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Effects of Different Feeding Systems on Performance and Milk Composition of German Fawn and Saanen Does

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ABSTRACT

The objective of this study was to compare the effects of two feeding systems (total mixed ration; **TMR** *vs.* roughage and concentrate offered separately; **SF**) on performance and milk composition of German Fawn (*n*=16) and Saanen (*n*=16) dairy goats. Animals were randomly allocated into 2 sub-groups and fed TMR or SF system. Roughage:concentrate ratio were arranged as 60:40 in TMR groups. Wheat straw (25%) and chopped alfalfa hay (75%) were used as roughage. Roughage was offered at *ad libutum* while concentrate was given in two equal meals (total 800 g/goat per day) in SF groups. The study was lasted 50 days. Live weights were recorded before morning feeding. Milk yields were recorded weekly. Individual milk samples were collected to determine total solids, fat, protein, casein, lactose, and urea-N. Feeding systems did not affect (P>0.05) milk yield, body weight, total solid, fat, protein, and casein concentrations. Separate access to roughage and concentrate decreased dry matter intake (P<0.01) and tended to decrease urea-N concentration (P= 0.053). Milk yield of German Fawn does was lower than Saanen does (P< 0.01; 1205.4 g/d *vs.* 1476.8 g/d). When milk composition of two genotypes were compared, protein was higher (P<0.01) in German Fawn does than Saanen does. In conclusion, there was no advantage of mixed diet over separate feeding for dairy goats having moderate milk yield (1200-1500 g/d).

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Farklı Yemleme Sistemlerinin Alman Alaca ve Saanen Keçilerinde Performans ve Süt Kompozisyonu Üzerine Etkisi

ÖZET

Bu çalışmada 2 yemleme sisteminin (toplam karışım rasyon; **TMR** ve stratejik yemleme; **SY**) Alman Alaca (*n*= 16) ve Saanen (*n*= 16) ırkı sütçü keçilerde performans ve süt kompozisyonu üzerine etkisi araştırılmıştır. Keçi ırkları şansa bağlı olarak 2 alt gruba ayrılmış gruplardan biri TMR, diğeri SY sistemi ile beslenmiştir. Her iki yemleme sisteminde de kaba yem:konsantre yem oranı 60:40 olarak düzenlenmiştir. Kaba yem olarak buğday samanı (%25) ve yonca samanı (%75) kullanılmıştır. Stratejik yemleme sistemi uygulanan alt gruplarda kaba yem ad libutum verilmiş, konsantre yem ise sabah ve akşam eşit miktarlarda olmak üzere 800 g/keçi şeklinde verilmiştir. Araştırma 50 gün sürmüştür. Araştırma süresince canlı ağırlıklar sabah yemlemesinden önce belirlenmiştir. Süt verimleri haftalık olarak saptanmıştır. Süt kuru madde, yağ, protein, kazein, laktoz ve üre-N düzeylerini belirlemek için haftalık bireysel süt örnekleri alınmıştır. Süt verimi, canlı ağırlık, süt kuru madde, yağ, protein ve kazein konsantrasyonlarının yemleme sistemleri arasında benzer (P>0.05) olduğu tespit edilmiştir. Kaba yem ve kesif yemin ayrı ayrı verildiği SY yemleme sisteminin kuru madde tüketimini azalttığı (P<0.01) ve süt üre-N konsantrasyonunu

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azaltma eğiliminde (P= 0.053) olduğu belirlenmiştir. Araştırma sonucunda, Alman Alaca keçilerin Saanen ırkına göre daha düşük süt verimine (P< 0.01; 1205.4 g/d *vs.* 1476.8 g/d) sahip oldukları saptanmıştır. Alman Alaca keçi sütlerinde protein düzeyinin Saanen ırkı keçilerden yüksek olduğu (P<0.01) belirlenmiştir. Sonuç olarak, orta düzeyde süt verimine sahip (1200-1500 g/d) sütçü keçilerde TMR yemleme sisteminin stratejik yemlemeye göre avantaj sağlamadığı söylenebilir.

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INTRODUCTION

Traditional production system for dairy goats has been replaced by intensive system recently due to increase labor requirement in traditional system and increase in productivity by improvement in management, health, breeding and feeding. Different feeding systems are available for intensive small ruminant production practice such as strategic feeding, complete feeding or total mixed ration (TMR) (Monzon-Gil et al. 2010) and choice (cafeteria) feeding (Görgülü et al. 1996; Görgülü et al. 2003; Rodriguez et al. 2007). Main differences among these feeding methods are in the way of supply of concentrate and level of feeding (restricted or *ad libitum*). These differences affect rumen retentition time of feed particles, rumen pH, and microbial population (Huuskonen et al. 2014). Increasing concentrate in the diet or using it separately may reduce rumen pH and digestibility of dietary fibre (Archimede et al. 1995).The TMR is a proper feeding system to solve problem with low ruminal pH which is having a negative effect on the microbial growth and milk fat content (Fox et al. 1990; Maltz et al. 1991; Gordon et al. 1995; Monzon-Gil et al. 2010).

Simple and effective feeding methods for dairy goats have not been extensively explored as for dairy cattle (Monzon-Gil et al. 2010). In addition, there are reports showing that dairy goats in various genotype may give different response to the feeding systems (Provenza et al. 2003; Mellado et al. 2004; Fukasawa et al. 2005). Therefore, the objective of the current study was to examine the effect of different feeding systems (total mixed ration *vs.* separate roughage- concentrate) on the milk yield, milk composition, and body weight chance of German Fawn and Saanen does.

MATERIAL and METHODS

Animals were managed according to the Turkish legislation regarding the use of animals in scientific experimentation.

Experimental design and treatments

Sixteen German Fawn (51.9±5.26 kg; mean±standard deviation) and 16 Saanen does (53.0±9.63 kg) were used in this study. Does were assigned to the two feeding methods according to milk yield (averaged 1484±368.2 g/day) and days after kidding (averaged 155.4±7.80 days) within genotype with 8 does each. Feeding methods were total mixed ration (TMR) and separate concentrate-roughage (SF). In TMR groups, roughage: concentrate ratio were arranged as 60:40. Concentrate consisted of (g/kg) barley grain (85.0), corn grain (235.0), wheat brans (256.0), corn brans (100.0), cotton seed meal (45.0), dried distillers grains with solubles (150.0), sunflower meal (100.0), limestone (20.0), salt (8.0), and vitamin-mineral premix (1.0). Wheat straw (25%) and chopped alfalfa hay (75%) were used as roughage sources. Both of them had been chopped using a SM 05 grinder-mixer to pass through a <3 cm screen.

In the does fed SF method, roughage and concentrate were in seperate feeders. Roughage was offered at *ad libutum* while concentrate was given in two equal meals (total 800 g/does/day, approximately 1.6% LW) daily. Rations were distributed twice daily, after morning (06:00 h) and evening (18:00 h) milkings. Chemical composition of the concentrate and roughage are presented in Table 1.

Does were housed in 3 m x 1.5 m (width x depth) pens in which bedding was peridocically placed and later removed. There was free access to water adequate for all animals. The study was lasted 50 days, after 14 days of adaptation period.

Measurements, sampling and analysis

Feeds and refusals were weighed daily to determine the intake. The wheat straw, alfalfa hay, and concentrate samples were milled through a 1-mm sieve (ZM-200, Retsch, United Kingdom) before analysis being analyzed. The dry matter (method 934.01), ash (method 942.05), ether extract (method 920.39), and nitrogen (method 984.13) contents were determined according to the AOAC (1999). Neutral detergent fiber (NDF) and acid detergent fiber (ADF) were determined with procedures using an Ankom procedure (Ankom® Tech. Corp., Fairport, NY, USA) without correcting for residual ash (Van Soest et al. 1991).

Does were milked twice daily by automatic milking machine (DeLaval, Tumba, Sweden) at 04:00 h and 16:00 h. Their individual milk production was recorded weekly. Milk samples were collected weekly and analyzed by infrared spectroscopy (Milko-Scan FT 120, Foss, Electric A/S, Hillerød, Denmark) to determine total solid, fat, protein casein, lactose, urea contents. Milk production was standardized as Fat-Corrected Milk (FCM) at 4% fat, according to the following formula: FCM= [(0.4 x milk (kg) + 0.15 x milk fat (kg)] milk yield (NRC, 2001).

Table 1. Chemical composition of concentrate and wheat straw and alfalfa hays (dry matter basis)

Chemical composition, %	Concentrate	Alfalfa hay[2]	Wheat straw[2]
DM (%)	91.0	88.3	93.1
Organic matter[1]	93.2	91.2	93.4
Crude protein (% of DM)	17.7	14.6	2.3
Ether extract (% of DM)	3.6	1.2	0.70
NDF (% of DM)	29.3	62.3	85.5
ADF (% of DM)	11.5	47.3	56.7
Ash (% of DM)	6.8	8.8	6.6
Crude fiber (% of DM)	7.3	34.8	41.4
NFC[1]	42.6	13.1	4.9

[1] Values were calculated; Organic matter= 100-% ash; NFC=100-(% CP+% NDF+% fat+% ash) (NRC, 2001)
[2] Chopped using a grinder-mixer

Statistical analyses

The treatment arrangement was a 2 x 2 factorial, with two genotypes and two feeding systems. T-tests were used to compare the differences in roughage/concentrate ratio preferred by does. Performance data were analyzed using the MIXED model procedure of SAS (2000), with a model consisting of genotype, feeding system and genotype x feeding system interaction. If there were significant effects, multiple comparison of means were carried out using the Tukey-Kramer test. Treatment differences with $P \leq 0.05$ were considered statistically significant, whereas statistical tendencies to differences were accepted if $0.05 < P \leq 0.10$. All data are reported as least squares means with pooled standard errors (SEM).

RESULTS and DISCUSSION

Effect of feeding systems

Dry matter intake was greater for does fed TMR than for fed SF ($P<0.01$), and there was a genotype and feeding system interaction ($P<0.01$). Milk urea content of does fed TMR was tend to higher than that of does fed SF ($P=0.053$). The higher DMI of dairy goats fed TMR has been related to a better ruminal utilization of diets components by the simultaneous consumptions of concentrate and roughage (DeVries and von Keyserlingk 2009; Monzon-Gil et al. 2010). Mixed diet probably favored more suitable rumen conditions, growth of cellulolytic bacteria, and lesser time for rumen pH<6.0 (Monzon-Gil et al. 2010). On the other hand, does fed with SF showed a marked decrease in roughage intake (52.7% *vs.* 60.0%, Table 2), and they had TMR having higher concentrate ratio. It is well known that high concentrate or separate concentrate usage in the diet may decrease total feed intake (Monzon-Gil et al. 2010) due to a decreased or an irregular rumen pH (Kleen et al. 2003) and satiety with energy intake (Forbes, 1983; Glimp et al. 1989; Yurtseven and Gorgulu, 2007) unless there is any physical limitation in the stomach capacity. Similarly Sauvant et al. (1991) reported that the goats receiving 100 g supplemental concentrate consumed 111 g less forage dry matter. Low roughage intake is obvious finding when roughage and concentrate were supplied separately, and decreased roughage intake dimished total feed intake, this could cause a reduction in milk yield if the dairy goats have high milk yield.

Milk yield and milk components except for milk urea content were not affected by feeding methods in the present study and this probably related to the relatively moderate milk yield (1200-1500 g/day) of the dairy goats. In addition, similar milk yield and composition could be expected when the dairy goats consumed similar amount of energy and protein as it was observed in the present study. Accordingly, Giger-Reverdin et al. (1987), Morand-Fehr et al. (1991), and Sanz Sampelayo et al. (1998) reported that milk production and composition of goats were mainly dependent on energy balance of the animal rather than the composition of the diets.

Earlier studies reported no differences in performance (Miguel-Romera et al. 2011) or milk composition between feeding systems when the proportion of concentrate in the diet was similar (Tufarelli et al. 2009). Gorgulu et al. (2003) compared Damascus goats receiving TMR *ad libitum* with those receiving 1 kg concentrate and *ad libitum* alfalfa hay, and reported similar amount of milk such as in the present study. Goetsch et al. (2003) reported that restricted intake of concentrate (approximately 2% LW) and *ad libutum* intake of roughage can yield average daily gain and average daily gain:dry matter intake similar to *ad libutum* consumption of a mixed diet. Also, in agreement with the findings in goats, Yrjänen et al. (2003) reported that there was no difference in milk yield, milk composition of Finnish Ayrshire cows fed TMR or separate feeding.

Separate concentrate supply resulted in a decrease in roughage intake when concentrate in the diet was increased (Table 2). Similar results were obtained in dairy cows (Agnew et al. 1996; Ingvartsen et al. 2001; Bach et al. 2007) when concentrate and roughage were supplied separately. It is well known that high concentrate may improve nitrogen utilisation efficiency in the rumen (NRC, 2001; Pathak, 2008) and may decrease milk urea nitrogen as in this study. Agnew et al. (1996) reported that high concentrate increased nitrogen utilisation efficiency and protein content of milk. Similarly Godden et al. (2001) revealed that milk urea nitrogen concentrations had a positive relationship with dietary levels of crude protein and protein fractions for instance undigestible protein, and a negative relationship with levels of nonfiber carbohydrate and with the ratios of these dietary constituents. Accordingly the goats fed with separate increased concentrate ratio in the diet had a decreased milk urea nitrogen in the present study as well.

Effect of genotype

German Fawn does tended to consume more dry matter than Saanen does (P=0.099). Saanen does had higher milk yield (P<0.01) and higher FCM (P<0.01) compared with German Fawn does. Milk yield in dairy goats depends on genotypes, parity, kidding season, stage of lactation and nutritional conditions. Previous comparisons between Saanen and German Fawn or Alpine dairy goats were inconsistent. In some studies milk yield of Saanen was higher (Mioc et al. 2008) than German Fawn Crossbreds or Alpine dairy goats, whereas in others studies milk yield was lower in Saanen (Pambu et al. 2011; Silva et al. 2013). Also, some researchers (Darcan and Güney, 2002) found no differences between these breeds.

Milk protein and casein were higher (P< 0.05) or tend to be higher (P=0.068) for German Fawn does than Saanen does. Conversely, fat:protein ratio of German Fawn does was lower as compared to Saanen does (P< 0.01). The milk component yields (fat, protein, and lactose) were lower in German Fawn does compared to Saanen does (P<0.01, P<0.05, and P<0.01, respectively).

Table 2. Effect of feeding systems on performance and milk composition of German Fawn and Saanen does

Genotype (G)	German Fawn		Saanen			P-value		
Feeding system[1] (FS)	TMR	SF	TMR	SF	SEM	G	FS	GxFS
Initial LW (kg)	52.1	51.8	50.0	52.6	2.65	0.815	0.657	0.591
Roughage ratio[2]	60.0	54.6[3]	60.0	50.8[3]	-	<.0001	<.0001	<.0001
Dry matter intake (kg/d)	1.79^{b}	1.76^{b}	1.86^{a}	1.62^{c}	0.021	0.099	<.0001	<.0001
Milk production (g/d)								
Actual	1209.2	1201.5	1480.2	1473.3	56.00	<.0001	0.897	0.995
4.0% FCM[4]	1229.3	1223.0	1551.3	1561.7	51.46	<.0001	0.969	0.872
Milk composition								
Total solid (%)	12.8	12.5	12.7	12.7	0.36	0.903	0.827	0.658
Fat (%)	4.2	4.2	4.5	4.4	0.24	0.343	0.819	0.941
Protein (%)	3.5	3.4	3.2	3.2	0.11	0.028	0.744	0.573
Fat:protein ratio	1.19	1.20	1.37	1.38	0.051	0.001	0.822	0.978
Casein (%)	2.7	2.6	2.5	2.5	0.089	0.068	0.629	0.612
Lactose (%)	4.3^{a}	4.1^{b}	4.3^{a}	4.2^{ab}	0.060	0.346	0.078	0.278
Urea (mg/dL)	41.5^{a}	37.0^{b}	38.5^{b}	38.3^{b}	1.16	0.477	0.053	0.072
Milk composition yield (g/d)								
Fat	49.7	49.6	63.8	64.8	2.55	<.0001	0.856	0.833
Protein	42.4	41.4	47.1	47.5	1.68	0.022	0.835	0.669
Lactose	51.9	50.0	63.5	62.7	2.38	<.0001	0.581	0.817
Dairy efficiency								
Milk/DMI	0.69^{b}	0.68b	0.80^{ab}	0.91^{a}	0.032	<.0001	0.088	0.076
FCM/DMI	0.70^{b}	0.70^{b}	0.84^{ab}	0.97^{a}	0.032	<.0001	0.046	0.043
BW								
kg	53.4	55.4	52.0	52.9	2.61	0.451	0.590	0.842
Change in BW	1.36	3.56	1.95	0.23	1.02	0.190	0.818	0.065

[1] TMR, total mixed ration; SF, separate feeding of concentrate and roughage
[2] TMR had standard roughage level (60%)
[3] Standard error of the each mean is 0.29
[4] FCM, fat corrected milk
[a, b]: means with different superscripts in the same column are significantly different.

Dairy efficiency expressed as Milk/DMI or FCM/DMI were lower for German Fawn does than Saanen does (both of them; P<0.01). Norris et al. (2011) reported that the protein content in Alpine dairy goats was higher than in Saanen dairy goats, which is consistent with the present results. Fat, protein and lactose yields were high due to higher milk yield of Saanen than German Fawn as expected.

Effect of genotype × feeding method interaction

There was an interaction between genotype and feeding systems for dairy in respect to DM intake ($P<0.01$) and FCM production efficiency ($P<0.05$). Saanen does fed concentrate separately consumed less feed than German Fawn does while does consumed similar amount of DM when fed TMR. This is probably related to the consumption of roughage, Saanen dairy goats in separate feeding groups consumed less roughage and increased the concentrate ratio in the diet. This could decrease feed intake due to ruminal effect of concentrate and satiety isues as discussed before. Due to this fact, the higher milk production efficiency could be expected as the does consumed a diet containing high concentrate (Sanz Sampelayo et al. 1998).

CONCLUSION

The results of the present study indicated that there was no advantage of mixed diet over separate feeding when the goats having about 1200-1500 g milk yield daily. The effect of separate feeding should be tested under the different concentrate supply strategy with high yielding (≥2000 g/d) dairy goats. In addition, water intake, blood biochemistry parameters, and milk fatty acid compositions should be watched to determine of pronounced impacts of separate feeding.

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REFERENCES

Agnew KW, Mayne CS, Doherty JG 1996. An Examination of The Effect of Method and Level of Concentrate Feeding on Milk Production in Dairy Cows Offered A Grass Silage-Based Diet. Journal of Animal Science, 63: 21-31.

AOAC 1999. Official Method of Analysis, 16th edn. Arlington, VA, USA. Association of Official Analytical Chemists

Archimede H, Sauvant D, Schimidely P 1995. Quantitative Review of Ruminal and Total Tract Digestion of Mixed Diet Organic Matter and Carbohydrates. Reproduction Nutrition Development, 37: 173-189.

Bach A, Iglesias C, Devant M 2007. Daily Rumen pH Pattern of Loosehoused Dairy Cattle as Affected by Feeding Pattern and Live Yeast Supplementation. Journal of Animal and Feed Sciences, 136: 146-153.

Darcan N, Güney O 2002. Comparative Study on The Performance of Crossbred Goats Under Cukurova Subtropical Climate. Journal of Applied Animal Research, 22: 61-64.

DeVries TJ, von Keyserlingk MAG 2009. Feeding Methods Affects The Feeding Behavior of Growing Dairy Heifers. Journal of Dairy Science, 92: 1161-1168.

Forbes JM 1983. Physiology of Regulation of Food Intake. In: J.A.F. Rook and P.C. Thomas (Editors). Nutritional Physiology of Farm Animals. Longman, USA.

Fox DG, Sniffen CJ, O'connor JD, Russell JB, Van Soest PJ 1990. The Cornell Net Carbohydrate and Protein System for Evaluating Cattle Diets, No. 34. Ithaca, NY: Cornell University Agricultural Experiment Station.

Fukasawa M, Tsukada H, Kosako T 2005. Selective Feeding Behaviour of Calves is Affected by Basal Diet. Journal of Animal Science, 76: 171-177.

Giger-Reverdin S, Sauvant D, Hervieu J 1987. Influence of The Kind of Compound Feed on Goat Milk Production and Composition. Annales de Zootechnie, 36: 334-335.

Glimp HA, Hart ST, VonTungeln D 1989. Effect of Altering Nutrient Density (Concentrate to Roughage Ratio) and Restricting Energy Intake on Rate, Efficiency and Composition of Growing Lambs. Journal of Animal Science, 67: 865-871.

Godden SM, Lissemore KD, Keton DF, Leslie KE, Walton JS, Lumsden JH 2001. Factors Associated with Milk Urea Concentrations in Ontario Dairy Cows. Journal of Dairy Science, 84: 107–114.

Goetsch AL, Detweiler G, Sahlu T, Hayes J, Puchala R 2003. Effects of Separate Offering of Forage and Concentrate on Feed Intake and Growth of Alpine Doelings. Small Ruminant Research, 48: 209-216.

Gordon GLR, McSweeney CS, Phillips MW 1995. An Important Role for Ruminal Anaerobic Fungi in The Voluntary Intake of Poor Quality Forages by Ruminants. In: Wallace, R.J. and LahlouKassi, A. (eds.) Rumen Ecology Research Planning. Proceedings of a Workshop Addis Ababa, Ethiopia.

Görgülü M, Güney O, Torun O, Özuyanık O, Kutlu HR 2003. An Alternative Feeding System for Dairy Goats: Effects of Free-Choice Feeding on Milk Yield and Milk Composition of Lactating Suckling Damascus Goats. Journal of Animal Feed Science, 12: 33-44.

Görgülü M, Kutlu HR, Demir E, Öztürkcan O, Forbes JM 1996. Nutritional Consequances of Free-Choice Among Feed Ingredients by Awassi Lambs. Small Ruminant Research, 20: 23-29.

Huuskonen A, Pesonen M, Joki-Tokola E 2014. Effects of Supplementary Concentrate Level Separate or Total Mixed Ration Feeding on Performance of Growing Dairy Bulls. Agricultural and Food Science, 23: 257-265.

Ingvartsen KL, Aaes O, Jens Bech A 2001. Effects of Pattern of Concentrate Allocation in the Dry Period and Early Lactation on Feed Intake and Lactational Performance in Dairy Cows. Livestock Science, 71: 207-221.

Kleen JL, Hooijer GA, Rehage J, Noordhuizen JPTM 2003. Subacute Ruminal Acidosis (SARA): A Review. Journal of Veterinary Medicine Series A, 50: 406-414.

Maltz E, Silanikove N, Karaso Y, Shefet G, Meltzer A, Barak M 1991. A Note on The Effects of Feeding Total Mixed Ration on Performance of Dairy Goats in Late

Lactation. Animal Feed Science and Technology, 35: 15-20.

Mellado M, Rodríguez A, Olvera A, Villarreal JA, Lopez R 2004. Diets of Nubian and Granadina Goats Grazing on Arid Rangeland. Journal of Range Management, 57: 630-634.

Miguel-Romera JA, Calvo-Ruiz JL, Ciria-Ciria J, Asenjo-Martin B 2011. Effect of Feeding Systems on Live-Weight, Reproductive Performance, Milk Yield and Composition, and The Growth of Lambs in Native Spanish Ojalada Sheep. Spanish Journal of Agricultural Research, 9: 769-780.

Mioc B, Prpic Z, Vnucec I, Barac Z, Susic V, Samarzija D, Pavic V 2008. Factors Affecting Goat Milk Yield and Composition. Mljekarstvo, 58: 305-313.

Monzon-Gil E, Castanon JIR, Ventura MR 2010. Effect of Low-Forage Rations on Milk Production of Dairy Goats: Separate Concentrate-Forage Versus Mixed Rations. Small Ruminant Research, 94: 196–200.

Morand-Fehr P, Bas P, Blanchart G, Daccord R, Giger-Reverdin S, Gihad EA, Hadjipanayiotou M, Mowlem A, Remeuf F, Sauvant D 1991. Influence of Feeding on Goat Milk Composition and Technological Characteristics. In: P. Morand-Fehr, Goat Nutrition (p. 25-36). Publication - European Association for Animal Production (46) Wageningen, NLD.

NRC 2001. Nutrient Requirements of Dairy Cattle. Washington DC, USA: 7th Review Ed. National Academy of Sciences

Pambu RG, Webb EC, Mohale L 2011. Differences in Milk Yield and Composition of Different Goat Breeds Raised in The Same Environment in South Africa. Agricultural Journal, 6: 237-242.

Pathak AK 2008. Various Factors Affecting Microbial Protein Synthesis in The Rumen. Veterinary World, 1: 186-189.

Provenza FD, Villalba JJ, Dziba LE, Atwood SB, Banner RE 2003. Linking Herbivore Experience, Varied Diets, and Plant Biochemical Diversity. Small Ruminant Research, 49: 257-274.

Rodriquez AB, Bodas R, Fernandez B, Lopez-Campos O, Mantecon AR, Giraldez FJ 2007. Feed Intake and Performance of Growing Lambs Raised on Concentrate-Based Diets Under Cafeteria Feeding Systems. Animal, 1: 459–466.

Sanz Sampelayo MR, Perez L, Boza J, Amigo L 1998. Forage of Different Physical Forms in The Diets of Lactating Granadina Goats: Nutrient Digestibility and Milk Production and Composition. Journal of Dairy Science, 81: 492-498.

SAS 2000. SAS User's Guide: Statistics, Version 8.0. SAS Inst, Inc, Cary, NC, USA.

Sauvant D, Morand-Fehr P, Giger Reverdin S 1991. Dry Matter Intake of Adult Goats. In: P. Morand-Fehr, Goat Nutrition. Publication - European Association for Animal Production (46) Wageningen, NLD.

Silva FG, Torres RA, Brito LF, Silva LP, Menezes GR, Brito LC, Euclydes RF, Rodrigues MT 2013. Genetic Evaluation of Alpine Goats Using Different Milk Control Intervals. Genetics and Molecular Research, 12: 2455-2464.

Türk Standartları Enstitüsü 2008. Hayvan Yemleri-Metabolik (Çevrilebilir) Enerji Tayini Kimyasal Metot. TS 9610, Ankara.

Tufarelli V, Dario M, Laudadio V 2009. Forage to Concentrate Ratio in Jonica Breed Goats: Influence on Lactation Curve and Milk Composition. Journal of Dairy Research, 76: 124–128.

Van Soest PJ, Robertson JB, Lewis BA 1991. Methods for Dietary Fiber, Neutral Detergent Fiber, and Nonstarch Polysaccharides in Relation to Animal Nutrition. Journal of Dairy Science, 74: 3583-3597.

Yrjänen S, Kaustell K, Kangasniemi R, Sariola J, Khalili H 2003. Effets of Concentrate Feeding Strategy on The Performance of Dairy Cows House in A Free Stall Barn. Livestock Production Science, 81: 173-181.

Yurtseven S, Görgülü M 2007. The Effects of Multiple Choices for Grain and Protein Sources Differing in Ruminal Degradability on Diet Selection and Performance of Lactating Dairy Goats. Journal of Animal Production, 48: 7-14.