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Fatty Acid Profile of Wool Grease from Olkuska Lambs

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In the chemical and cosmetics industry wool grease is recognised as high quality raw material of animal origin, i.e. lanolin. It consists of two factions: grease and sweat produced by skin glands (perspiratory and sebaceous glands). The openings of those two glands are situated on the skin, which results in the mixing of those two secretions and the formation of wool grease (Cholewińska et al., 2016).

The substances present in grease, including the fatty acid profile, can be affected by diet and various types of treatments (including bathing). The grease consists of about 35% esters of higher fatty and wax acids and aliphatic alcohols, 25% free fatty acids, 25% sterols, as well as a small amount of hydroxyl acids and salts (Jover et al., 2002). The next fraction of wool grease, i.e. the sweat, consists of 99% water. Other components of sweat include: urea, chloride and potassium sulphate and other water-soluble organic salts and acids. Due to its high potassium content, it is its source in industry (Dankowski et al., 2005; Jaber et al., 2012).

The composition of the sheep wool grease depends on the breed, age, nutrition and climatic and geographic conditions. It protects wool from atmospheric and mechanical factors and has further bacteriostatic effects. In addition, it lubricates wool and it is an indicator of the animal's health (Cholewińska et al., 2016; Lopez-Mesas et al., 2005).

The purpose of the work was to present the characteristics of fatty acids in the wool grease of lambs up to the fifth week of age. The impact of bathing on the profile was also assessed.

Materials and methods

Animal material and wool tests

The animal material consisted of the Olkuska lambs raised within the premises of the Agricultural Experimental Station in Swojec. The main herd is composed of about 40 items. Sheep are covered by the genetic resources conservation program. These animals are traditionally raised in the 1 lambing/year system. They are maintained in the alcove and pasture deep litter system, and the sheep-shearing takes place once a year - in May. The average yield of grease wool is about 4 kg/mother/year. In the summer season, the sheep are kept on the grassy pasture with the access to hay provided throughout the year *ad libitum*. In winter, they receive oat at 300g/piece/day.

Obtaining wool samples for research

The samples of wool for testing were collected from lambs from twin litters (8 litters), whose age did not exceed 5 weeks. The control group consisted of 8 lambs (control lamb sample). Wool samples were taken from the left side of the lambs at the blade height from the area of 4x5 cm. In total,

32 samples were collected for testing, which were unified by weight up to 0.4 g (+/- 0.015 g). All the samples were stored in paper envelopes at the temperature of 25°C and 70% humidity until chemical analyses were carried out.

One lamb of each twin pair was bathed with the use of Virbac shampoo (about 60-70 ml shampoo per 10l of water), Sebolytic series (dermatological shampoo for dogs and cats for skin with seborrheic symptoms). The composition of the shampoo: monosaccharides/alkyl polyglycosides, salicylic acid, linoleic and y-linolenic acid, octopirox and bound in the form of spherulites® zinc glucan and vitamin B6 (virbac.pl).

Research on fatty acid profile

Wool grease was obtained by Soxhlet extraction method and its content was determined in the tests. For the examination of the fatty acid profile of mother and lamb wool, the AGILENT 7890A gas chromatograph manufactured by AGILENT TECHNOLOGIES (USA) was used. The flame ionisation detector (FID) was used. The research specified the quantity and quality of saturated and unsaturated fatty acids. During the chromatography, 12 saturated fatty acids (C4-C18) and 13 unsaturated fatty acids (C14-C20) were distinguished.

Elaboration of the results

Fatty acids were grouped into saturated (SFA), mono-unsaturated (MUFA) and poly-unsaturated (PUFA) fatty acids. The results are presented as arithmetic means and the percentage content.

The results and their discussion

The wool grease content in both the wool of bathed and washed lambs was at the level of 5%. The bathing of lambs resulted in different levels of individual fatty acids. In the examined fatty acid profile in the control lamb sample, 15.17 g/100g SFA, 12.13 g/100 g MUFA and 47.77 g/100 g PUFA were detected. Detailed quantities of individual fatty acids are presented in Table no. 1.

The content of saturated fatty acids in the wool grease of bathed lambs accounted for 17.33%, while in the case of the control lamb sample, it was about 3 percentage points higher. The percentage content of mono-unsaturated fatty acids was at a similar level of ~ 16%, while the percentage content of poly-unsaturated fatty acids was higher by 3.7 percentage points.

The characteristics of the fatty acid profile also showed the occurrence of margaric acid (C17-0) in the bathed lambs sample while it was not found in the control lambs sample. The wool grease of the control lambs sample revealed three times higher level of stearic acid as compared to the wool grease of the bathed lambs. It was also revealed that the wool grease of the control lamb sample was characterised by twice as much content of myristoleic acid (C14:0) and 1.5 times as much of palmitoleic acid (C16:1).

The occurrence of individual acids performs both protective and greasing function on the skin film and hair. Unsaturated fatty acids affect the proper functioning of the skin and also have a bacteriostatic role by means of creating acidic reaction on its surface, which is unfavourable for the development of bacteria (Bojarowicz and Woźniak, 2008, Mierzejewski, 1998).

Table 1. Fatty acid profile in wool grease from lambs (%/100 g)

Fatty acids	*Lambs up to 5 weeks of age – control*		*Lambs up to 5 weeks of age – bathed*		*Difference (percentage points)*
	content (%/100 g)	*SD*	*content* (%/100 g)	*SD*	
BUTYRIC (C4:0)	6,32	*4,75*	4,86	*3,84*	1.46
CAPRIC (C10:0)	0.46	*0.35*	0.37	*0.29*	0.1
UNDECANOIC (C11:0)	0.63	*0.48*	0.47	*0.37*	0.17
LAURIC (C12:0)	0.49	*0.37*	0.33	*0.26*	0.16
MYRISTIC (C14:0)	2.12	*1.59*	1.66	*1.31*	0.46
PENTADECANOIC (C15:0)	2.89	*2.17*	1.91	*1.51*	0.98
PALMITIC (C16:0)	3.86	*2.9*	3.78	*2.99*	0.08
MARGARIC (C17:0)	0	*0*	3.01	*2.38*	-3.01
STEARIC (C18:0)	3.41	*2.56*	0.93	*0.74*	2.47
MYRISTOLEIC (C14:1)	0.67	*0.51*	0.34	*0.27*	0.34
MONOENOIC (C15:1)	0.61	*0.46*	0.51	*0.41*	0.09
PALMITOLEIC (C16:1)	3.38	*2.54*	2.15	*1.7*	1.23
OLEIC (C18:1n9c)	10.63	*7.98*	11.66	*9.21*	-1.03
VACCENIC (C18:1n7t)	0.85	*0.64*	0.69	*0.55*	0.16
LINOLEIC (C18:2n6c)	2.49	*1.87*	2.63	*2.08*	-0.14
trans-LINOLEIC (C18:2n6t)	2.51	*1.89*	1.79	*1.42*	0.72
CLA	15.86	*11.91*	16.47	*13.02*	-0.61
YES (C18 - 3n3)	6.97	*5.23*	8.05	*6.36*	-1.08
DIHOMO-γ-LINOLENIC (C20:3n6)	2.24	*1.68*	2.59	*2.05*	-0.36
ARACHIDONIC (C20:4n6)	32.13	*24.12*	34.07	*26.92*	-1.94
cis-5,8,11,14,17EPA (C20:5n3)	1.42	*1.07*	1.68	*1.33*	-0.26
ΣSFA	20.20	*15.17*	17.32	*13.69*	2.88
ΣMUFA	16.16	*12.13*	15.36	*12.14*	0.79
ΣPUFA	63.63	*47.77*	67.30	*53.18*	-3.67

The determined fatty acids profile in the wool of lambs up to the fifth week of age was obably affected by their age and related diet. The tested lambs consumed mainly milk and, in addition, small amounts of oats and hay.

Linoleic acid, CLA and oleic acid occurring in both bathed and control lambs samples belong to exogenous acids absorbed mainly from milk (Patkowska-Sokoła et al., 2005, Pappas, 2009, Kakela and Hyvarinen, 1996). They affect the metabolism of the skin, protect the skin against water loss and are components of the lipid barrier while oleic acid additionally has a function associated with the regeneration of the epidermis and reduces inflammation (Zielińska and Nowak, 2014).

An additional factor affecting the fatty acid profile of wool grease could be the maternal environment (puerperal care by the mother - licking) and the functioning of sebaceous glands.

During the growth of lambs there occur also changes in the structure of wool, and hence - in the amount of grease and perspiration released and the content of individual acids (Niżnikowski, 2011, Staniszkis and Grycewicz, 1959).

Summary

The determination of the fatty acid profile of lambs allows undertaking further research on the impact of individual factors on its composition in future. However, undoubtedly its composition is directly affected by the diet associated with the lambs age. An additional factor may also be the continuous development of skin glands and the changing structure of wool. However, there was no significant effect of lamb bathing on the composition of the wool grease because its composition changed only to a small extent.

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FATTY ACID PROFILE OF WOOL GREASE FROM OLKUSKA LAMBS

Summary

The presence of individual fatty acids in sheep wool grease has a significant effect on the condition of wool and skin. The diet has the largest effect on the fatty acid profile. Other factors are age, breed, and climatic and geographic conditions. The study was designed to determine the fatty acid profile of lamb grease wool and to investigate the effect of bathing on its composition. The results showed the presence of margaric acid (C17: 0) in a sample from bathed lambs that did not appear in the control lambs sample. On the other hand, the control lamb samples contained twice as much myristic acid (C14:0) and 1.5 times as much palmitoleic acid (C16:1). The wool grease from both tests showed the presence of fatty acids typical of a milk-rich diet: linoleic acid, CLA, and oleic acid. Probably the fatty acid profile was also influenced by the maternal environment - the lambs at that time were licked by mothers. The fatty acid content is mainly studied in tissues, while there are few studies on their content in wool. Given the importance of lanolin in the pharmaceutical and cosmetic market, knowledge of factors affecting its composition should be supplemente

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Olkuska sheep with lamb (Photo: J. Sikora)