On the medico-biological basis for the use of marmot fat in Transbaikalia and Mongolia

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SUMMARY

The purpose of this work is to comprehensively study the tarbagan fat in Buryatia, to observe the commercial use of marmots in Transbaikalia and some regions of Mongolia, and to identify the medico-biological bases of its use by the population of the region. Shown are high values of iodine numbers and the degree of unsaturation of the studied fat, low values of its peroxide numbers. Revealed 36 high molecular weight fatty acids, including a large percentage of mono and polyunsaturated. Among the latter, linoleic and linolenic ones prevailed. In Transbaikalia and some regions of Mongolia, the local population still retains remnants of nutrition associated with the consumption of foods characterized by a deficiency of essential fatty acids. Based on a comprehensive analysis of the data obtained and published sources, it was concluded that

Key words: marmots, tarbagan, black-capped marmot, marmot fat, subcutaneous fat,cavity fat, brown fat, fatty acid composition, polyunsaturated fatty acids, essential fatty acids.

Groundhog fat is widely known for its positive qualities and is used by the population of Transbaikalia for various diseases. Its main use is associated with diseases of the respiratory and digestive system. In this report, we will try to substantiate the medico-biological basis for the use of marmot fat by the population of the region, drawing on the results of its study by our team, as well as materials on the biology of the animals studied, some published historical materials concerning the subject of research from different positions.

Types of marmots and their use in Transbaikalia

There are two types of marmots in Transbaikalia: tarbagan (Marmota sibirica) and black-capped marmot (M. camtschatica). Ecologically, the tarbagan is a representative of the mammalian faunasteppe ecosystems, and black-capped marmot - high-mountain alpine or loach. Thus, in the height-belt distribution, these types of marmots are fundamentally different from each other. The attitude of the Trans-Baikal peoples towards marmots has been based on hunting motivation for a long time. The Tarbagan was used by the Central Asian nomadic peoples, and the black-capped marmot was used by the peoples who mastered the breeding of reindeer in the high-mountain tundra of the region. Here it is important to emphasize the difference between peoples in their exploitation of different types of landscapes in accordance with the biology of the animals they breed and the associated economic structure and material culture. The Central Asian peoples mastered various types of steppe landscapes, and the peoples engaged in reindeer breeding - forest and alpine landscapes.

It is necessary to identify how important the commercial use of marmots was, about which information can be obtained from the analysis of literary sources. The marmot, along with the wild boar and the beaver, became the subject of hunting in the Neolithic era [1]. Groundhog skins were used for sewing clothes. The meat and some internal organs (liver, kidneys, stomach) of the marmot were eaten. Obviously, since the early commercial use of marmots, useful and healing properties of the products obtained from them have been discovered. This can be judged from the information from the medieval treatise of Tibetan medicine "Chzhud-shi" [2]. It mentions the use of meat and marmot liver: "... Groundhog meat," oily "," heavy "," hot ", useful for abscesses,

expels diseases of the cold and wind from the stomach, kidneys, lower back and head "..." In case of diseases of the wind, treat with a combination of heat and cold with marmot meat "," ... marmot liver connects broken bones "... In Mongolian traditional medicine [3] it is indicated that tarbagan meat is used for colds, treats female diseases. Tarbagan fat is used for colds, eliminates muscle inflammation. The heart of tarbagan is recommended for fever of the heart, and its bile can be used for poisoning with poison, it is useful for wounds, and eliminates diseases caused by alcohol. Tarbagan meat and fat were used to treat tuberculosis, wounds, injuries of internal and external organs, frostbite and burns, sums up the famous Mongolian researcher of tarbagan Eregdendagwa [4]. But the question arises: was the marmot so attractive as an object of use for food?

Section 89 of the medieval source "The Secret Legend of the Mongols" of 1240 [5] describes that Temujin, the future Genghis Khan, after escaping from captivity by the tayshuds, fed together with his family on the hunt for tarbagan and gophers. In the next 90th section, it is written that his brother Balgutei, before sunset, caught so many tarbagans that his small horse could hardly bring them.

Another source of these times is the description of travelers to the Mongols Plano Carpini and Guillaume Rubruk (1245–1247, 1253–1255) [6]. Rubruk wrote that in eastern countries there are a lot of marmots and they are caught in large numbers.

Sources of subsequent years [7, 8] only confirm the importance of marmots for Central Asian peoples. PC. Kozlov [8] wrote that almost every day one or several Mongol horsemen had to be met with guns behind their backs and tarbagans tied to the saddle. With regard to the importance of the black-capped marmot for the Evenk reindeer breeders of Northern Transbaikalia, the following can be said. In the annual life calendar of the Evenka hunter, the time from mid-July to early September was specially devoted to hunting the black-capped marmot [9, 10]. A review of sources shows that marmot hunting, the number of which was previously high, was carried out mainly by social strata with low incomes. The largest number of tarbagans in Transbaikalia was mined in 1910 and 1911. - 2.5 and 1.3 million individuals, respectively [11].

Accumulation of fat reserves by marmots

The next aspect is related to the size of the accumulation of fat reserves in marmots. According to our data, tarbagans in Buryatia begin to accumulate fat reserves in July (Table 1). Marmots were usually hunted from mid-July to hibernation. It is known that up to 47% of all fat reserves of marmots are contained in their intermuscular space. Thus, the consumer's interest of the subject is associated precisely with the palatability of fatty groundhog meat. Confirmations come both from the time of the animals' catch, when the fat is formed, and from direct observations of the subjects of the fishery.

Table 1

Accumulation of subcutaneous and intraperitoneal fats of tarbagan in Buryatia

Половая группа	Показатели	Июль			Август			Сентябрь		
		M±S.E.	Lim	N	M±S.E.	Lim	N	M±S.E.	Lim	N
Самцы	Масса тела, кг	-	6,0–6,8	2	5,52 ± 0,22	4,3–6,9	14	6,32 ± 0,18	5,3–7,6	14
	ПЖ, г	-	580,0–632,0	2	336,7 ± 53,3	110,7–720,0	12	566,6 ± 19,7	440,0–681,8	14
	ИЖ, г	-	195,5–468,2	2	237,0 ± 24,9	115,1–487,6	13	444,8 ± 31,7	229,3–615,0	14
Самки	Масса тела, кг	4,53 ± 0,38	3,9–5,2	3	5,03 ± 0,20	4,4–5,8	6	5,48 ± 0,20	4,5–6,2	10
	ПЖ, г	253,3 ± 66,9	163,0–384,0	3	262,2 ± 53,7	88,8–402,0	5	544,2 ± 38,6	420,0–750,0	10
	ИЖ, г	108,0 ± 23,2	62,1–137,0	3	167,3 ± 25,2	65,2–243,0	6	475,6 ± 73,3	260,3–940,0	9

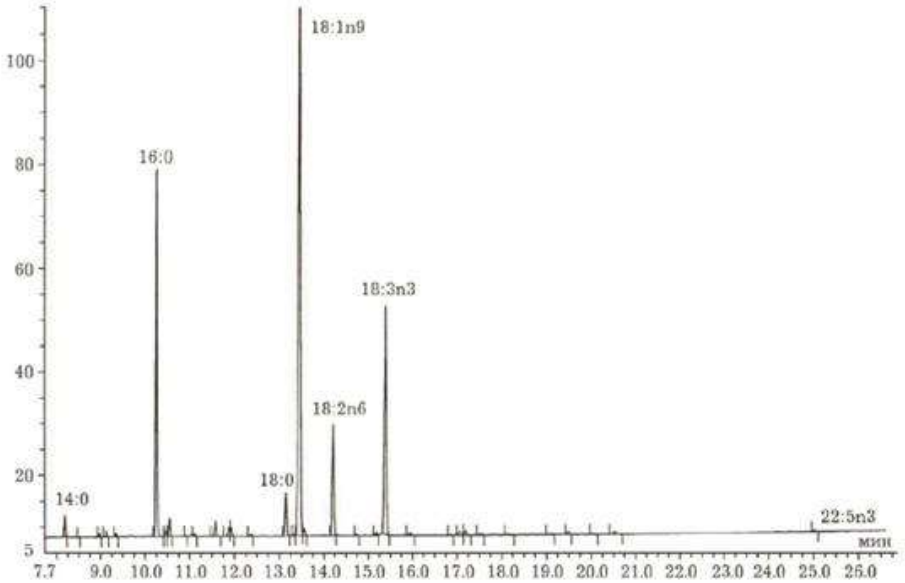
Примечание. *ПЖ – подкожный жир, ИЖ – интраперитонеальный жир, M ± S.E. – стандартная ошибка средней*, Lim – *пределы варьирования признака, N – число изученных особей.*

Tarbagan fat study

Studies of the composition of fatty acids responsible for physicochemical and medical

biological properties of tarbagan fat are relatively small [12, 13, 14]. In this regard, we in 2003-2005. were studied subcutaneous, cavity and brown fats of tarbagan in Buryatia [15] in order to identify the medico-biological bases of its use by the population of the region. An unusually high iodine number of the studied fat, high unsaturation and low values of peroxide numbers are shown (Table 2) [15]. Brown fat, in comparison with other species, was distinguished by lower values of iodine numbers. The study of the fatty acid composition of tarbagan fat revealed a wide spectrum - 36 high-molecular acids, with the maximum amount of C16: 0 (palmitic), C16: 1n7 (palmitoleic), C18: 1n9 (oleic), C18: 1n11 (vaccenic), C18: 2n6 (linoleic) and C18: 3n3 (linolenic) (Fig. 1) [15].

Significance of polyunsaturated fatty acids in marmot biologyThe peculiarities of the biology of marmots are long seasonal hibernation. During hibernation, the drop in metabolic rate reaches 1–5% of normal values, the body temperature of marmots drops to ambient temperature (5 ° C and slightly below). Hibernation consists of hibernation buts (torpor), which last 2-4 weeks, and awakening buts (arousal), lasting 20-30 hours. The duration of hibernation bouts increases from autumn and reaches a maximum in the middle of winter and then decreases towards spring. The body temperature of marmots during waking up for 4–6 hours increases from 0–5 ° C to 37 ° C and is maintained at this level for some time, after which the animal again falls into a state of numbness. The processes of energy release by the brown fat of these hibernating animals are responsible for the reversal of body temperature from hypometabolic to normal levels. Brown fat, which is localized close to the main internal organs, primarily the heart, large arteries (aortic arch), is distinguished by high heat production. Its brown color is due to the presence of numerous blood vessels, mitochondria in the cell and colored proteins of the cytochrome transport system contained in them. It is known that biochemically, in brown fat, oxidative phosphorylation is uncoupled under the action of a specific proton carrier in their mitochondria, the so-called unbound protein (thermogenin), and therefore the oxidation energy is spent not on ATP synthesis, but on heat release. This heat is used to warm up the body of hibernating animals during their periodic awakenings during hibernation. large arteries (aortic arch), is characterized by high heat production. Its brown color is due to the presence of numerous blood vessels, mitochondria in the cell and colored proteins of the cytochrome transport system contained in them. It is known that biochemically, in brown fat, oxidative phosphorylation is uncoupled under the action of a specific proton carrier in their mitochondria, the so-called unbound protein (thermogenin), and therefore the oxidation energy is spent not on ATP synthesis, but on heat release. This heat is used to warm up the body of hibernating animals during their periodic awakenings during hibernation. large arteries (aortic arch), is characterized by high heat production. Its brown color is due to the presence of numerous blood vessels, mitochondria in the cell and colored proteins of the cytochrome transport system contained in them. It is known that biochemically, in brown fat, oxidative phosphorylation is uncoupled under the action of a specific proton carrier in their mitochondria, the so-called unbound protein (thermogenin), and therefore the oxidation energy is spent not on ATP synthesis, but on heat release. This heat is used to warm up the body of hibernating animals during their periodic awakenings during hibernation. contained in them. It is known that biochemically, in brown fat, oxidative phosphorylation is uncoupled under the action of a specific proton carrier in their mitochondria, the so-called unbound protein (thermogenin), and therefore the oxidation energy is spent not on ATP synthesis, but on heat release. This heat is used to warm up the body of hibernating animals during their periodic awakenings during hibernation. contained in them. It is known that biochemically, in brown fat, oxidative phosphorylation is uncoupled under the action of a specific proton carrier in their mitochondria, the so-called unbound protein (thermogenin), and therefore the oxidation energy is spent not on ATP synthesis, but on heat release. This heat is used to warm up the body of hibernating animals during their periodic awakenings during hibernation.



Rice. 1. Experimental chromatogram of tarbagan fat analysis. Vertical: intensity absorption,%. Horizontal: retention time, min.

table 2

Physicochemical indicators of tarbagan fat

Показатель	Жир (подкожный/полостной/бурый)	
	Самцы	Самки
Цвет	Светло-желтый/светло-желтый/бурый	Светло-желтый/светло-желтый/бурый
Запах	Слабый, специфический	Слабый, специфический
Йодное число	110/108/72	112/109/75
Перекисное число	0,04/0,09/0,19	0,03/0,07/0,15
Кислотное число	0,5	0,5
Число омыления	188,85	188,35

Interest in the study of the ratio of different types of fatty acids in marmot fats is due to the effect on the hibernation process. The obtained data indicate that in animals provided with a high ratio of polyunsaturated fatty acids, the duration of hibernation bout increases, and their body temperature drops to the lowest levels [16]. Changes in the ratio of different types of fats by the end of hibernation may serve as one of the triggers of awakening in these animals [17]. Currently, there is a great interest in polyunsaturated (essential) fatty acids in human nutrition. They should be contained in healthy food in sufficient quantities, ensuring the normal functioning of all body systems [18, 19, 20].

Molecular mechanism of influence of polyunsaturated fatty acids on the morphofunctional state of organs is associated with the characteristics of the fluidity and viscosity of the liquid crystal structure of cell membranes. When dietary polyunsaturated fatty acids are included in membrane phospholipids, their properties change. The phospholipid membranes of hibernating animals and cold-water fish contain more unsaturated fatty acids in comparison with non-hibernating species and fish living in warm climates.

Peculiarities of nutrition of nomadic peoples of Transbaikalia and MongoliaThe nutritional features of the Central Asian nomadic peoples traditionally consisted in a relatively small use of herbaceous plant foods (greens). The exception is the widespread use of various types of onions in nutrition [21]. It is known that plant chloroplasts contain a large amount of linolenic acid [22]. The fats of animals bred by nomads (they did not breed birds and pigs) contain more saturated fatty acids and significantly less polyunsaturated ones. The religious beliefs of the Mongol-speaking peoples imposed a ban on hunting birds. At the same time, living in arid zones, remote from significant water bodies, excludes the use of such potential sources of essential fatty acids as fish. Observations that we carried out in the southern parts of Transbaikalia and during expeditionary work in 2007 in all administrative regions of Mongolia, with the exception of South Gobi, the fact of the survival of the remnants of the described type of food among the low-income strata of the population in the provincial parts of these territories is confirmed. Along with this, they have a great interest in marmot fishing, despite their low modern number, in order to meet the historically established nutritional needs.

Conclusion

Based on a comprehensive review of data related to the subject of research, the following can be concluded.

The pronounced use of fatty marmot meat by the Central Asian peoples and peoples pursuing black-capped marmots in the high-mountain tundra is undoubtedly associated with the replenishment of the need for essential fatty acids along with other rare sources, in contrast to the cultures of other peoples, in which such compensation was carried out by a large consumption of fish or a large proportion of plant foods in the diet.

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