ANNALES
UNIVERSITATIS MARIAE CURIE-SKŁODOWSKA
LUBLIN – POLONIA
VOL. XXVI (4) SECTIO EE 2008

[1]Instytut Żywienia Zwierząt, [2]Katedra Hodowli Owiec i Kóz, Uniwersytet Przyrodniczy w Lublinie
Akademicka 13, 20-950 Lublin,
e-mail: rklebaniuk@poczta.fm

RENATA KLEBANIUK[1], EDYTA KOWALCZUK[1],
GRZEGORZ KOCHMAN[1], KRZYSZTOF PATKOWSKI[2],
MONIKA ŁECHTAŃSKA[1]

Effect of goats nutrition on milk yield, its chemical composition and fatty acid profile of fat

Wpływ żywienia kóz na wydajność, skład chemiczny oraz profil kwasów tłuszczowych tłuszczu mleka

Summary. The objective of the present study was to evaluate the impact of differentiated goat nutrition on milk yield and composition, mineral content and fatty acid profile of caprine milk fat. The investigation included 40 goats from two farms (A and B). During the research period, the goats from farm A received a ration comprising pasture green forage, meadow hay and concentrate, whereas a feed ration for goats from farm B was composed of carrot, meadow hay, carrot, concentrate and dry sugar beet pulp. Concentrate feeds were based on cereals and legumes or rapeseed meal and mineral-vitamin mixture. During the study period at each farm, goat nutrition was evaluated six times (feed intake, chemical composition of feeds, nutritive value of ration) as well as milk yield and composition (basic components and mineral composition, fatty acid profile in milk fat).

The goats fed diets with carrot and pulp besides hay and concentrate, showed the mean daily milk yield higher by 12%. No differences concerning the SFA level in goat milk fat were recorded. Milk fat from goats supplied with a pasture fodder-based diet (farm A) contained a higher amount of MUFAs as compared to milk fat from those whose diet included carrot (farm B). A contrary significant dependence was determined for the PUFAs. The mineral composition of milk was shown to vary, but only phosphorus and iron levels differed significantly.

Key words: goat, nutrition, milk yield, milk chemical composition, fatty acid profile

INTRODUCTION

The main commercial purpose for goat raising in Poland is milk. The numerous values of caprine milk established its high position in human nutrition. Powerful justification for goat milk comes from medical needs of formula-fed infants allergic to cow milk proteins as well as elder people or afflicted with various disorders [Ziemlański 2001]. The last decades were marked with a considerable number of medical research including both human and animals [Sawaya *et al*. 1984, Oprządek and Oprządek 2003], which have confirmed the beneficial properties of caprine milk mainly due to the presence of CLA (conjugated linolenic acid). Besides, there is a substantial group of consumers who simply enjoy the unique taste of goat milk products, like cheese or yoghurt [Rejman and Kowrygo 2002]. Caprine milk composition and quality are related to many factors including genetic and environmental ones, including milking, storage but predominantly animal nutrition [Zan *et al*. 2006, Soryal *et al*. 2005, Sanz Sampelayo *et al*. 2007].

The objective of the present study was to assess the impact of differentiated goat nutrition strategies on milk yield and composition and fatty acid profile of its fat.

MATERIAL AND METHODS

The investigations included a total of 40 goats managed in two farms (A and B). In the research period (the end of July to October, 2006), the goats` diet comprised pasture green forage, meadow hay and a concentrate in farm A, while carrot (roots with leaves), meadow hay, concentrate mixture and dry pulp in farm B. Concentrates prepared by farmers based mainly on cereal grains (barley, oats, wheat) and either on legume seeds (field pea – farm A) or rapeseed meal (farm B) and a mineral-vitamin diet. All the animals had free access to water. In each farm, the goat feeding strategy was evaluated six times during the study period (feed intake, chemical composition of feed, nutritional value of feed ration) as well as milk efficiency and composition.

The determination of essential nutrients in feedstuffs (dry matter, crude protein, crude fiber, crude fat, crude ash) was performed in compliance with the AOAC method [Official... 2000]. The nutritional value of feeds and feed rations was assessed using the Winwar 1.6 computer program. The goat milk samples were examined for basic nutrient contents (protein, fat, lactose, minerals) by means of Milko-Scan 104 apparatus. In milk fat, a fatty acid profile (% in acid sum) was analyzed by gas chromatography using Varian GC 3800 model equipped with a capillary column CP WAX 52CB DF 0.25 UM of 60 m length; gas carrier – helium at a flow rate 1.4 ml/min; initial column temperature 120 C was gradually increased at 2 C/min up to 210°C, determination time – 127 min, feeder temperature – 260°C, detector temperature 260°C, make-up gases – hydrogen and oxygen. Mineral contents (calcium, potassium, magnesium, sodium, iron, zinc, copper and manganese) in feedstuffs and milk were established using the method of AAS atomic absorptive spectrophotometry [Wierciński 1984], while phosphorus level by Fiske-Subbarov procedure [Gniot-Szulżycka *et al*. 2002]. The basic analyses of feeds, fatty acid profile in milk fat as well as initial milk and feed sample preparation for mineral determination (dry mineralization and solution preparation) were performed in the Laboratory of the Institute of Animal Nutrition. The determination of mineral contents in the prepared solutions were made in the Central Laboratory of the University of Life Sciences in Lublin. The basic milk composition was analyzed in the District Cooperative for Dairy Services in Lublin. The data was analyzed statistically using the Statistica program version 5.1G (Stat Soft), while significance of differences established by Duncan test.

RESULTS AND DISCUSSION

Feed rations differed between the farms under study, but their nutritive value was comparable and satisfied the nutritional requirements of the animals. The chemical composition and nutritional value of the feedstuffs used in the farms (Tab. 1) were similar to those presented as feeding standards for cattle, sheep and goats [Normy... 2001]. The goats in farm A, whose ration included meadow hay, pasture green forage and a concentrate were characterized by an increased by ca 3.5% dry matter intake, while protein PDIN and protein PDIE were by 3% and over 9%, respectively, higher (Tab. 2) as compared to the goats in farm B, at a similar energy intake for milk production unit. Goats demonstrate considerable breed and individual variation in relation to the feed intake capacity (FIC) [Jamroz and Potkański 2004]. In farm A, the indigenous x White Improved Goat crosses were maintained, whereas in farm B the herd of goats comprised White and Fawn Improved goats. Voluntary dry matter ingested from ration is modulated by a goat breed and body weight as well as the physical structure of feed, its chemical composition and a ratio of bulky/concentrate feed in a ration [Sauvant *et al.* 1991]. Compared to other ruminants, goats also consume more dry matter in relation to body weight [De Simiane *et al.* 1981].

Fodder carrot included into goats` diet of the B object is numbered among bulky juicy feeds but assessment of its nutritive value showed that it does not have any fill value (FV), (Tab. 1). The crude fiber content in carrot is mostly composed of the easily soluble fraction NDF (cellulose, hemicellulose, lignin), while the ADF fraction with cellulose and lignin appears in only a small amount [Chachułowa 1999]. Goats exhibit a high ability to digest crude fiber, i.e. in 80–85% [Kowalski 2006].

Nutritional need for minerals in goats is limited in norms [Normy... 2001] to only two essential macroelements: calcium and phosphorus and their interrelation. An adequate supply of each of them is required, thus calcium to phosphorus ratio in goat's diet should be 1.2:1 up to 2.5. Excess of calcium content possesses a lower risk to organism than its deficiency, still it may compromise the absorption of phosphorus, magnesium and manganese [Kowalski 2006]. Kowalski [2006] found that 1 kg of dry matter in a ration for goat should contain ca 2 g sodium, 2 g magnesium and 1.5 g sulfur. According to the AFRC [The nutrition... 1998], 1 kg of dry matter in a goat ration should also contain 19–20 mg copper, 50–60 mg zinc, 1.11–0.20 mg cobalt, 60–120 mg manganese, 30–40 mg iron and 0.05 mg selenium. In the diets fed to the goats under study, a calcium to phosphorus proportion was 1.8:1 and 1.7:1 in farm A and B, respectively, (Tab. 2) and appeared to be higher than reported in the literature [Normy... 2001, Kowalski 2006]. Substantial differences were also established for the other mineral contents in the rations (Tab. 3) as compared to the recommended ones [The nutrition... 1998].

The key nutritional determinant of caprine milk yield proves to be energy intake. A response to additional energy supplied in a ration is more pronounced in the first half of lactation [Jarrige 1989]. A lack of appetite in the early lactation with concurrent increased nutritional needs due to high milk production result in energy deficiency. Then, organism is forced to mobilize its energy body reserves for milk synthesis [Morand-Fehr *et al.* 1987]. A negative energy balance may persist for 6–8 lactation weeks, while replenishment of body reserves launches around 4th lactation month [Jarrige 1989].

Table 1. Chemical composition and nutritive value of feeds
Tabela 1. Skład chemiczny i wartość pokarmowa skarmianych pasz

Item Wyszczególnienie	Farm A Gospodarstwo A			Farm B Gospodarstwo B			
	meadow hay siano łąkowe	pasture green forage zielonka pastwiskowa	concentrate mieszanka treściwa	meadow hay siano łąkowe	carrot marchew pastewna	fodder dry wysłodki suszone	concentrate mieszanka treściwa
$g \cdot kg^{-1}$ DM							
Dry matter Sucha masa	864	221	892	846	131	889	889
Crude protein Białko ogólne	93.9	105.7	132.4	98.6	103.2	98.3	156.7
Crude fiber Włókno surowe	81.3	87.2	45.6	88.7	91.3	88.1	41.2
Ether extract Tłuszcz surowy	17.4	12.3	32.8	19.1	5.5	7.3	27.3
Crude ash Popiół surowy	365.2	310.8	49.1	321.9	99.7	206.8	45.4
NFE BAW	442.2	484	740.1	471.7	700.3	599.5	729.4
Calcium Wapń	8.6	8.6	6.9	7.2	3.8	12.6	5.9
Potassium Potas	12.7	16.7	15.6	14.3	39.8	7.2	18.9
Magnesium Magnez	2.2	2.4	5.1	1.9	2.1	3.3	7.2
Sodium Sód	4.2	2.9	0.5	5.1	9.8	1.9	0.8
Phosphorus Fosfor	3.1	2.3	8.3	3.7	3.5	2.3	9.7
$mg \cdot kg^{-1}$ DM $mg \cdot kg^{-1}$ s.m.							
Iron Żelazo	432.7	215.1	287.9	482.1	61.8	454	332.9
Copper Miedź	14.9	7.3	5.6	15.8	5.2	9.8	7.8
Zinc Cynk	38.2	38.7	78.2	43.2	22.3	25.1	98.7
Manganese Mangan	185.4	123.6	65.9	98.2	12.9	54.8	94.9
Nutritive value of 1 kg DM Wartość pokarmowa w 1 kg s.m							
UFL JPM	0.6	0.74	1.24	0.7	1.1	1	1.12
PDIN, g BTJN, g	53.7	62.8	167.5	68.2	63.2	73	208.4
PDIE, g BTJE, g	66.2	73.2	172.3	71.3	87.4	104.3	176.2
SFU JWK	1.8	1.28	-	1.9	-	-	-

NFE – Nitrogen Free Extract; UFL – Unite Fourragere Lait (Feed Unit for milk production); PDIN and PDIE – Protein truly Digestible in the small Intestine; SFU – Fill Units for Sheep
BAW – związki bezazotowe wyciągowe; JPM – jednostka paszowa produkcji mleka; BTJN i BTJE – białko trawione w jelicie cienkim; JWK – jednostka wypełnienia dla owiec (kóz)

Table 2. Daily intake of feed and nutrients by goats in farm A and B
Tabela 2. Dzienne pobranie pasz i składników pokarmowych przez kozy w gospodarstwach A i B

Item Wyszczególnienie	Farm A Gospodarstwo A	Farm B Gospodarstwo B
Feed intake, kg Pobranie pasz, kg		
Meadow hay – Siano łąkowe	1.6	2.0
Pasture green forage – Zielonka pastwiskowa	3.0	-
Carrot – Marchew pastewna	-	2.0
Dry sugar beet pulp – Wysłodki suszone	-	0.5
Concentrate – Mieszanka treściwa	1.0	0.5
Intake in the ration Pobranie w s.m. dawki		
UFL – JPM	2.42	2.41
PDIN, g – BTJN, g	264.4	256.5
PDIE, g – BTJE, g	292.6	267.6
SFU – JWK	3.31	3.20
Dry matter, kg – SM, kg	2.92	2.83
Crude protein, g – Białko ogólne, g	316.4	306.4
Crude fiber, g – Włókno surowe, g	209.5	230.7
Ether extract, g – Tłuszcz surowy, g	61.2	49.0
Crude ash, – Popiół surowy, g	748.4	680.2
NFE, g – BAW, g	1584.7	1568.3
Calcium, g – Wapń, g	23.6	21.3
Potassium, g – Potas, g	42.3	46.1
Magnesium, g – Magnez, g	9.1	8.4
Sodium, g – Sód, g	8.1	12.4
Phosphorus, g – Fosfor, g	13.2	12.5
Iron, mg – Żelazo, mg	990.1	1177.6
Copper, mg – Miedź, mg	30.2	35.8
Zinc, mg – Cynk, mg	147.6	133.6
Manganese, mg – Mangan, mg	393.8	235.2

Symbols like in Tab. 1 – Symbole jak w tab. 1

Table 3. Mean daily milk yield
Tabela 3. Średnia dzienna wydajność i zawartość składników podstawowych w mleku badanych kóz

Farm Gospodarstwo	Yield, kg Wydajność, kg	Milk composition, % Skład mleka, %				
		dry matter sucha masa	lactose laktoza	protein białko	fat tłuszcz	ash sole mineralne
A	4.25[b]	17.6	5.0	4.2	7.6	0.8
B	4.78[a]	17.4	5.2	4.3	7.2	0.7

[a, b] – values differ significantly at $p \leq 0.05$
[a, b] – wartości różnią się istotnie przy $p \leq 0,05$

Table 4. Fatty acid profile in analyzed milk fat, %
Tabela 4. Profil kwasów tłuszczowych w badanym mleku, %

Fatty acid Kwas tłuszczowy	A	B	SEM
C 4:0	2.6	2.7	0.07
C 6:0	2.5	2.6	0.09
C 8:0	2.8	2.7	0.05
C 10:0	8.3	8.2	0.78
C 12:0	3.4	3.3	0.09
C 14:0	10.4	10.5	0.98
C 16:0	24.5	24.3	2.47
C 16:1	2.4	2.2	0.06
C 18:0	12.2	12.6	1.17
C 18:1	26.7	26.1	2.76
C 18:2	2.5	2.8	0.03
C 18:3	1.6	1.8	0.01
C 18:4	0.1	0.2	0.001
Total Razem	100	100	-
PUFA/SFA	0.063[b]	0.072[a]	-

[a, b] – values differ significantly at p ≤ 0.05
[a, b] – wartości różnią się istotnie przy p ≤ 0,05

Table 5. Content of minerals in goat's milk
Tabela 5. Zawartość składników mineralnych w mleku kóz

Farm Gospodar- stwo	Macroelements, g · l[-1] Makroelementy, g · l[-1]					Microelements, mg · l[-1] Mikroelementy, mg · l[-1]			
	Ca	Mg	K	P	Na	Fe	Cu	Zn	Mn
A	1.29–1.46 1.38	0.13–0.16 0.14	1.26–2.04 1.65	0.89–1.17 1.03[b]	0.34–0.50 0.42	0.50–1.25 0.88[a]	0.004–0.03 0.02	3.0–4.8 3.9	0.05–0.07 0.06
B	1.33–1.61 1.55	0.15–0.18 0.16	1.28–2.15 1.98	1.50–1.77 1.62[a]	0.33–0.42 0.38	0.12–0.98 0.45[b]	0.009–0.07 0.06	3.1–4.0 3.6	0.02–0.09 0.04

[a, b] – values differ significantly at p ≤ 0.05
[a, b] – wartości różnią się istotnie przy p ≤ 0,05

The investigations covered the lactation period of goats, from 2–3 up to 6–7 milking months. Daily milk yield of goats (Tab. 3) in farm B (fed with meadow hay, concentrate containing rapeseed meal and with carrots) was higher ($p \leq 0.05$) than of the goats in farm A (receiving except meadow hay also pasture green forage and a concentrate containing field pea). The basic chemical composition of the collected milk was similar in both farms and characteristic of this species of animals. Only dry matter content in farm A was shown to be slightly higher, as compared to the goats from farm B.

Besides the milk fat content, its composition, i.e. fatty acid profile is very important [Belury and Kempa-Steczko, 1997, Janicki *et al*. 2005]. Animal fat is characterized by some different contents of fatty acids as against vegetable fat. Ruminants in turn, produce a great number of various fatty acids from C10 to C18, of one to four branches.

Acids of longer chains are less common [Nürnberg *et al*. 1995, Parodi 1997, Wolff 1995]. Fatty acid profile of milk fat (the percentage in total acid pool) of the investigated goats from both farms appeared to be characteristic of this species [Hames and Hopper 2005]. However, some differences concerning the content of fatty acids in the milk fat under study were established (Tab. 4). Saturated fatty acid level in caprine milk fat was similar in the both farms, contrary to mono- and polyunsaturated fatty acid contents. Milk fat from goats fed a pasture fodder-based diet (farm A) contained more (by ca 3%) MUFA (monounsaturated fatty acids) compared to milk fat from goats whose diet included carrot (farm B). A reverse significant correlation was stated regarding the PUFA (polyunsaturated fatty acids) concentration. The acid content differences in milk fat were likely to arise not only from a bulky feed type but the formula of concentrate feeds in the studied farms. A number of researches [Morand-Fehr *et al*. 2007, Sawaya *et al*. 1984, Sklan 1992, Boyourth *et al*. 1994] indicate the impact of various types of feedstuffs, their preparation modes as well as application of different forms of high energy additives on a profile of fatty acids in animal products.

Mineral composition of caprine milk relies upon nutrition strategy to a small extent [Bielak 1995]. Most minerals in goat organism are under strict homeostatic control mechanisms, eg. calcium, iron, zinc. If a ration contains them in excess, their absorption is reduced [Herdt 2000]. Caprine milk provides such components like calcium, phosphorus, potassium, chloride or magnesium as well as trace elements, eg. molybdenum or iodine [Wielba and Pasternak 2001]. According to Kruczyńska [1992], macro element concentration in milk does not depend on a nutrition strategy or a type of feed administered, while the effect of microelement supply is different. The Author reports that microelement concentration in milk is mainly dependent on iodine and selenium levels in a ration, whereas iron and copper content is insignificant. This finding is consistent with the research results of Brzóska *et al*. [1999]. The milk samples under study showed substantial variation and differences in mineral composition between the goat treatment groups (farm A and B), individuals and lactation stage. However, only the mean content of phosphorus and iron differed significantly (Tab. 5). In milk produced by the goats fed a diet with a slightly elevated phosphorus level, this element concentration proved higher compared to the other farm. An opposite correlation was determined in relation to the milk iron level, which supports the hypothesis of strict homeostatic control mechanism for iron in an organism [Kruczyńska 1992, Ganong 2005].

CONCLUSIONS

1. Goats fed a diet consisting of carrot and dry sugar beet pulp, besides hay and concentrate, showed a higher by 12% milk yield than the animals whose diet based on pasture green forage, meadow hay and a concentrate containing field pea.

2. No differences in the SFA contents in goat milk fat were found. Milk fat from goats based on pasture forage ration (farm A) contained more MUFAs compared to milk fat from goats fed a diet containing carrot (farm B). An opposite significant dependence referred to PUFAs.

3. Differences were recorded in milk mineral composition, but solely phosphorus and iron content differed significantly.

REFERENCES

Bielak F., 1995. Kształtowanie się jakościowych i technologicznych cech mleka w zależności od poziomu żywienia mineralnego krów i higieny jego pozyskiwania. Rozpr. hab., Rocz. Nauk. Zoot. Kraków 1995.

Boyourth C., Vernay M., Moncoulon R., 1994. Effect of calcium salt soft fatty AIDS on rumen function the digestibility of ration by sheep. J. Sci. Food and Agric. 64, 341–347.

Brzóska F., Gąsior R., Sala K., Zyzak W. 1999. Effect of linseed oil fatty acid calcium salts and vitamin E on milk yield and composition. J. Anim. Feed Sci. 8, 367–378.

Chachułowa J., 1999. Pasze. Wyd. Rozwój SGGW Warszawa.

De Simiane M., Giger S., Blanchart G., Huguet L., 1981. Nutritive value of cultivated forages. [In:] Nutrition and systems of goat feeding (eds. P. Morand-Fehr, A. Bourbouze, M. De Simiane). ITOVIC_INRA, Tours, France.

Ganong W. 2005. Review of Medical Physiology. McGraw-Hill.

Gniot-Szulżycka J., Leżnicki A., Komoszyński M., Kowalczyk S., Wojczuk B., 2002. Materiały do ćwiczeń z biochemii. Wyd. UMK.

Hames B. D., Hooper N. M., 2005. Biochemia. PWN Warszawa.

Herdt T. H. 2000. Variability characteristic and test selection in herd-level nutritional and metabolic profile testings. Vet Clin. North Am. Food Anim. Pract. 16 (2), 387–403.

Jamroz D., Potkański A., 2004. żywienie zwierząt i paszoznawstwo. Podstawy szczegółowego żywienia zwierząt. T. 2. PWN Warszawa.

Janicki B., Borys B., Borys A., Borzuta K., 2005. Effect of different participle size of rapeseed and linseed in fattening lamb diets. II Yield of slaughter byproducts. 11th Seminar FAO-CIHEAM „Advanced nutrition and feeding Strategies to Improve Sheep and Goat Production”, September 8–10, 2005. Catania Italy, 53.

Jarrige R., 1989. Żywienie przeżuwaczy. Omnitech Press, Warszawa.

Kowalski Z. M., 2006. Żywienie kóz mlecznych i odchów koźląt. [In:] Podstawy szczegółowego żywienia zwierząt (eds. D. Jamroz, A. Potkański). PWN, 187–212.

Kruczyńska H. 1992. Efektywność mineralnego żywienia krów i cieląt w warunkach Wielkopolski. Rozpr. Nauk. 231, Rocz. AR w Poznaniu.

Mir Z., Goonewardene L. A., Okine E., Jaegar S., Scheer H. D., 1999. Effect of feeding canola oil on constituents, conjugated linoleic acid (CLA) and long chain fatty acids in goats milk. Small Rumin. Res. 33, 137–143.

Morand-Fehr P., Sauvant D., Brun-Bellut J., 1987. Recommendations alimentaires pour les caprins. Bulltin Technique, C. R. Z. V. Theix, 70, 213–222.

Morand-Fehr P., Fedele V., Decandia M., Frileux Y. Le., 2007. Influence of farming and feeding systems on composition and quality of goat and sheep milk. Small Rumin. Res. 68, 20–34.

Normy żywienia bydła, owiec i kóz. Wartość pokarmowa pasz dla przeżuwaczy, 2001. Pr. zb. IZ Kraków.

Nürnberg K., Matthes H. D., Bitler G., Silesky D., Ender K., Nürnberg G., 1995. Lipids composition and meat quality of longissimus muscle in lambs. 2nd Dummerstaf Muscle-Workshop Muscle Growth and Meat Quality, Rostok, 17–19.

Official methods of analysis, 2000. International, 17th Ed., AOAC Inter., Gaithersburg, MD, USA.

Belury M. A., Kempa-Steczko A., 1997. Conjugated linoleic acid modulates hepatic lipids composition in mice. Lipids 32, 2 199–204.

Oprządek J., Oprządek A., 2003. Modyfikowanie składu kwasów tłuszczowych w tłuszczu mięsa przeżuwaczy. Med. Wet. 59 (6), 492–495.

Parodi P. W., 1997. Butyric acid from the diet: action at the level of gene expression. J. Nutr. 127, 1055–1060.

Rejman K., Kowrygo B., 2002. Mleko i przetwory mleczne w wyżywieniu ludności Polski. Prz. Spoż. 2, 8–11.

Sanz Sampelayo M. R., Chilliard Y., Schmidely Ph., Boza J., 2007. Influence of type of diet on the fat constituents of goat and sheep milk. Small Rumin. Res. 68, 42–63.

Sauvant D., Morand-Fehr P., Giger-Reverdin S., 1991. Dry matter intake of adult goats. [In:] Goat Nutrition (red. P. Morand-Fehr). EAAP Publication 46, Pudom Wageningen.

Sawaya W. N., Safi W. J., Al-Shalhat A. F., Al-Mohammad M. M., 1984. J. Dairy Sci. 67, 1655-1659.

Sklan D., 1992. A note on production responses of lactating ewes to calcium soaps of fatty acids. Anim. Prod. 55, 167-175.

Soryal K., Beyene F. A., Zeng S., Bah B., Tesfai K., 2005. Effect of goat breed and milk composition on yield, sensory quality, fatty acid concentration of soft cheese during lactation. Small Rumin. Res. 58, 275–281.

The nutrition of goats, 1998. AFRC Technical Committee on Responses to Nutrients. Report 10, CAB International.

Wielba F., Pasternak K., 2001. Pierwiastki śladowe w systemie antyoksydacyjnym zwierząt. Med Wet., 57, 11, 788–791.

Wierciński J. 1984. Ogólne zasady przygotowania materiału biologicznego do analizy składników chemicznych instrumentalnymi metodami Centralnego Laboratorium Aparaturowego AR w Lublinie. (Instrukcja do użytku wewnętrznego z późn. zm.).

Wolff J. A., 1995. Milk and meat lipids of ruminants generally contain high levels of saturated fat (40 to 70%) and trans – fatty acids. J. Food Lipids, 13, 1, 100–112.

Žan M., Stibilj V., Rogelj I., 2006. Milk fatty acid composition of goats grazing on alpine pasture. Small Rumin. Res. 64, 45–52.

Ziemlański Ś., 2001. Normy żywienia człowieka. Fizjologiczne podstawy. PZWL, Warszawa.

Streszczenie. Celem badań była ocena wpływu zróżnicowanego żywienia kóz na wydajność, skład mleka, zawartość składników mineralnych oraz profil kwasów tłuszczowych tłuszczu mleka. Badaniami objęto 40 kóz w dwóch gospodarstwach (A i B). W okresie badawczym kozy otrzymywały w dawkach: zielonkę pastwiskową, siano łąkowe i mieszankę treściwą – gospodarstwo A; marchew, siano łąkowe, mieszankę treściwą oraz suszone wysłodki – gospodarstwo B. Mieszanki treściwe sporządzane były w oparciu o zboża i motylkowe lub poekstrakcyjną śrutę rzepakową oraz mieszankę mineralno-witaminową. W każdym z gospodarstw sześciokrotnie w okresie badawczym oceniano żywienie kóz (pobranie pasz, skład chemiczny pasz, wartość pokarmową dawek) oraz wydajność i skład mleka (zawartość składników podstawowych, mineralnych oraz profil kwasów tłuszczowych w tłuszczu).

Kozy żywione paszą z udziałem marchwi i wysłodków charakteryzowały się wyższą o 12% średnią dzienną wydajnością mleka. W tłuszczu mleka kóz nie stwierdzono różnic w zawartości nasyconych kwasów tłuszczowych (SFA). Tłuszcz mleka kóz żywionych paszą opartą na zielonce pastwiskowej (gosp. A) zawierał więcej kwasów jednonienasyconych (MUFA) w porównaniu z tłuszczem mleka kóz grupy żywionej dawkami z udziałem marchwi (gosp. B). Odwrotną, istotną zależność stwierdzono odnośnie kwasów wielonienasyconych (PUFA). Stwierdzono różnice w składzie mineralnym mleka, istotnie jednak różnił się jedynie poziom fosforu i żelaza.

Słowa kluczowe: kozy, żywienie, wydajność mleka, skład chemiczny mleka, profil kwasów tłuszczowych