Archiv Tierzucht 54 (2011) 2, 177-187, ISSN 0003-9438

Effect of day length and exogenous melatonin on chemical composition of sheep milk

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Abstract

Changes in day length are a major factor in the productivity of farm animals showing reproductive seasonality. Parameters of milk production in sheep and goats are dependent on melatonin and prolactin concentrations. Changes in the prolactin secretion in lactating sheep have an effect on the amount of milk produced, synthesis of milk proteins, fat and immunoglobulins (i.e. milk composition). In the end the quality and commercial value of milk is determined as well. The aim of this study was therefore to find out the effect of day length and exogenous melatonin on the chemical composition of milk and the level of fatty acids. Subjects were 60 Polish Longwool Sheep. Animals were randomly assigned to three groups, Group I (n=20) – ewes raised under natural day length; Group II (n=20) ewes raised under natural day length and were implanted with melatonin; Group III (n=20) – ewes exposed to an artificially short photoperiod (16D:8L). Sheep were milked twice daily using the Alfa Laval Agri milking machine. Composite milk samples were collected every 28 days to determine chemical composition and fatty acid content. The results obtained showed that the administration of exogenous melatonin and the simulation of a short-day photoperiod during the summer period had significant effects on the milk levels of solids, protein, fat and lactose, and on the fatty acid content of sheep milk.

Keywords: sheep, milk, chemical composition, exogenous melatonin, day length

Zusammenfassung

Auswirkung von Tageslänge und exogenem Melatonin auf die chemische Zusammensetzung von Schafsmilch

Änderungen in der Tageslänge sind ein wesentlicher Faktor bei der Produktivität von Nutztieren, die eine sich wiederholenden Saisonabhängigkeit zeigt. Die Parameter für die Milchproduktion in Schafen und Ziegen sind von der Melatonin- und Prolaktinkonzentration abhängig. Änderungen in der Prolaktin-Sekretion in laktierenden Schafen haben Auswirkung auf die produzierte Milchmenge, die Synthese von Milchproteinen, Fett und Immunglobulinen (d. h. auf die Milchzusammensetzung). Schließlich werden auch Qualität und Verkaufswert der Milch bestimmt. Darum bestand das Ziel dieser Studie darin, die Auswirkung von Tageslänge und exogenem Melatonin auf die chemische Zusammensetzung der Milch auf dem Niveau der Fettsäuren festzustellen. Die Versuchsobjekte waren 60 Polnische Langwolleschafe. Die Tiere wurden statistisch auf drei Gruppen verteilt, Gruppe I (n=20) – weibliche Schafe, die unter natürlicher Tageslänge aufgezogen wurden; Gruppe II (n=20) – weibliche Schafe, die unter natürlicher Tageslänge aufgezogenen wurden und denen Melatonin implantiert wurde; Gruppe III (n=20) – weibliche Schafe, die einer kürzeren Kunstlichtperiode ausgesetzt waren (16D:8L). Die Schafe wurden unter Verwendung der Alfa-Laval-Agri-Melkmaschine zweimal am Tag gemolken. Alle 28 Tage wurden Milch-Sammelproben gesammelt, um die chemische Zusammensetzung und den Fettsäuregehalt zu bestimmen. Die erhaltenen Ergebnisse zeigten, dass die Verabreichung von exogenem Melatonin und die Simulierung einer Kurztag-Lichtperiode während des Sommerzeitraums bei Schafsmilch signifikante Auswirkungen auf die Konzentrationen von Feststoffen, Protein, Fett und Laktose und auf den Fettsäuregehalt in der Milch hatten.

Schlüsselwörter: Schafe, Milch, chemische Zusammensetzung, exogenes Melatonin, Tageslänge

Introduction

The growing interest in sheep milk products and the promotion of their health benefits may be what is contributing to the development of sheep farming (Ciuryk *et al.* 2004, Fischer *et al.* 2007, Molik *et al.* 2008). The healthy dietary qualities of sheep milk are due to its high nutrient content (Anifantakis 1986, Haenlein 1996, Żegarska 1998, Pakulski *et al.* 2006). Sheep milk is characterized by lower cholesterol content, more beneficial composition of fatty acids and better hygiene (lower Somatic Cell Content) (Bonczar 2006a, Bonczar 2006b, Borys & Pisulewski, 2001, Olechnowicz *et al.* 2010). Sheep milk is also prized for its dietetic and curative properties because it contains orotic acid and amygdalin, which are recognized as having anticarcinogenic properties (Sawicka *et al.* 1987). The dietetic qualities of sheep milk and the increased interest in cheeses with very good taste and nutritional properties require that this product be marketed all year round (Bonczar 1989, 2006b, Borys *et al.* 2006, Ciuryk *et al.* 2004, Szumacher-Srabel *et al.* 2001, Wasilewicz-Niedbalska *et al.* 2001, Wójtowski *et al.* 2001). However, milk form late in the production season can have manufacturing properties that differ from those of early and mid-season milk (Lucey 1996). Seasonal variation in milk composition has been associated with several factors among which environmental condition such a photoperiod can play an important role. A study by Molik *et al.* (2007) showed that the milk yield of sheep can be determined by day length. Sheep entering lactation during the short day regime produced 50 % less milk than sheep milked during the long day. The differences found in milk yield resulted from changes in melatonin and prolactin concentrations. In short-day animals exposed to decreasing photoperiod, melatonin concentrations were found to increase and prolactin secretion was found to decline (Misztal *et al.* 1996, Molik *et al.* 2006). Changes in prolactin secretion in lactating sheep influence the amount of milk produced. Identifying the relationships between photoperiod and lactation length may help to explain the role of melatonin in regulating milk synthesis and modulating its chemical composition. The aim of this study was to determine the effect of day length and exogenous melatonin on the chemical composition of sheep milk.

Materials and methods

Animals

The study was carried out at the Experimental Station of the Department of Swine and Small Ruminant Breeding of the Agricultural University in Krakow, Poland. Sixty Polish Longwool ewes were used in the experiment. Longwool ewes were chosen as this is a breed that exhibits strong seasonal reproduction activities. The ewes were 4-5 years age and recorded a mean body weight of 60±5 kg. All animals were housed in individual pens under a natural photoperiodic and thermoperiodic environment (longitude: 19° 57′ E, latitude: 50° 04′ N). Ewes recorded an average Body Condition Score (BCS) of 3 (on a scale from 0-5; where O=emaciated and 5=obese) (Russel *et al.* 1969).

Throughout the experiment, sheep were fed according to their physiological status. Thus from the preparation for mating, to the end of the 4th month of pregnancy, all ewes were fed in accordance with the standards of the National Research Institute of Animal Production (Krakow – Balice, Norms, 1993), based on the seasonal feeds available (forage pasture, hay and feed concentrate). From the 5th month of pregnancy, to the end of experiment, sheep received an additional 1.5 kg pelleted diet per day (7.5 MJ net energy and 220 g crude protein). Supplementary hay was also provided. All animals had free access to water and a mineral lick.

Experimental design

Ewes oestrous cycle was synchronized using Chronogest sponges (Chronogest, Intervet International, Boxmeer, The Netherlands). All groups of sheep were mated between 15 and 30 September and lambed in the second half of February. Lambs were reared with mothers for 56 days after which they were weaned and mothers were used for milking. On day 57, the ewes were divided into three groups: Group I (n=20) – ewes raised under natural day length; Group II (n=20) ewes raised under natural day length and were implanted with melatonin as slow-release implants (Ceva Animal, France), implanted subcutaneously behind the ears. Each implant contained 18 mg of melatonin; Group III (n=20) – ewes exposed to an artificially short photoperiod (16D:8L). After weaning, ewes were milked twice daily with an Alfa-Laval milker until drying. Milk yield was recorded individually at 10-day intervals.

To determine chemical composition, composite milk samples were collected every 28 days from each group of sheep. Milk solids, protein, fat and lactose were analysed according to the method of Budsławski (1981).

Fatty acid content was determined by gas chromatography (chromatograph PYE-UNICAM series 104 with chromatography column SUPELCOWAX 10.30 m, ø 0.53 mm, 1.0 µm) following the method described by Mann (1964).

Throughout the experiment, sheep from groups I and II were kept indoors with outdoor access. Throughout lactation, sheep from group III were housed indoors on an area of 20 m^2 under artificial short day (16D:8L).

Statystical analysis

Chemical compositions and fatty acids concentrations are expressed as a mean±SEM. The effects of the treatments chemical compositions milk were analyzed by one-way analysis of variance (ANOVA) followed by the post-hoc least significant difference test, using the SAS 8.1 (SAS 2000). The differences in the parameters of lactations between groups were assayed by the nonparametric ANOVA rank Kruskal-Wallis test, using the same SAS software.

Results

The results obtained showed significant (P≤0.01) differences in milk solids content in the second month of milking. In the next months of milking, milk solids content increased with significant differences (P≤0.05) (Table 1).

Table 1
Changes of chemical composition in sheep's milk

Traits	Group I Control Group		Group II Exogenous melatonin		Group II 16D: 8L	
	$\bar{x}$	S(X)	$\bar{x}$	S(X)	$\bar{x}$	S(X)
Collection 1 - April						
Dry matter, %	18.26	0.2	18.09	0.2	17.46	0.2
Protein, %	5.47	0.07	5.83	0.49	6.19	0.04
Fat, %	7.92^{A}	0.02	7.17^{B}	0.01	5.93^{C}	0.02
Lactose, %	3.87^{C}	0.07	4.09^{B}	0.03	4.32^{A}	0.01
Collection 2 - May						
Dry matter, %	19.2^{B}	0.01	15.7^{A}	0.06	21.8^{C}	0.02
Protein, %	6.6^{B}	0.01	5.86^{A}	0.02	6.87^{B}	0.01
Fat, %	7.43^{B}	0.01	5.21^{C}	0.02	9.8^{A}	0.01
Lactose, %	4.29^{A}	0.01	4.23^{B}	0.04	4.02^{C}	0.01
Collection 3 - June						
Dry matter, %	19.2^{b}	0.02	19.0^{b}	0.06	20.0^{a}	0.02
Protein, %	7.1^{b}	0.07	7.15^{b}	0.01	7.5^{a}	0.07
Fat, %	7.01	0.04	6.73	0.04	7.46	0.02
Lactose, %	4.01^{B}	0.01	4.09^{A}	0.02	3.88^{C}	0.01
Collection 4 - July						
Dry matter, %	20.8^{b}	0.06	20.84^{b}	0.01	20.31^{a}	0.05
Protein, %	6.8^{B}	0.04	7.8^{A}	0.01	7.09^{B}	0.01
Fat, %	8.81^{A}	0.08	7.75^{B}	0.01	8.02^{B}	0.03
Lactose, %	4.8^{A}	0.01	4.17^{B}	0.01	4.17^{B}	0.05

^{A,B,C}mean indicates with the different letters in verse shows differences at *P*≤0.01, ^{a,b}mean indicates with the different letters in verse shows differences at *P*≤0.05

The highest protein content at the second sampling was characteristic of the milk from sheep housed under 16D:8L conditions (6.87±0.01 %), whereas the milk from melatonin-implanted sheep contained significantly (P≤0.01) less protein (5.86±0.02 %) (Table 1). In June, a significantly (P≤0.05) higher protein content was found in the milk from sheep maintained under 16D:8L conditions (7.5±0.07 %), whereas the milk from the control group and melatonin-implanted sheep contained less protein (7.1±0.07 % and 7.15±0.01 %, respectively). In the fourth month of milking, a significantly (P≤0.01) higher protein content was characteristic of the milk from melatonin-implanted sheep (7.8±0.01 %), with less protein contained in the milk from 16D:8L (7.09±0.01 %) and the control group of sheep (6.8±0.04 %). When analysing the changes in fat content, significant differences were found in the first month of milking (Table 1). During the second sampling fat content was significantly (P≤0.01) highest for the milk from sheep maintained under 16D:8L conditions (9.8±0.01 %), with the lowest amount of fat contained in the milk from melatonin-implanted sheep (5.21±0.02 %). In July, fat content was the highest in the control group of sheep (8.81±0.08 %). Significantly (P≤0.01) lower amounts of fat were found in the milk from 16D:8L (8.02±0.03 %) and melatonin-implanted sheep (7.75±0.01 %). The analysis of changes in milk lactose content revealed significant (P≤0.01) differences between the analysed groups.

Changes in the fatty acid content in the milk of sheep from groups I, II and III in the first month of milking are shown in Table 2. The significantly (P≤0.05) highest content of saturated fatty acids was characteristic of the milk from 16D:8L sheep (7.79±2.6 %), with the least saturated fatty acids found in the milk from melatonin-implanted sheep (7.24±2.6 %). When analysing changes in the content of unsaturated fatty acids, significant (P≤0.05) differences were observed between the group of melatonin-implanted sheep (3.28±1.9 %) and the 16D:8L group (2.53±1.4 %). In the first month of milking, the highest content of polyunsaturated fatty acids was characteristic of the milk from sheep implanted with melatonin (1.67±0.9 %; Table 2).

Table 2
Changes of fat acid in sheep's milk in April, %

Fatty acid	Collection 1- April					
	Group I Control Group		Group II Exogenous melatonin		Group II 16D: 8L	
	$\bar{x}$	S(X)	$\bar{x}$	S(X)	$\bar{x}$	S(X)
C 4:0	2.97[a]	1.1	3.25[b]	1.7	3.15	1.6
C 6:0	2.71[a]	0.9	2.82	1.4	2.88[b]	1.5
C 8:0	2.80	0.9	2.94	1.8	2.89	1.6
C 10:0	9.96	3.1	9.78[a]	4.2	10.94[b]	6.3
C 12:0	6.42[c]	2.4	5.98[a]	1.9	7.31[b,d]	3.9
C 14:0	14.08[a,c]	5.3	12.54[b,e]	5.9	15.54[d,f]	7.4
C 15:0	1.08	0.7	1.10	0.6	1.027	0.6
C 16:0	27.60[b]	9.3	26.59[a,c]	11.4	29.19[d]	10.3
C 17:0	0.47	0.03	0.56	0.04	0.40	0.03
C 18:0	5.97[b]	1.6	6.83[d]	2.3	4.54[a,c]	1.7
C 10:1	0.45	0.03	0.39	0.01	0.51	0.04
C 14:1	0.43[b]	0.02	0.29[a,c]	0.01	0.516[d]	0.04
C 16:1	1.45[a]	0.8	1.12[b]	0.8	1.30	0.7
C 17:1	0.23	0.4	0.26	0.02	0.18	0.01
C 18:1	15.76[b]	7.4	17.54[d]	6.9	12.85[a,c]	5.9
C18:2	2.05	0.9	2.45[b]	1.3	1.89[a]	0.7
C 18:3	0.66[d]	0.04	0.90[a,c]	0.05	0.46[b]	0.03
CLA	0.61[b]	0.04	0.68[d]	0.02	0.49[a,c]	0.03
SFA	7.4	2.8	7.24[a]	2.6	7.79[b]	2.9
MUFA	3.01	1.7	3.28[b]	1.9	2.53[a]	1.4
PUFA	1.36	0.8	1.67[a]	0.9	1.18[b]	1.1

CLA: conjugated linoleic acid, SFA: saturated fatty acid, MUFA: monounsaturated fatty acid, PUFA: polyunsaturated fatty acid

Significantly (P≤0.05) lower amounts of polyunsaturated fatty acids were found in the milk from sheep housed under 16D:8L conditions (1.18±1.1 %). Conjugated linoleic acid (CLA) was the most abundant in the milk from melatonin-implanted sheep (0.68±0.02 %). Significantly (P£0.05) less CLA was contained in the milk from 16D:8L sheep (0.49±0.03 %) and the control group of sheep (0.61±0.04 %).

When analysing changes in the content of saturated fatty acids in the second month of milking (Table 3), significant (P≤0.05) differences were found between sheep kept under 16D:8L conditions (7.98±3.2 %) and the control group (7.69±3.1 %) (Table 3). There were also significant (P≤0.05) differences in the content of unsaturated fatty acids between these groups (2.26±1.3 % vs. 2.62±1.9 %).

Table 3
Changes of fat acid in sheep's milk in May, %

Fatty acid	Collection 2- May					
	Group I Control Group		Group II Exogenous melatonin		Group II 16D: 8L	
	$\bar{x}$	S(X)	$\bar{x}$	S(X)	$\bar{x}$	S(X)
C 4:0	2.68[A]	1.2	2.76	1.8	2.95[B]	1.6
C 6:0	2.53	1.1	2.56	1.5	2.70	1.5
C 8:0	2.72	1.4	2.78	1.9	2.87	1.7
C 10:0	10.59[a]	3.3	10.87	3.8	11.56[b]	6.4
C 12:0	7.35[a]	2.4	7.68	2.9	8.21[b]	3.8
C 14:0	15.73[a,c]	7.3	16.43[b]	7.4	16.84[d]	7.6
C 15:0	1.11	0.9	1.10	0.8	1.13	0.8
C 16:0	29.14	9.8	29.62	11.6	30.02	12.3
C 17:0	0.36	0.04	0.36	0.03	0.31	0.02
C 18:0	4.67[b]	1.6	3.87	2.4	3.21[a]	1.8
C 10:1	0.52	0.06	0.54	0.02	0.62	0.03
C 14:1	0.59	0.05	0.59	0.03	0.75	0.04
C 16:1	1.86[b]	0.8	1.62[a,c]	0.9	1.84[d]	0.7
C 17:1	0.20	0.4	0.20	0.01	0.18	0.01
C 18:1	13.08[b]	7.4	12.71[d]	6.7	10.60[a,c]	6.9
C18:2	1.72	0.9	1.87	0.9	1.50	0.7
C 18:3	0.37	0.04	0.38	0.04	0.28	0.02
CLA	0.49	0.02	0.43	0.01	0.40	0.03
SFA	7.69[a]	3.1	7.8	2.8	7.98[b]	3.2
MUFA	2.62[b]	1.9	2.56	1.8	2.26[a]	1.3
PUFA	1.05	0.7	1.13	0.8	0.9	0.04

CLA: conjugated linoleic acid, SFA: saturated fatty acid, MUFA: monounsaturated fatty acid, PUFA: polyunsaturated fatty acid

The highest CLA content in the third month of milking was characteristic of the milk from the control group of sheep (0.71±0.04 %) and the lowest CLA was contained in the milk from melatonin-implanted sheep (0.35±0.01 %), with significant (P≤0.05) differences (Table 4). Significantly (P≤0.05) the highest content of saturated fatty acids was characteristic of the milk from melatonin-treated sheep (8.06±3.1 %). Meanwhile, the highest content of unsaturated fatty acids was found in the milk from the control group of sheep (2.71±1.9 %). Significantly (P≤0.05) lower amounts of these acids were contained in the milk from melatonin-implanted sheep (2.38±1.7 %). In the last month of milking (July) the highest CLA content was characteristic of the milk from the control group of sheep (0.96±0.3 %), whereas the milk from sheep maintained under 16D:8L conditions had the lowest CLA content (0.38±0.02 %), with significant (P£0.05) differences. In July (Table 5), the milk from the control group of sheep continued to have the highest content of unsaturated fatty acids (2.93±1.7 %). The milk from sheep maintained under a 16D:8L regime had a significantly (P£0.05) lower content of these acids (2.44±0.8 %). There were significant (P£0.05) differences in the polyunsaturated fatty acid content of milk between the control group of sheep (1.68±0.6 %) and those raised under short days (1.20±0.1 %).

Table 4
Changes of fat acid in sheep's milk in June, %

Fatty acid	Collection 3- June					
	Group I Control Group		Group II Exogenous melatonin		Group II 16D: 8L	
	$\bar{x}$	S(X)	$\bar{x}$	S(X)	$\bar{x}$	S(X)
C 4:0	2.64	1.2	2.41[a]	1.6	2.97[b]	1.8
C 6:0	2.55	1.1	2.35[a]	1.5	2.74[b]	1.6
C 8:0	2.75	1.3	2.74	1.7	2.96	1.7
C 10:0	10.4[a]	4.2	11.84[b]	5.1	11.53	7.5
C 12:0	6.8[a]	2.8	8.78[b]	3.9	7.89	3.9
C 14:0	14.26[a]	7.2	17.58[b,d]	8.2	15.78[c]	8.1
C 15:0	1.29	0.9	1.13	0.8	1.13	0.9
C 16:0	28.26[a]	10.9	30.13[b]	11.8	29.25	13.1
C 17:0	0.42	0.02	0.37	0.02	0.35	0.02
C 18:0	4.60[b]	1.9	3.29[a]	2.1	4.06	2.1
C 10:1	0.48	0.03	0.50	0.03	0.55	0.04
C 14:1	0.57	0.02	0.59	0.04	0.61	0.05
C 16:1	2.16	0.7	1.67	1.1	1.88	0.7
C 17:1	0.26	0.02	0.21	0.01	0.24	0.01
C 18:1	12.76[b]	7.6	11.53[a]	6.9	12.12	7.2
C 18:2	2.36[b]	0.9	1.87[a]	0.9	2.04	0.8
C 18:3	0.39	0.02	0.30	0.02	0.29	0.01
CLA	0.71[b]	0.04	0.35[a]	0.01	0.50	0.03
SFA	7.41[b]	3.2	8.06[a]	3.1	7.87	3.9
MUFA	2.71[b]	1.9	2.38[a]	1.7	2.54	0.6
PUFA	1.37	0.8	1.11	0.9	1.16	0.4

CLA: conjugated linoleic acid, SFA: saturated fatty acid, MUFA: monounsaturated fatty acid, PUFA: polyunsaturated fatty acid

Table 5
Changes of fat acid in sheep's milk in July, %

Fatty acid	Collection 4- July					
	Group I Control Group		Group II Exogenous melatonin		Group II 16D: 8L	
	$\bar{x}$	S(X)	$\bar{x}$	S(X)	$\bar{x}$	S(X)
C 4:0	2.58	1.3	2.38[a]	1.1	2.93[b]	0.9
C 6:0	2.48[c]	1.2	2.33[a]	0.9	2.84[b,d]	0.8
C 8:0	2.58[a]	1.3	2.61	1.2	3.07[b]	1.7
C 10:0	9.61[a]	4.7	10.46	5.6	11.80[b]	8.2
C 12:0	5.91[a]	2.9	7.87[b]	4.2	7.31	3.7
C 14:0	12.64[a]	6.8	16.71[b]	8.6	15.80	9.1
C 15:0	1.46[b]	0.8	1.10	0.9	0.86[a]	0.09
C 16:0	27.27[a]	11.9	28.89	12.3	29.81[b]	12.4
C 17:0	0.53	0.03	0.39	0.02	0.35	0.02
C 18:0	4.88	1.9	3.89	1.9	4.64	1.4
C 10:1	0.40	0.02	0.55	0.1	0.45	0.02
C 14:1	0.51	0.03	0.69[b]	0.2	0.34[a]	0.06
C 16:1	2.22[b]	0.8	1.80	0.7	1.01[a]	0.3
C 17:1	0.38[a]	0.02	0.23	0.01	0.14[b]	0.01
C 18:1	13.59	7.8	13.89	7.1	12.73	6.9
C18:2	2.95[b]	0.9	1.56[a]	0.9	2.04	0.8
C 18:3	0.40	0.02	0.42	0.1	0.36	0.01
CLA	0.96[b]	0.3	0.41	0.1	0.38[a]	0.02
SFA	6.99	2.8	7.67	3.3	7.94	3.4
MUFA	2.93[a]	1.7	2.74	1.8	2.44[b]	0.8
PUFA	1.68[a]	0.6	0.99	0.06	1.20[b]	0.1

CLA: conjugated linoleic acid, SFA: saturated fatty acid, MUFA: monounsaturated fatty acid, PUFA: polyunsaturated fatty acid

Discussion

The day length is an important factor in the initiation and maintenance of lactation as a modulator of melatonin and prolactin concentrations. It is the changes in prolactin secretion in lactating sheep that primarily affect the amount of milk produced, synthesis of milk proteins, fat and immunoglobulins (i.e. milk composition), and thus the quality and technological suitability of milk. Photoperiod is an important factor influencing animal productivity. It plays a particularly important role in short-day animals, in which day length has an effect on changes in melatonin and prolactin secretions (Misztal *et al.* 1996, Misztal *et al.* 2001). Studies by Sawicka *et al.* (1987) and Ciuryk *et al.* (2001) indicated that in seasonally breeding ewes milk composition i.e solids content, proteins and fat levels increased when lactation continued. The present study demonstrated that administration of exogenous melatonin and simulation of the short day had a significant effect on the chemical composition of milk and the level of fatty acids. The administration of melatonin implants during the long day reduced the average solids content. The present study showed that milk from Control group was characterized by lower proteins content compared to experimental groups. Ewes exposed to an artificial short photoperiod (16D:8L) and those with melatonin implants produced milk with higher fat level. However, the highest concentration of fat was noted in milk collected from ewes kept under an artificial short days condition (16D;8L). The results of our study are similar to data received by Auldist *et al.* (2007) who determined the effect of exogenous melatonin on milk yield and composition of milk from dairy grazing cows. Moreover, similarly to our results got from melatonin-implanted ewes and those kept under an artificial short-days conditions, authors indicated that melatonin decreased lactose concentration in milk (Auldist *et al.* 2007). In the present study melatonin decreases lactose level after only 30 days of lactation. The present findings, especially those obtained for changes in protein content in the Control group, can be related to the studies by El-Saied *et al.* (1998) and Cappio-Borlino *et al.* (1997). In their findings, protein and fat content increased in Valle del Belice sheep during lactation. In seasonally breeding animals (sheep) melatonin modulates not only prolactin secretion but it is able to modify milk composition, as well. Furthermore, studies by Molik *et al.* (2007, 2008) showed that ewes milking during the long photoperiod could produce more milk than ewes milking under the short-day conditions. That suggest that melatonin can affect milk production in seasonally breeding ewes. The precise mechanism of action of melatonin is still unclear, however there are speculations that prolactin could be one of the factor which mediates of galactopoietic effects of the day-length on milk composition (Dahl *et al.* 2000).

In the present study, as lactation continued, in milk from Control group the content of SFA (saturated fatty acid) decreased and the content of PUFA (polyunsaturated fatty acid) increased. Implantation of exogenous melatonin and exposition of ewes to an artificial short days (16D:8L) caused decrease in MUFA (monounsaturated fatty acid) and PUFA content. Moreover, the present study revealed that as lactation began and continued, the levels of butyric, caproic and caprylic acids consistently decreased and the content of capric acid increased. A study by Bonczar (1989) and Wojtowski *et al.* 2001 and Meluchova *et al.* (2008) showed that towards the end of lactation, the milk from sheep had an increased content of C4:0, C6:0, C18:0, C18:1 and C18:3 fatty acids, and a decreased content of C8:0, C10:0, C12:0, C14:0, C16:0 and C18:2 acids.

It is worth to indicate that milk from the Control group had the highest level of CLA. The administration of melatonin via subcutaneous implants and an artificial short-days conditions reduced CLA content of milk and caused lower healthy dietary qualities of milk.

The present study showed that the introduction of biochemical and light modulation of photoperiod through increased melatonin secretion via subcutaneous implants and an artificial short-day condition can affect milk composition in seasonally breeding ewes. Melatonin not only decrease lactose concentration but also caused a significant deterioration in the fatty acid profile of milk. These results imply seasonal variations in milk composition common to Polish milking ewes which cannot be overridden by farming though diet or breeding system. Further studies are needed to confirm that phenomenon in order to make sheep milk production system more regular around the year together with better manufacturing properties of milk.

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Received 16 June 2010, accepted 23 January 2011.

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