DOI: 10.21005/AAPZ2019.49.1.13

FOLIA POMERANAE UNIVERSITATIS TECHNOLOGIAE STETINENSIS
Folia Pomer. Univ. Technol. Stetin., Agric., Aliment., Pisc., Zootech. 2019, 348(49)1, 121–130

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ALTERNATIVE USE OF MARE MILK

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Abstract. Mare milk, compared to the milk of other animal species used for dairy purposes, is distinguished by a wealth of bioactive substances conferring health benefits. Mare milk positively affects the human immune system and digestive system. It is rich in nutrients that have a beneficial effect on the skin and protect its cells against oxidative stress. The aim of the survey was to investigate consumer awareness of the alternative use of mare milk. The survey was conducted among students from four fields of study (bioengineering of food, dietetics, agriculture, and animal husbandry) and people with no connection to agriculture. In total, responses were obtained from 200 people. Fifty-one per cent of respondents were unaware that horses are used for dairy purposes. Mare milk is most often (60% of respondents) associated only with food for foals. The respondents' awareness of the chemical composition of milk was low (37%). The main food product made from mare milk that was familiar to the respondents (70%) was kumis.

Key words: mare, lactation, colostrum, milk, kumis, cosmetics.

INTRODUCTION

The horse is one of the few species of domestic animals used for transport, warfare and sport. Horses are used to a lesser extent in the food industry, for their meat or milk, although the nutritional and therapeutic properties of mare milk were recognized as early as the fifth century by Herodotus (Salimei and Park 2017). The health benefits of mare milk have been appreciated mainly because it is similar in composition to human milk and because it can be used to produce fermented alcoholic beverages. In this respect, mare milk is very well known in ethnomedicine and is an important component of the traditional diet of Asian steppe peoples, among whom consumption of horse milk is culturally and environmentally rooted (Langlois 2011; Ishii et al. 2014). On the Eurasian continent, mainly the Asian part, milk has been widely acquired from mares throughout the centuries (Potocnik et al. 2011). It has most often been consumed in the form of the fermented beverage kumis, which was popular among the Huns, Avars, Prussians and Sambians. In Central Asia, mare milk remains an important component of the human diet (Lasota-Moskalewska 2005). Over the few years, there has also been increased interest in mare colostrum and milk in the human diet in Europe, especially France and Germany (Doreau and Martin-Rosset 2011; Salimei and

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Park 2017). In Italy, mare milk has been recognized as a potential substitute for cow milk for allergic children (Curadi et al. 2001). Mare milk is also effective in the treatment of liver inflammation, chronic peptic ulcer disease, and tuberculosis. The therapeutic and hypoallergenic properties of mare milk result from the fact that its composition differs significantly from that of cow milk, which is most commonly used in the human diet, and is similar to that of human milk (Malacarne et al. 2002; Salimei et al. 2002; Kucukcetin et al. 2003; Doreau and Martin-Rosset 2011), especially its low nitrogen content, low ratio of casein to whey proteins, and high lactose content (Markiewicz-Kęszycka 2012; Salimei and Park 2017). In addition, some characteristics, including high content of polyunsaturated fatty acids and low cholesterol, appear to be contributing to the growing interest in mare milk and its increasingly common use in the human diet (Salimei 2015). The demand for this raw material by the pharmaceutical and cosmetic industries is growing as well (Markiewicz-Kęszycka 2012). Beverages made from or based on mare milk have numerous medicinal properties. For example, they contain lactic acid, which reduces fever and aids digestion. Kumis, the most popular drink made from mare milk, is used in the treatment of tuberculosis and as a probiotic in diabetes and leukaemia. Kumis also has a positive effect on gastrointestinal diseases, anaemia and nervous system disorders (Spitsberg 2005; Danków et al. 2012; Salimei and Park 2017). Another issue raised in the study is the use of mare milk in cosmetology. Various kinds of creams, body lotions, soaps, shower gels and shampoos are made from it. Manufacturers have combined effects characteristic of cosmetics with the antibacterial and therapeutic properties of milk. They have created creams for all skin types. These are natural products that can be used by the entire family (Danków et al. 2012; Salimei and Park 2017).

Mare milk is a natural low-fat product with a high content of antibacterial lysozyme, which is beneficial for human health (Amirante et al. 2004; Danków et al. 2012). The composition and properties of mare milk are very similar to those of human milk, and therefore can replace it in the diet of infants. During digestion, both of these types of milk produce a precipitate which is very well absorbed by humans, including infants. Horse milk is a valuable source of mono- and polyunsaturated fatty acids essential for the normal growth and development of the human nervous system (Malacarne et al. 2002; Amirante et al. 2004, Danków et al. 2012). High microbiological quality, i.e. low levels of somatic cells and bacteria, is characteristic of mare milk. The total bacterial count in fresh milk is similar to that of pasteurized cow milk. This may be due to the small number of teats and small udder of mares (Salimei and Park 2017).

Mare milk has found applications in the kitchen, in cosmetics and in various diseases. It is suitable for direct consumption after milking, mainly due to its sweet taste. The best known product made from mare milk is probably kumis. Kumis, produced by fermenting mare milk, is a popular beverage in Russia and western Asia, Mongolia and northern China. It is particularly favoured by the elderly, in accordance with tradition or for therapeutic purposes (Doreau and Martin-Rosset 2011). Kumis is known for its wealth of trace elements, vitamins and bioactive proteins (Uniacke-Lowe 2011; Salimei and Park 2017). Kumis, also known as milk wine, is a good source of B vitamins (B1, B2 and B12) and vitamins PP, D, E and C. It also contains antibiotics, enzymes and trace elements (Danków et al. 2013). In Western

European countries, especially Germany, France and Italy, powdered mare milk is becoming increasingly popular. Powdered dairy products retain certain specific features of raw mare milk, such as high levels of whey proteins and polyunsaturated fatty acids and low casein content. Compared to its cow milk counterparts, powdered mare milk has significantly higher levels of arginine, cystine and aspartic acid (Marconi and Panfili 1998).

Mare milk has many valuable assets. It positively affects the human immune system and digestive system. It is rich in ingredients that have a beneficial effect on skin and protect its cells from oxidative stress. The polyunsaturated fatty acids in equine milk protect the skin against water loss and normalize its metabolism. In addition, the milk contains anti-inflammatory factors that have a significant impact on diseases such as psoriasis and atopic dermatitis, because they reach the deeper layers of the skin. Moreover, it accelerates wound healing and protects the skin against bacteria or viruses. It has a positive effect in the treatment of osteoporosis. Used in patients with diabetes, it may allow the dose of insulin to be reduced. Mare milk aids treatment of gastric and pancreatic ulcers as well as gall bladder inflammation. It is also used in the treatment of migraine, alleviating attacks and increasing the intervals between them. Lysozyme exerts a positive effect in cancer patients by inducing tumour necrosis. The valuable properties of mare milk are useful during treatment with antibiotics, facilitate detoxification of the body, and help during recovery after chemotherapy. Due to its high content of essential fatty acids, which are not produced in the body and are an important component of dairy products for infants, it is used in paediatrics. Mare milk improves the work of the heart muscle and circulation in the limbs. It contains more than 40 bioactive substances, so that its effects on the human body are multifaceted. In addition, concentrates with collagen and calcium are produced from the milk and used to treat diseases such as pharyngitis, influenza, and inflammation of the airways or urinary tract (Kucukcetin et al. 2003; Schopen et al. 2009; Danków et al. 2012).

The aim of the study was to present the properties of mare milk and its alternative uses in human nutrition, as well as public awareness of the possibility of using mare milk.

MATERIAL AND METHODS

The study was based on a questionnaire designed by the authors, conducted among students of various fields of study (bioengineering of food, dietetics, agriculture, and animal husbandry) and people with no connection to agriculture. The survey was conducted in January 2018 on a university campus. The survey consisted of 20 questions regarding the alternative use of mare milk and general information related to milk. Most of the questions (15) were closed, single-choice questions. The questions regarding the fat content of milk, livestock species from which milk is obtained, cosmetics based on mare milk, culinary applications of mare milk, and the medicinal properties of mare milk were open questions. The questionnaire was completed by 200 people. Among the 200 respondents, 55% were women and 45% men. Thirty-five percent of respondents were 15–20 years of age, 35% were aged 21–30 and 30% aged 31–40. People living in rural areas were the largest group (65%; data at the time of the survey), 20% of respondents were residents of cities with a population of up to 100,000, and 15% lived in cities with a population of over 100,000. The percentage distribution of responses to each question is presented in the form of graphs.

RESULTS

The first four questions concerned the gender, age, place of residence and education of the respondents. The next question asked the respondents whether they buy milk, and with what fat content. Only a quarter of respondents stated that they do not buy milk at all. The respondents' preferences regarding fat content in milk are presented in Fig. 1.

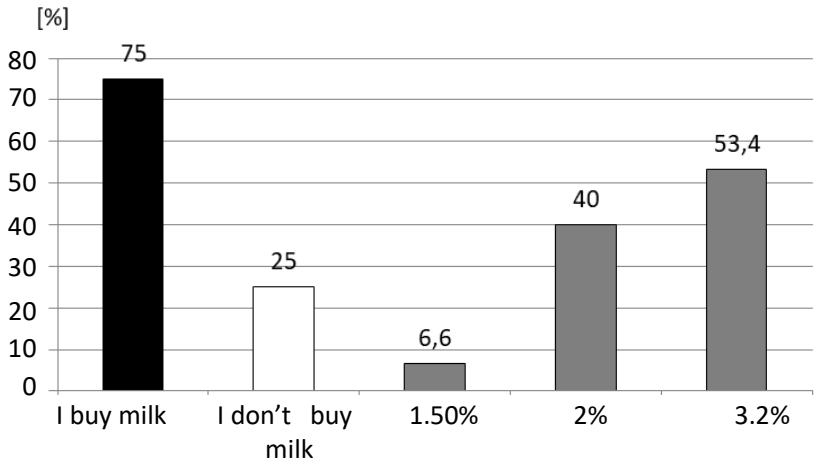

Fig. 1. Respondents' preferences regarding fat content of milk

In the next question, the respondents were asked about the origin of the milk they buy. As many as 87% of respondents choose the most common kind of milk, i.e. cow milk. The remaining 13% choose goat milk (5%), horse milk (5%) and sheep milk (3%) – Fig. 2.

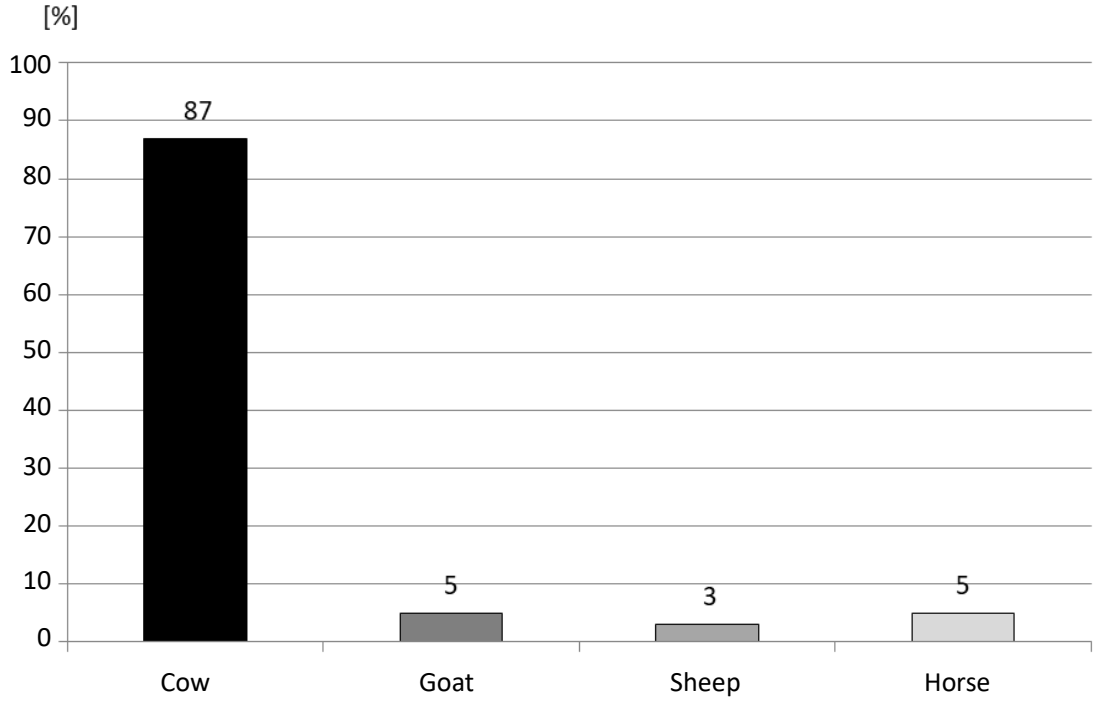

Fig. 2. Percentage shares of milk of different species in the respondents' preferences

There are many reasons for the low level of interest in mare milk. One such factor is undoubtedly the lack of knowledge and awareness of the availability of this product; 51% of respondents were unaware that there are mare milk farms in Poland.

The next question concerned knowledge of the definition of colostrum. Figure 3 presents the breakdown of the respondents in terms of knowledge of the definition of colostrum.

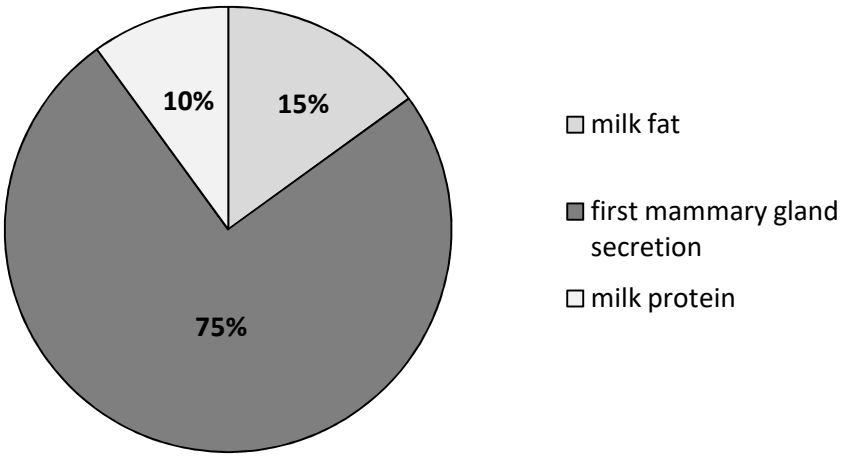

Fig.3. Respondents' answers concerning the definition of colostrum

An important issue related to milk production is lactation. Lactation is the period of milk secretion by the mammary glands of mammalian females after parturition. The length of lactation depends on the species, breed and type of use. The vast majority of respondents (77.5%) chose the correct answer, but 30 people (15%) believed that lactation is the first secretion of the mammary gland, and the remaining 7.5% indicated that it is vitamins contained in milk.

Mare milk has very valuable properties, owing to which it has numerous applications. Despite the low level of interest in mare milk, 55% of respondents were aware of its valuable properties.

The chemical composition of mare milk resembles that of human milk. Therefore, it can be used as a substitute for breast milk in the diet of neonates. Among the respondents, 120 (60%) did not know that mare milk is more similar to breast milk than cow milk. Only 80 people (40%) were aware of this.

Mare milk is used as an element of cosmetics. It has components that have a beneficial effect on the skin. For this reason various kinds of balsams, creams, shower gels and shampoos are made with this milk. Among those surveyed, 120 respondents (60%) had no idea about such cosmetics, while 80 people (40%) had heard of and in some cases even used cosmetics based on horse milk. Cosmetics based on horse milk are suitable for all skin types, even irritated skin. Over half of the respondents (65%) indicated that they were unaware of this use of cosmetics with the addition of mare milk.

Mare milk has culinary applications. It can be used for dishes that are based on milk. Among the respondents, only 60 people, or 30%, knew that mare milk can be used for culinary purposes.

In the next question, respondents were asked if they had ever drunk mare milk. Due to the lack of interest in and knowledge about mare milking farms, the respondents had had little opportunity to drink mare milk. Only 40% of respondents had consumed mare milk.

Mare milk is difficult to find in the Polish market and is not very popular. It has a sweet and distinct flavour, so it is suitable for drinking immediately after milking. Among those surveyed, 62.5% correctly answered the question about the taste of mare milk, while 17.5% responded that it is sour, and 20% indicated that it is bitter.

The next question checked the respondents' knowledge regarding the chemical composition of milk, and concerned lactose. Among those surveyed, 60% of respondents answered correctly that lactose is milk sugar. Of the remaining respondents, 25% indicated that lactose is albumin and 15% responded that it casein.

The next question also concerned the chemical composition of milk. This time, respondents were asked about the fat content in mare milk. Horse milk has very low fat content compared to that of other mammals – only 1.21%. A very small number of respondents gave the correct answer, while 75 people (37.5%) indicated 3.2% fat and 32.5% of respondents indicated 2% fat content.

In the next question, the respondents revealed their knowledge of what is probably the most popular food product made from mare milk, i.e. kumis, also called milk wine. Of those surveyed, 140, or 70%, had heard of or even drunk kumis. Only 30% of respondents had never heard of such a product.

The last question concerned the respondents' knowledge of diseases that can be treated with mare milk, or in which it has a positive effect during recovery. Only 50% of respondents were able to answer this question. They mentioned food allergies, atopic dermatitis, psoriasis, and atherosclerosis. The remaining respondents were not able to correctly answer this question.

DISCUSSION

The horse is not only an odd-toed ungulate used as a draught animal. It can also be used for its milk. Many people are unaware of this type of use of horses, hence the low level of popularity and awareness of mare milk among consumers, which was confirmed in the survey conducted for this study.

The milk of mares, compared to the milk of other species used for dairy purposes, is largely similar in composition to human milk and has a wealth of bioactive substances making it a product with health benefits (Salimei et al. 2002). Due to allergies and diseases of civilization, Polish people are increasingly looking for alternative food products and 'functional foods'. The market niche for this raw material is growing. This is likely to be influenced by the popularity of eco-friendly products, supported by numerous advertising campaigns, as well as society's increasing wealth (Markiewicz-Kęszycka 2012). Despite the growing popularity of mare milk, public knowledge about it is still incomplete. This is evidenced by the results of the survey conducted for the present study.

Mare milk is a natural low-fat product with a high content of antibacterial lysozyme, which has a beneficial effect on human health. The survey showed that the respondents' knowledge

of the chemical composition of mare milk, mainly protein, sugars and fats, is not at a high level. At the same time, it is primarily due to the chemical composition of mare milk that it is considered a functional food.

The fat globules of mare milk are uniform in size and smaller than those of cow milk (Malacarne et al. 2002). Small fat globules do not combine well, which is why it is almost impossible to skim cream from mare milk. The fat globules of mare milk consist of three layers: an inner protein layer, a middle phospholipid layer, and an outer layer of high-molecular-weight glycoproteins. On the surface of the outer layer there is a branched structure of oligosaccharides similar to that found in the fat globules of human milk, which is not present in cow milk (Danków et al. 2006).

Mare milk has a very low fat content, ranging from 0.44% to 2.22%, with more fat in the early stages of lactation than at the end (Caroprese et al. 2007; Pikul et al. 2008; Pikul and Wójtowski 2008). Mare milk is a source of mono- and polyunsaturated fatty acids. Monounsaturated fatty acids do not cause cholesterol accumulation like saturated fats and do not spoil as easily as polyunsaturated fatty acids. Moreover, they have a positive effect on the concentration of high-density lipoproteins (HDL) transporting cholesterol from the walls of the blood vessels to the liver, where it is broken down into bile acids, which are then eliminated from the body. At the same time, monounsaturated fats reduce the concentration of low-density lipoproteins (LDL), which circulate throughout the body and are deposited in the blood vessels (Markiewicz-Kęszycka 2012; Pecka et al. 2012, Markiewicz-Kęszycka et al. 2014).

The fat content in mare milk is almost three times lower than in cow milk, the milk most commonly consumed by people, which results in a relatively high concentration of fat-soluble vitamins. The lactose content is comparable to that of human milk, but much higher than in cow milk. The high lactose content in mare milk has a positive effect on calcium absorption in the intestines (Malacarne et al. 2002). In comparison with cow milk, mare milk has a different composition and protein structure. The content of casein proteins in mare milk is less than 50%, so it is an albumin type of milk. Whey proteins in mare milk account for almost 40%. This composition of proteins makes it a more beneficial source of nutrients than cow milk (Csapo et al. 2009).

During digestion in the human digestive system, mare milk forms a characteristic precipitate, which is much better absorbed by infants than coagulating cow milk. In addition, there are more whey proteins in mare milk than in cow milk, and thus higher levels of hormones, immunoglobulins, lysozyme and lactoferrin (Chifalo et al. 2006; Danków et al. 2012).

Mare milk has found application in the kitchen, in cosmetics, and as a medicinal product or one supporting treatment or convalescence. The people surveyed indicated kumis as the best known food product made from mare milk, but their knowledge of the health benefits of mare milk was mainly limited to allergic diseases.

Kumis is a beverage obtained from mare milk by lactic acid and alcoholic fermentation. Its colour is milky white with a bluish tint. The taste of kumis is slightly sour, with a characteristically perceptible yeasty aftertaste. The smell is aromatic, pleasant and slightly sour, and it has a fine-grained consistency. It has a very high nutritional value and beneficial dietetic and

health properties. In comparison with milk obtained from other livestock species, mare milk is largely similar in composition to human breast milk and has a wide range of bioactive substances that give it health-promoting properties (Mackiewicz-Kęszycka 2012).

A study conducted by a team of researchers from the University of Jena demonstrated that mare milk improves the health of people with atopic dermatitis. Systematic use reduces the severity and extent of eczema (Foekel et al. 2009). Mare milk benefits patients with Crohn's disease and ulcerative colitis (Mackiewicz-Kęszycka 2012). Mare milk also has positive effects on patients with cardiovascular diseases, bronchial and lung diseases, cirrhosis, stomach ulcers, osteoporosis (by increasing calcium absorption), and anaemia. Mare milk accelerates wound healing and has a bactericidal effect. In diabetic patients, it improves the glycaemic index (Csapo-Kiss et al. 1995; Chifalo et al. 2006). In people who suffer from migraine, it alleviates attacks and extends the interval between them. Due to its high content of lysozyme, it is used in the treatment of tumours and in convalescence following chemotherapy and radiotherapy (Kucukcetin et al. 2003). The content of fatty acids, mainly linolenic and linoleic, positively affects brain and nerve cell development and the neurological stability of people with Alzheimer's disease. MMF (Mares Milk Factor) and MMF forte concentrates produced from mare milk, with collagen and calcium, are used in the treatment of pharyngitis, influenza, and inflammation of the airways and urinary tract (Kucukcetin et al. 2003).

In summary, the level of public awareness of the use of mare milk in medicine and cosmetology is low. A campaign is needed to promote the many uses of mare milk in dietetics, cosmetology and medicine.

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ALTERNATYWNE WYKORZYSTANIE MLEKA KLACZY

Streszczenie. Mleko klaczy, w odniesieniu do mleka innych gatunków zwierząt użytkowanych mlecznie przez człowieka, wyróżnia się bogatym zestawem składników bioaktywnych, które czynią z niego produkt o właściwościach prozdrowotnych. Kobyle mleko pozytywnie wpływa na układ odpornościowy człowieka i układ pokarmowy. Jest bogate w składniki, które korzystnie wpływają na skórę i chronią jej komórki przed stresem oksydacyjnym. Celem badań ankietowych było zbadanie świadomości konsumentów w zakresie alternatywnego wykorzystywania mleka klaczy. Ankieta została przeprowadzona wśród studentów czterech kierunków studiów (bioinżynieria produkcji żywności, dietetyka, rolnictwo i zootechnika) oraz ludzi niezwiązanych z rolnictwem. Łącznie uzyskano odpowiedzi od 200 osób; 51% ankietowanych nic nie wie o mlecznym kierunku użytkowania koni. Mleko klaczy najczęściej (60% ankietowanych) kojarzone jest wyłącznie z pokarmem dla źrebiąt. Świadomość respondentów na temat składu chemicznego mleka jest niska (37%). Głównym produktem spożywczym wytwarzanym z mleka klaczy, kojarzonym przez respondentów (70%), jest kumys.

Słowa kluczowe: klacz, laktacja, siara, mleko, kumys, kosmetyki.