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SHEEP IN THE POLISH CARPATHIANS: GENETIC RESOURCES CONSERVATION OF THE PODHALE ZACKEL AND COLOURED MOUNTAIN SHEEP

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Summary

Native breeds of sheep in the Polish Carpathians (Polish Mountain Sheep, Podhale Zackel, Coloured Mountain Sheep) are very well adapted to the local environmental conditions, undemanding in feed and highly resistant to adverse living conditions. They play an important role in rural tourism as a component of landscape, folk culture and supplier of many valuable products. To save local breeds from extinction and preserve valuable characteristics in the population they were included in the sheep genetic resources conservation program, while the national agri-environmental program provides breeders with financial support. Podhale Zackels accompanied man during the period when the wild Carpathian areas were being settled and became a permanent feature of the highlander economy and culture. Coloured Mountain Sheep were kept by mountaineers due to the dark hue of their wool and skin, used to produce regional dresses and decorative elements. Mountain breeds are a multipurpose sheep. They give milk for production of traditional products (*oscypek*, *bundz*, *bryndza*, *redykolka*, *żentyca*), wool and delicious meat. Podhale Lamb, derived from mountain sheep, gained the status of Protected Geographical Indication.

Keywords

sheep • the Carpathians • genetic resources conservation

1. Sheep in the Polish Carpathians

Shepherding and sheep breeding in the Polish Carpathians have a long tradition (Figure 1). Pastures were used jointly by several villages by the thirteenth century and since the fourteenth century sheep were milked and lump cheese (*gruda*) was made [Drozdowski 1961]. Wallachian populations and settlements had a huge impact on the development and process of sheep breeding. Wallachians were originally the population of the Balkan Peninsula, speaking Eastern Romance languages, leading a seminomadic, pastoral way of life. Settled in the areas of the Polish Carpathians Wallachian shepherds blended with the indigenous people and spread their own customs, beliefs, pastoral culture and terminology. These customs are present to this day in the highlander names and rituals [Czamańska 2007].

Photo by W. Puchalski, IZ PIB archive

Fig 1. Zackel herd

Sheep in the Polish Carpathians were derived from the Wallachian Zackel which were brought there by the Wallachians. As the influx of the Wallachian population to the Polish Carpathians stopped, the natural, local and economic conditions shaped the two types of sheep. In the Hutsul region and the Beskid Mountains they remained closer to the Wallachian Zackel. In the Tatras and Podhale areas they differed slightly from the former type. According to Czaja [1952], two types of zackel could be distinguished: the Beskid Zackel, bred in the Beskid Mountains and the Tatras (Podhale) Zackel, found in the Tatras and Podhale, which differed significantly in size and usability. The Beskid Zackel were larger, meatier and useful for providing milk, similar in type to the Wallachian Zackel. The Podhale Zackel were much smaller but also useful in providing milk.

Zackel is a large group of sheep of comprehensive usability. It is widespread in southern Europe, namely in Greece, the Carpathian mountains, the Balkans and Hungary. A characteristic feature of zackel is their exceptional resistance to climatic conditions and diseases. Zackel are strong, undemanding and suitable for long treks and enclosures. They can use steep, difficult to access pastures and thanks to their long neck and narrow mouths they can eat scant vegetation. Density wool coat, with long flocks falling on both sides of the trunk, provides excellent protection against the adverse effects of long rain.

The group was divided into a number of local varieties with different names: Greek Zackel (Karagouniko, Skopelos, Vlahico) are animals of low body weight and poor wool, but have good milk yield. Bulgarian Zackel (Karakachan, Greek Sarakatsan) of brown wool are found virtually in the whole Balkan Peninsula. The Albanian Zackel – skutar

sheep (Shkodrane) produces thick and long wool which is used for making mattresses, pillows, rugs and blankets. The Balkan Zackel (Pramenka) give curled wool and are found all over the former Yugoslavia (Sjenica, Pirot, Lipa, Vlashka, Bardok). The Hungarian Zackel (Raczka, Rack) is a primitive sheep, with long spirally twisted horns, thick wool of white and brown/white color, and comes from the Carpathian region of Transylvania. The Raczka is also present in the Romanian Carpathians and Slovakia. It is bigger in size than the Hungarian variety and has multipurpose utilization. Transylvanian Zackels are bigger than the others and their wool is thicker and longer, reaching 40 cm in annual regrowth. The sheep are very similar to the Polish Mountain Sheep. Curkana (Tsurcana) is the local name for the Romanian Sheep. These are almost half the number of sheep in Romania and can be white, black and gray. Zackles in Slovakia (Walaszki) produce thinner and smoother wool than other sheep and their milk yield is very high (100–150 kg of milk). And from Slovak Zackels good quality leather sheepskins are obtained.

2. Podhale Zackel

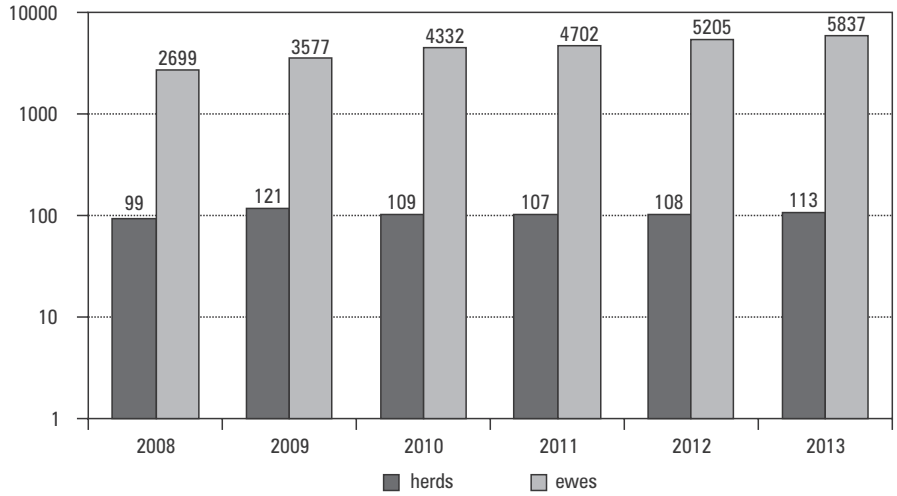
The Podhale Zackel breed is remarkably well-adapted to the harsh climate and topography of the mountainous regions of Poland and have a comprehensive usability. Woolen *buk* cloth was produced of wool and felts for the production of *kapce* (boots), *cuhy* and *gunie* (coats). After weaning the lambs from the ewes, about 50 litres of milk are obtained which are processed into cheese. The sheep of this breed have become an integral part of the highlanders economy and culture.

In the late nineteenth and early twentieth centuries, there were several attempts to improve the usefulness of zackel by introducing them into different Podhale breeds of sheep; these were the Negretti merinos, the Cygaje from Hungary, the English Black Sheep, and even the Wensleydale breed rams. Using Friesian rams and Pomeranian *fagas* in Podhale turned out to be ineffective, due to the decrease in immunity of the zacklo-friezes breed. However, in Sądecki region it perpetuated the type of foothills sheep that has better milk and wool production. The most successful was the last pre-war attempt of the zackel refinement with his close relative, the Transylvanian zackel. The result was a significant improvement. The hybrids were well acclimatized and had a heavy woolly coat. Unfortunately, the negative side was a lower zackel milk yield and shorter lactation.

After the war further efforts to develop a new type of mountain sheep were made. The most important role in creation of a refined variety of zackel, Polish Mountain Sheep, played the Experimental Institute of Animal in Grodziec Śląski under the guidance of prof. M. Czaja. By mating Podhale native ewes with imported Romania and Transylvania Zackel and Frisian rams, body weight of adult ewes and milk yield were increased and the nature of efficiency and woolly coat character were changed.

The process of perfecting the breed stock, aimed at improving use value, resulted in the transformation of their genotype and consequently led to the displacement of the original zackel genetic principles. The Podhale Zackel ceased to be distinguished as a separate breed and was given, along with other refined sheep, the name Polish Mountain Sheep. To maintain the number of positive features, specific to the old zackel

(such as resistance to harsh environmental conditions and diseases, characteristic woolly covering with the wispy structure, excellent protection against the adverse impacts of rainfall, strong maternal and herd instinct or longevity), in 2007 at the National Research Institute of Animal Production a program of conservation of genetic resources for the breed was adopted. From the population of existing Polish Mountain Sheep, Podhale Zackel type ewes were selected. These were characterized by phenotypic features consistent with the pattern specified in the program. About 2.7 thousand sheep met the program requirements. Within a few years of its implementation, the protected population has doubled (Figure 2).



Source: National Research Institute of Animal Production

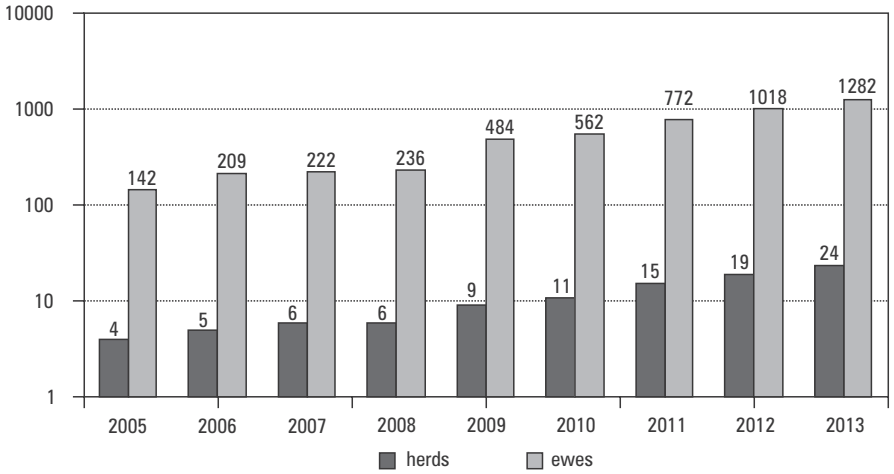
Fig. 2. Changes in the protected population CP

3. Color variety of the Polish Mountain Sheep

Work on the separation of color sheep from the Polish Mountain Sheep population began in 1999 and consisted in selecting animals on the basis of their appearance, color and nature of the cover. Since 2000 the Regional Association of Sheep and Goats Breeders in Nowy Targ has been keeping the books for the color variety of Polish Mountain Sheep breeds and assessing its usefulness. All herds of coloured variety of Polish Mountain Sheep are located in the districts of Nowy Targ and the Tatra Mountains (Małopolska). The size of herds range from 13 to 120 ewes. Thanks to isolation of coloured sheep as an independent breed its practical value and the quality of products derived from it could be determined. Tests such as these are carried out at the National Research Institute of Animal Production. These included wool usability characteristics, the analysis – carried out with molecular biology techniques – of the breed genetic structure and its

comparison with other native breeds. Recently, a comprehensive assessment of breed's usefulness and quality of the products obtained from it is made.

Since the launch of the protection of coloured variety of Polish Mountain Sheep, the dynamic growth of the protected population can be observed (Figure 3). In 2005, four farmers attended the program and the flocks had total of 142 ewes and 6 rams stud. In subsequent years, the protected population gradually increased by including individual flocks into the program. The biggest, twofold increase in population occurred in 2009. Since the launch of program of the coloured mountain sheep protection, the population increased by more than 1100 ewes. In 2013, the protection program included nearly 1300 ewes in 24 flocks.



Source: National Research Institute of Animal Production

Fig. 3. Changes in protected population POGB

4. Protection of sheep genetic resources in Poland

Poland is one of the forerunners of species protection, both in wild fauna and livestock, including sheep. The crisis of Polish sheep-breeding and the decline of the sheep population was a threat to the existence of many valuable indigenous breeds. Many of the old breeds have disappeared forever (*karnówka*, *krukówka*) and other breeds and varieties formed after the war and associated with certain regions of the country were also in danger due to the lack of profitability on their farms. In order to save these valuable populations, which are a part of the cultural heritage, certain actions were taken to maintain the biodiversity of these farm animals. In 1999, the work on the National Program of Protection of Animal Genetic Resources began [Krupiński et al. 2003] and a year later the Ministry of Agriculture and Rural Development approved protection programs

for specific sheep populations. Among them were the following breeds of sheep: the *wrzosówka* and *świniarka*, coloured variety of the Polish Mountain Sheep classified as mixed-wool sheep; the long woolly sheep – *olkuska*, *kamieniecka*, the Pomeranian, Leine; lowland sheep – *wielkopolska*, *koridеil*, *uhruska* and *żelaźnieńska*; the coloured merino and merino fertile Booroola. After a few years the Booroola merino protection was abandoned, due to low interest of breeders and the only flock of Leine breeding sheep were killed by fire. In 2005 an amendment to the protection programs was developed, adapting them to the requirements of the EU [Program ochrony… 2005]. In 2008 the program included the protection of the old type of Merino Sheep and Podhale Zackel.

Since 2005 the breeding of native breeds of sheep has been supported by payments under the Rural Development Program. The National Research Institute of Animal Production since 2002 has served as the national coordinator for the protection of farm animals genetic resources. Breeders of a native breed, who are affiliated with the conservation program, receive a grant for every ewe in the herd. Participation in the protection program is voluntary and the rules are established by the agreement between the beneficiary – the owner of the herd and the relevant regional association of sheep and goats breeders. The main objective of the program is to preserve endangered breeds, to identify the pattern of population, select features that are subject to systematic assessment, fashion and review evaluation methods of the breeding value and generate rules used to select animals for mating. The program also introduces a range of additional tools to help its implementation, such as scientific research, actions promoting and popularizing the use of native breeds of sheep in environmental protection and rural tourism. All these regulations are expected to improve the profitability of breeding of endangered populations and to promote products derived from them.

5. The use of mountain sheep

In Poland the use of dairy sheep products has only regional importance and is practically limited to the mountain regions of our country: Podhale and Beskidy. The Polish Mountain Sheep, inextricably connected with these areas, is a breed of well-known production capacity. Two groups of sheep extracted from the population of the Polish Mountain Sheep: the Polish Mountain Sheep and the coloured variety of the Podhale Zackel are now recognized as separate breeds. However, the way in which dairy is obtained, used and managed remains unchanged. It is done according to the centuries-old traditions of mountain sheep breeding. During the lactation period of around 150 days ewes of these breeds provide about 60–70 litres of milk, from which the traditional cheeses are produced.

The Polish Mountain Sheep, Podhale Zackel, Polish Mountain Sheep of coloured variety are animals used for many purposes (Figure 4). Mountain sheep meat is very tasteful, equally appreciated by domestic and foreign consumers. Milk lambs products are known for their quality and exported to Italy. Wool and hides are used for making of various kinds of garments (traditional highlander dress, fur coats, sweaters, socks, slippers), as well as blankets and decorative hides.

Photo by A. Kawęcka

Fig. 4. Ewes of Polish Colored Mountain Sheep and Podhale Zackel

Sheep grazing on mountain pastures are permanently integrated into the landscape of the Polish mountains and are an integral part of highland folklore. An unbreakable link of mountain people and animals, sealed by traditions passed down from generation to generation, has survived many adversities with which Polish sheep-breeding has struggled for years. The culmination of their efforts are the very colorful celebrations of pastoralism, which are held yearly in Podhale and Beskidy. During this festive time the highlanders complete all the rites required by sheep breeding. The economic aspect of these activities is vital too. They attract tourists, providing additional earnings for local traders, farmers, owners of boarding houses and inns.

Mountain sheep fulfil an ecological function and at the same time are the most economical form of environment maintenance. Sheep grazing and the rational use of meadows and pastures lands have positive impact on the soil and botanical composition of green growth and improve the quality of the landscape. Sheep grazing is particularly important in mountain areas [Drożdż 2001]. In national parks cultural grazing is carried out, once neglected but restored again, in the 1980's. Grazing prevents soil erosion, enhances plant species composition, prevents the spread of wild shrubs and trees and favours the growth of low vegetation (crocus, clover, herbs). Grazing is associated with a special form of pasture fertilization the so-called *koszarzenie* (sheep

enclosure). At night, sheep grazing in a pasture are herded into *koszar* (sheep enclosure). There they leave their excrements, rich in macro-elements, which they tread into sod and thus limit the loss of nitrogen to the atmosphere and its leaching to the ground [Drożdż and Twardy 2004].

6. Traditional products

Products made from mountain sheep's milk are excellent. They are traditional products probably known to all consumers: *żentyca*, *bundz*, *bryndza podhalańska*, *oscypek* and *redykołka*. *Bryndza podhalańska* was the first product in Poland to be granted the protection of the EU. Sometime later, *oscypek* and *redykołka* were registered (Table 1). Regional products with legally protected names and manufacturing technologies are created only in certain regions of the European Union. An agricultural product or food can use the following three forms of the European system of protection of names: Protected Designation of Origin (PDO), Protected Geographical Indication (PGI) and Traditional Speciality Guaranteed (TSG). In 2013 there was 1163 products with registered names and the list is constantly getting longer. Among European countries, Italy leads with 254 products, followed by France (200 products) and Spain (164). Poland has 35 registered products and is in the eight place [www.ec.europa.eu/agriculture/quality/door/list.html].

In accordance with the traditional recipe approved by the European Union, [Rozporządzenie Rady... 2006] milk for *oscypek* production can only come from ewes of Polish Mountain Sheep with an acceptable addition (max. 40%) of cow's milk obtained from Polish Red cows. Cheese production season lasts from May to September, due to the limited availability of sheep's milk. The method of *oscypek* production is passed on from generation to generation and is based on traditional tools, terminology and customs. Raw sheep's milk is heated in a boiler and rennet (*klag*) is added. The coagulated milk is mixed with wooden *ferula*, strained and then the curd is torn into portions and kneaded in the bucket. The handmade cheese block is repeatedly kneaded and brewed in a hot water bath at 70° C. The cheese is formed with the use of the ring carved on the inside (*oscypiorka*), which is put in the middle and the parts left outside are kneaded by hand into a conical shapes, giving it the distinctive fusiform appearance. Then, it is pierced by the spire and the ends are cut-off. Next, it is soaked for about a day in brine (broth) and after drying it is laid on the shelf above a burning fire (*watra*) in the hut. *Oscypek* is smoked for a few days and takes on a unique flavour and brilliant color from yellow to light brown. *Oscypek* weight ranges from 0.6–0.8 kg.

For the production of *bundz*, after the coagulation of milk, whey is filtered in a special scarf. The cheese is very tasty, but less durable. By ripening salted and minced *bundz* (for two weeks) bryndza is obtained that can be stored for a longer period. During the production of cheese, following by the heating of whey, proteins coagulate and very tasty and nutritious drink – *żętyca* – is made. It can be consumed directly while fresh or after a few days when it was left to ferment (souring). Preferably, it is served chilled or as an additive to foods [Musiał 2006]. *Redykołki*, another product of the status of the PDO, is a small cheese in the shape of animals, hearts or spindles. It is made at the end

of the grazing season with the remains of cheese. The name of these products is derived from *redyk* or return of sheep from mountain pastures (*hale*), when the shepherds are giving the animals back to the farmers.

The joint actions taken by Regional Association of Sheep and Goat Breeders in Nowy Targ and the Tatra-Beskid Cooperative of Producers "Gazdowie" in Leśnica brought the Podhale lamb the status of Protected Geographical Indication (PGI). And it is the only meat product of Polish sheep recognized in the EU under this label. The highland lamb is a meat produced from Podhale Zackel lamb, the Tatra Polish Mountain Sheep and the coloured variety of Polish Mountain Sheep that were not older than 60 days. The carcass weight of these milk lambs is from 4 to 8 kg. Registration of Podhale lamb as a regional product protected in the EU is an opportunity for the wider promotion.

In Poland it is the Ministry of Agriculture and Rural Development that is responsible for registration of products of specific geographical origin and specific, traditional quality. The law on the registration and protection of names and designations of agricultural products and foodstuffs and traditional products [Ustawa... 2004] regulated the registration of names at EU level and brought into being a list of traditional products (LPT) at the national level. Currently, there are 1151 traditional products listed, standing out for their quality or unique properties brought about by the use of traditional production methods and at least 25 years existence. The list of Traditional Products was established to promote and gather information about the region. Products are put on such a list not to protect their names but as a result of broadening the consumers' knowledge about them. All dairy products derived from mountain sheep were put on the LPT (Table 1). In addition to the above-mentioned Podhale lamb, the list has also registered Beskid lamb and meat products derived from domestic Pomeranian sheep, *olkuska*, *świniarki* and *wielkopolska* sheep.

Table 1. Regional and traditional products of mountain sheep

Product	Designation, date of registration in the EU	LPT, Voivodeship
Bunc / bundz / grudka	–	Małopolska, Silesian
Bryndza podhalańska	CHNP, 12/06/2007	Małopolska
Bryndza żywiecka	–	Silesian
Bryndza wołoska wędzona	–	Silesian
Oscypek	CHNP, 14/02/2008	Małopolska, Silesian
Redykołka	CHNP, 01/12/2009	Małopolska, Silesian
Żętyca / żentyca	–	Małopolska, Silesian
Jagnięcina beskidzka (lamb)	–	Silesian
Jagnięcina podhalańska (lamb)	CHOG, 12/10/2012	Małopolska

CHNP – Protected Designation of Origin, CHOG – Protected Geographical Indication, LPT – List of Traditional Products

7. Health-promoting qualities of sheep products

Pastures play a major role in the nutrition of mountain sheep. In turn, sheep provide healthy and nutritionally beneficial products. Numerous studies have shown that animals fed with green forage and other volume food produce meat with less fat and the preferred profile of fatty acid. The nutritional value of the sheep's products is determined by its chemical composition. Table 2 shows selected components of milk and meat according to different livestock species. Sheep's milk in comparison with goat and cow milk contains more fat and protein of which almost 80% is casein – an extremely useful substance in processing of milk. Sheep products are a rich source of potassium, phosphorus, calcium and magnesium and vitamins [Danków and Pikul 2011, Milewski 2006]. They fully cover the demand for amino acids. They contain many substances biologically active and important for our health. These fatty acids are one of the main indicators of quality of fat, and fulfil a number of functions in the human diet. Saturated fatty acids (SFA) and cholesterol may be synthesized in the animal's body and their excess is harmful to our health, because it increases amount of cholesterol in the blood, especially the fraction associated with lipoproteins LDL, known as a bad cholesterol [Łoźna et al. 2013]. Monounsaturated fatty acids (MUFA) and polyunsaturated (PUFA) have the opposite effect and reduce the levels of LDL. PUFA acids are classified as essential fatty acids (EFAs) which the body does not produce and must be provided by food. The most important acids are: linoleic acid, α-linolenic acid, arachidonic acid, eicosapentaenoic acid and docosahexaenoic. They reduce the risk of diet-related diseases and are extremely important in the physical development of children and adolescents.

A polyunsaturated fatty acid, having valuable properties, is a conjugated linoleic acid (CLA). From the point of view of human nutrition, CLA has many health-promoting properties. Among others, it is a factor preventing obesity, it has anti-sclerosis and anticancer properties and stimulates the immune system. Its presence is found primarily in muscle tissue and in the milk fat of ruminants. In terms of comparing the meat of various livestock species for the content of CLA, it was found that lamb is the richest source while other types of meat do not contain this ingredient or have it in trace amounts [Patkowska et al. 2000].

In the milk and meat of ruminants there is a vitamin descendant substance L-carnitine. It regulates the body's lipid metabolism, lowers cholesterol, prevents atherosclerosis and obesity, reduces fat, and has a beneficial effect on the nervous system. Supplementation with L-carnitine is often used by people practicing competitive sports, because it increases the tolerance to effort ratio. Research has shown that products derived from sheep contain most of this compound [Bodkowski et al. 2011].

Food products derived from the Polish Mountain Sheep, Coloured Mountain Sheep and Podhale Zackel, raised in the Tatra and Beskid Mountains on natural, unfertilised pastured lands of various botanical composition of the sward, rich in herbs, fully meet the current needs of consumers looking for food that is not only tasty but also has health-promoting qualities. The increase in consumer interest in organic products and high quality food provides an opportunity for the development of the products made

from the meat and milk of mountain sheep and for the increase of the size of sheep population.

Table 2. The chemical composition of meat and milk of different species of livestock

Ingredients	Meat		
	Lamb	**Beef**	**Pork**
Dry matter [%]	22.6–24.1*	24.2–25.7	27.5
Protein [%]	19.3–20.5*	20.9–22.0	21.33
Fat [%]	1.8–2.5*	1.2–2.2	2.66
Ash [%]	1.1*	1.1	1.0
Calcium [mg]	5–6	4.2	4.6
Cholesterol (mg · 100 g^{-1})	55–58*	63–64	62–64
Fatty acids MUFA [%]	35.0–38.7*	41.0–46.0	53.8
Fatty acids PUFA [%]	11.4–12.4*	6.0–10.0	7.8
CLA [nmol · mg^{-1}]	12.3	6.24	0.7
Thiamine [mg]	0.12	0.07	0.07
Niacin [mg]	3.9	3.6	3.4
Vitamin B12 [µg]	1.8	3.0	0.7
L-carnitine [mg · 100 g^{-1}]	210	64	30
	Milk		
	Sheep milk	**Cow's milk**	**Goat's milk**
Dry matter [%]	18.2–19.5*	11.2–14.5	10.7–20.1
Protein [%]	5.9–6.6*	3.0–4.0	2.8–5.0
Fat [%]	6.9–7.5*	3.0–4.5	2.5–9.7
Ash [%]	0.9*	0.7	0.7
Lactose	4.3–4.6*	4.3–5.2	4.0–5.0
Cholesterol [mg · 100 g^{-1}]	20	14	11
CLA [nmol · ml^{-1}]	12.4	8.7	6.7
Thiamine [mg]	0.3	0.2	0.3
Niacin [mg]	2.1	0.4	1.4
L-carnitine [mg · 100 ml^{-1}]	11.1	8.4	5.9

Source: Bodkowski et al. 2011, Danków and Pikul 2011, Kawęcka and Paraponiak 2006, Milewski 2006, Patkowska-Sokoła et al. 2000

* Data on mountain sheep

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