{a}	16.3±2.2^{e}	8.4±0.1^{d}	3.2±0.1^{bc}	1.4±0.1^{bc}	1.7±0.2^{ab}	1.2±0.1^{cd}
P	***	***	***	*	***	***	***

^{a,b,c} Means with different superscript within the same column are significantly different from each other (*P ≤ 0.05, *P ≤ 0.01, *P ≤ 0.001). NS: Non significant. P: Significant level.

Table 3. Changes in L,a and b in sheep colostrum during ten days after parturition (mg/100g). Values given are means ± SD.

Days	L	a	b
1	47.2±0.06[a]	-4.2±0.01[d]	7.0±0.02[g]
2	50.1±0.01[b]	-3.7±0.01[c]	6.0±0.01[f]
3	50.8±0.01[b]	-3.5±0.02[c]	5.6±0.01[f]
4	50.2±0.01[b]	-2.9±0.01[b]	4.8±0.01[e]
5	49.2±0.04[b]	-2.9±0.01[b]	4.6±0.01[d]
6	52.5±0.02[c]	-2.3±0.03[a]	4.7±0.01[d]
7	52.9±0.01[c]	-2.3±0.03[a]	4.2±0.05[c]
8	51.7±0.03[c]	-2.5±0.01[a]	3.6±0.00[b]
9	51.9±0.01[c]	-2.4±0.01[a]	3.7±0.01[a]
10	52.5±0.03[c]	-2.3±0.20[a]	3.7±0.01[b]
P	*	*	*

[a,b,c] Means with different superscript within the same column are significantly different from each other (*P≤ 0.5), P: Significant level.

observed by Kracmar et al. (6). The Mn level remained the same during the whole period. Other minor elements showed fluctuations during the whole period. During the experimental period, except for days 1 and 2, the most abundant minor element was B. For B and Si in sheep colostrum and milk, no data was reported in previous studies. In this study toxic elements such as Al and Cd were determined. This may be due to the environmental situation (i.e. local contamination).

There are no reports dealing with the *L, a* and *b* values of sheep colostrum during 10 days postpartum. In present study when yellowness and greenness of colostrum samples decreased, lightness increased. Colour values of sheep colostrum as mineral concentrations varied significantly at day 6 postpartum. There was a slight compositional fluctuation between days 7 and 8 postpartum.

As a result the element contents and colour values varied with progression of time postpartum. In terms of the levels of elements and colour values, especially, yellowness index, Awassi sheep colostrum converted to normal milk at day 9 postpartum since these values were nearly constant.

ACKNOWLEDGEMENT

The author would like to thank Mahmut Keskin, Assoc. Prof. and Sabri Gül , PhD, Department of Animal Science for statistical analysis, or supply of colostrums samples and maintenance of ewes.

REFERENCES

1. Pakkanen R, Aalto J. 1997. Growth factors and antimicrobial factors of bovine colostrums. Int. Dairy J, 7**:** 285-297.
2. Walstra P, Jennes S. 1984. Biosynnthesis and secration of milk. In *Dairy Chemistry and Physics,* P Walstra and R Jenness (eds), pp. 12-26, Jonh and Wiley& Sons, New York.
3. Hadjipanayiotou M. 1995. Composition of ewe, goat and cow milk and of colostrum of ewes and goats. Small Rum. Res, 18: 255-262.

4. Fevrier C, Coll A, Sanchez A. 1993. Complete sequence of the caprine beta-lactoglobulin gene. J. Dairy Sci, 77: 3493-3497.
5. Haenlein GFW. 2004. Goat milk in human nutrition. Small Rum. Res, 51: 155-163.
6. Kracmar S, Kuchtic J, Bara M, Varadyova Z, Kracmarova E, Gajdusek S, Jelinek P. 2005. Dynamics of changes in contents of organic and inorganic substances in sheep colostrum within the first 72 h after parturition. Small Rum. Res, 56: 183-188.
7. Pattison SE, Tjomas EW. 2004. The effect of sire breed on colostrum production of crossbred ewes. Livest. Prod. Sci, 86: 47-53.
8. Gorbon A.M, İzzeldin OM. 1997. Mineral content of camel milk and colostrum, J. Dairy Res, 64: 471-474.
9. Csapo JJ, Keszthelyil T, Csapo-Kiss Z, Lengyel A, Andrassy-Baka B, Varga-Visi E. 1998. Composition of colostrum and milk of different breeds of ewes. Acta Agraria Kaposvariensis, 2: 1-21.
10. Güler Z**.** 2007. Levels of 24 minerals in local goat milk, its strained yoghurt and salted yoghurt (tuzlu yoğurt). Small Rum. Res, 67: in pres (online available).
11. Kinneer PR, Gray CD. 1994. *SPSS for windows*. Department of Psychology. Univ. Of Aberdeen, 458 p, UK.
12. Kume S, TanabeS. 1993. Effect of pariety on colostral mineral concentrations of Hostein cows and value of colostrum as a mineral source for newborn calves. J. Dairy Sci, 76: 1654-1660.
13. Posati LP, Orr ML. 1976. *Composition of Foods*. Dairy and Egg Products, USDA-ARS, Consumer & Food Economics Inst., Agr. Press, Washington.
14. Sahan N, Say D, Kacar A. 2005. Changes and chemical and mineral contents of Awassi ewes' milk during lactation. Turk J. Vet. Anim. Sci, 29: 589-593.
15. Shen LH, Robberecht H, Van Dael P, Amaro M. 1995. Estimation of the bioavailability of zinc and calcium from human, cows, goat and sheep milk by an in vitro method. Biol. Trace Elem. Res, 49: 107-117.
16. Garcia MIH, Puerto PP, Baquero MF, Rodriguez ER, Martin JD, Romero CD. 2006. Mineral and trace element concentrations of dairy products from goats' milk produced in Tenerife (Canary Islands). Int. Dairy J., 16: 182-185.