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Milk productivity of Saanen goats while feeding organic humic origin feed supplement

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Abstract. The results of the study of Saanen goats milk productivity while feeding humic origin organic feed supplement of «VitaHum» are presented in the paper. Studying milk productivity of different goat breeds, as well as using balanced rations of biologically active feed supplements for therapeutic and prophylactic properties and improving metabolic processes and body functions, are important issues for animal breeding industry, since goat husbandry in Ukraine is in a state of formation. «VitaHum» is completely different from existing biologically active peat supplements on the market because it is received not as a result of peat hydrolysis by alkalis or acids, but by a natural way of chelation. It does not contain humic acids sodium salts with alkali residues with which no reaction had taken place, but residues of amino acids, peptides, carboxylic acids and other useful substances in pure «natural» organic form. This feed supplement meets European standards of organic products. It was found that with the industrial technology of the animal management and feeding with mixed diets when using humic origin feed supplement «VitaHum» during the entire lactation period, milk yield was increased by 15.9% or 137.3 kg, milk protein content by 0.11 abs. percent. However, the goats from the control group had the advantage in milk fat content by 0.09 abs. percent (P > 0.999). The maximum average daily milk yield of 3.55 kg was observed in the second experimental group of goats, which received feed supplements «VitaHum» in addition to the main diet. However, as a result of a significant advantage in milk yield from goats of the experimental group, a noticeably higher amount of both milk protein and milk fat mass fraction was obtained by 5.94 kg and 4.63 kg, respectively. Analysis of the qualitative milk composition of the experimental goats showed that the percentage of milk solids non-fat (MSNF) was in the range of 8.45–8.58%, and the content of somatic cells in the milk of control group animals was higher by 7.05%. The qualitative milk composition was quite satisfactory for this breed of goats, as the milk fat mass fraction was 3.94–4.03% and protein one 3.52–3.63%. The ratio of fat and protein at the level of 1.15–1.09 units indicated a good physiological state of the digestive system of the Saanen breed goats.

Keywords: feed supplement «VitaHum»; goat; Saanen breed; lactation; milk

Молочна продуктивність кіз зааненської породи за згодовування органічної кормової добавки гумінової природи

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Анотація. Наведено результати дослідження молочної продуктивності кіз зааненської породи за згодовування органічної кормової добавки гумінової природи «Віта Гум». Ця добавка кардинально відрізняється від існуючих на ринку біологічно активних препаратів тим, що отримана не внаслідок гідролізу торфу лугами або кислотами, а природнім шляхом – хелатоутворенням. У складі містяться не натрієві солі гумінових кислот із залишками лугів з якими не відбулася реакція, а залишки амінокислот, пептидів, карбонові кислоти та інші корисні речовини у чистому «природному» органічному вигляді. Кормова добавка відповідає Європейським стандартам органічної продукції. Встановлено, що за промислової технології експлуатації тварин і годівлі загальнозмішаними раціонами з додаванням кормової добавки гумінової природи «ВітаГум» упродовж усього періоду лактації надій підвищився на – 15,9%, або 137,3 кг, уміст молочного білка – на 0,11 абс. відсотка. А ось за вмістом жиру в молоці, перевага була на стороні кіз контрольної групи і становила 0,09 абс. відсотка (P > 0,999). Проте, в наслідок значної переваги за надоєм від кіз дослідної групи отримано значно більшу кількість як молочного білка, так і масової частки молочного жиру, відповідно на 5,94 кг і 4,63 кг. Аналіз якісного складу молока у піддослідних кіз показав, що відсотковий вміст сухого знежиреного молочного залишку (СЗМЗ) знаходився у межах 8,45–8,58%, а вміст соматичних клітин у молоці контрольних тварин був вищим на – 7,05%. Якісний склад молока цілком задовільний для цієї породи кіз, оскільки масова частка жиру в молоці становила – 3,94–4,03%, а білка – 3,52–3,63%. Співвідношення жиру і білка на рівні 1,15–1,09 одиниці вказувало на добрий фізіологічний стан травної системи організму кіз зааненської породи.

Ключові слова: біологічно активна добавка «ВітаГум»; кози; зааненська порода; лактація; молоко

Introduction

Biological features of goats contribute to their successful breeding in different climatic conditions of the world. There are some advantages of breeding goats, among them cheaper management and the fact that they consume a large number of different types of pasture grass. Based on the productivity in goat husbandry, all breeds are classified into two main groups: specialized (dairy, meat, down, wool) and combined (dairy-meat, meat-wool, meat-wool-dairy).

According to Atanovska-Masliuk et al. (2018), the total number of goats in the world is about 1.5 billion and most of them are in Asia – 55.4%, in Africa – 38.7%, while in Europe only 1.75%. China is among the leading countries, where the number of goats is 139.8 million, India is in the second place with 133.4 million and Nigeria is in the third place with 78.0 million.

In terms of gross milk production, India is leading, where more than 6 million tons of goat milk are produced annually.

The most organized market for goat milk is found in Europe, especially in France. The European goat sector is specialized for milk production, mostly for industrial cheesemaking, while also supporting traditional on-farm manufacturing (Miller & Lu, 2019). The share of goat milk and meat in the total production is small, but this branch of animal husbandry has been developing intensively in recent years in the world (Bagnicka et al., 2016; Ruiz Morales et al., 2019), and also in Ukraine (Skoryk, 2016). The proper development of the goat husbandry can be one of the reserves of replenishment of food resources in Ukraine, because goat's milk is characterized by a variety of products, healing and dietary properties (Pirova et al., 2017), high competitiveness due to efficient use of feed, good reproductive qualities and their high acclimatization capacity (Ryzhkova et al., 2019).

The United States is not yet a large global goat milk producer, but the sector has expanded rapidly, with dairy goat numbers doubling between 1997 and 2012 (Lu & Miller, 2019).

In Europe, dairy goat production is more common around the Mediterranean basin, where it is important from an economic, environmental and sociological perspective to the Mediterranean countries: Spain, France, Italy and Greece. Europe owns only 5.1% of the world's dairy goat herds, but produces 15.6% of the world's goat milk; this is the only continent where goat milk has such an economic importance and organization (Escareño et al., 2012).

Dairy small ruminants account for approximately 21% of all sheep and goats in the world, produce around 3.5% of the world's milk, and are mainly located in subtropical-temperate areas of Asia, Europe, and Africa and concentrated around the Mediterranean and Black Sea, where their dairy products are typical ingredients of the human diet. Dairy goats are concentrated in low-income, food-deficit countries of the Indian subcontinent, where their products are a key food source, but are also present in high-income, technologically developed countries. Dairy small ruminants account for a minor part of the total agricultural output in France, Italy, and Spain (0.9 to 1.8%) and a larger part in Greece (8.8%) (Pulina et al., 2018).

Goat milk is an increasingly important dairy product around the world; goat dairy products are increasingly consumed and traded. North and South America contributed 4.4% of global production during 2006 through 2017, but in 2017, Asia has produced 57%, Africa 24%, and Europe 15% of the global goat milk supply (Lu, 2017; Kljajevic et al., 2017).

Cheese yield is influenced strongly by the composition of milk, especially fat and protein contents, and by the efficiency of the recovery of each milk component in the curd (Pazzola et al., 2019).

Despite the fact, that goat's milk is less popular than cow's one, it has a unique nutritional value (Antonenko, 2019; Li, 2019).

Compared to cow's, goat's milk is more caloric, it contains an increased amount of dry matter, fat, protein, and its amino acid composition is close to women's. Its valuable qualities, healing properties define dairy goat husbandry as a promising industry.

Due to its beneficial impact on human health, goat's milk has found a niche in the range of healthy food in developed countries. Assessing the quality of goat's milk has great economic importance, especially in protein and fat content, which influences the amount of produced cheese (Chumak et al., 2020).

Digestibility of goat's milk and its dairy products is very high, about 94–98%. Goats should get full and balanced diet by all the nutritional elements in order to make high quality milk (Horchanok et al., 2019).

Many scientists focused on the functional properties of the goat milk along with sheep milk. The goat milk has not only high nutritional value but also therapeutic value and dietary characteristics (Lad et al., 2017).

Qualitative and quantitative indicators of goat's milk depend on a number of factors, including feeding. The content of nutrients and biologically active substances in the diet, providing of animals with pastures, housing conditions, breeding records are the factors that must be taken into account to obtain high quality, environmentally friendly end products (Giaccone et al., 2007; Dubeuf et al., 2018).

Goat breeding as a branch of animal husbandry in Ukraine has ample opportunities for effective development due not only to the complex of important products obtained from goats, but also to the use of resource-saving technologies.

Since the 2000s, goat breeding has become a popular area of animal husbandry in Ukraine, the main livestock kept on subsidiary farms is more than 80%, and the total number of goat livestock is about 590.000 of animals.

An important component of the industry development is the presence of zoned goats breeds for pure breeding and crossbreeding. According to the results of the world analysis and native experience in dairy goat breeding, for developing pure breeding and improvement of local livestock, four main promising dairy breeds have been identified in Ukraine: Saanen, Alpine, Togenburg, Anglo-Nubian and European breeds and types derived from them (Adnoy, 2014).

Therefore, the study of milk productivity in different goats breeds under the same conditions, as well as the use of biologically active feed supplements in their balanced diets for therapeutic and prophylactic properties and improving metabolic processes and body functions, are relevant.

The aim of the work was to determine the impact of humic origin feed supplement «VitaHum» on milk productivity, the physical and chemical composition of milk from Saanen breed goats.

Materials and methods

The experimental part of the work in studying the effect of humic origin feed supplement «VitaHum» in the diets of Saanen breed goats during the entire period of lactation was conducted in LLC PCF «Ukrselkhozprom» Dnipropetrovsk region.

For this purpose, two groups of goats with 10 animals in each were formed, they were analogues in age, live weight, physiological state and productivity. The scheme of scientific and economic experiment is presented in Table 1.

According to the experiment scheme, the animals from the control and experimental groups during the preparatory period consumed the basic diet, which consisted of traditional for the steppe zone forages, balanced according to the existing norms of feeding goats.

During the research period, goats from the 2nd experimental group consumed a feed supplement «VitaHum» in a dose of 0.2 ml/kg per day to the main diet.

«VitaHum» differs radically from existing biologically active peat supplements on the market because it is received not as a

Table 1 – Scheme of the experiment

Group	Number of animals	Period	
		preparatory	research
1st control	10	the basic diet (BD) is balanced according to existing norms of feeding	BD
2nd experimental	10	BD	BD + feed supplement «VitaHum» 0,2 ml/kg per day for 1 kg of live weight

result of peat hydrolysis by alkalis or acids, but by a natural way of chelation.

It does not contain sodium salts of humic acids with alkali residues with which no reaction has taken place, but residues of amino acids, peptides, carboxylic acids and other useful substances in pure «natural» organic form. This feed supplement meets European standards of organic products.

The structure of the diet and its nutritional value were determined by the physical weight of the components in accordance with the established norms. The nutritional value of feed was determined on the basis of research by the laboratory of zootechnical evaluation and mass analysis of feed in the LLC PCF «Ukrselkhozprom» according to (ISO 6497:2002, IDT): DSTU ISO 6497:2005 National standards of Ukraine according to the methods of zootechnical and biochemical analysis and relevant standards (Petukhova et al., 2010).

Dairy productivity of goats was determined by conducting control milking during the time of experiment, every 10 days and also at the end of the experiment. During the experiment, analysis of milk yield was conducted based on the performance data of experimental groups of animals.

Determination of the qualitative composition of goat milk was performed continuously throughout the experimental period.

Selection of the average milk sample was performed automatically on the milking machine during the milking of animals. After that, samples were sent for analysis to the laboratory. The fat and protein mass fraction (%) was determined on automatic analysers «Ekomilk 120-KAM 98-2A».

The qualitative composition of milk was determined by the fat and protein mass fraction (%).

$$M\ 4\% = (0{,}4 \times У) + (15 \times MF);\ \text{where} \quad (1)$$

M 4% – 4% milk, kg;
У – yield per lactation, kg;
MF – milk fat, kg;
0,4 and 15 – constant coefficients;

Amount of milk fat, kg:

$$MF = (У \times FM) / 100;\ \text{where} \quad (2)$$

MF – milk fat, kg;
У – yield per lactation, kg;
FM – mass fraction of fat in milk, %.

Amount of milk protein, kg:

$$MP = (У \times PM) / 100;\ \text{where} \quad (3)$$

MP – milk protein, kg;
У – yield per lactation, kg;
PM – mass fraction of protein in milk, %.

The obtained digital material was processed by variation statistics according to traditional methods using a standard package of applied statistical programs (Melnichenko et al., 2006).

Results

LLC PCF «Ukrselkhozprom» produces traditional forage, which is most common in the steppe zone. The diet of animals consisted of wheat straw, alfalfa hay, fodder beet, carrots, sunflower meal, wheat bran, salt briquette, and vitamin-mineral complex SWEETIICS.

Structure and daily diet of Saanen breed lactating goats are shown in Figure 1.

The diet structure of experimental goats consisted of roughage by 35.72%, moist feed by 40.48%, concentrated by 23.80%. By types of feed consumed, the structure of the diet was as follows: wheat straw – 11.90%, alfalfa hay – 23.81%, roots – 40.48%, wheat bran – 11.90%, sunflower meal – 11.9% (Fig. 1).

The daily diets of the control and experimental groups contained metabolic energy of 22.92 MJ (91.68%), dry matter – 2.45 kg (91.01%), crude protein – 452.34 g (92.30%), and digestible protein

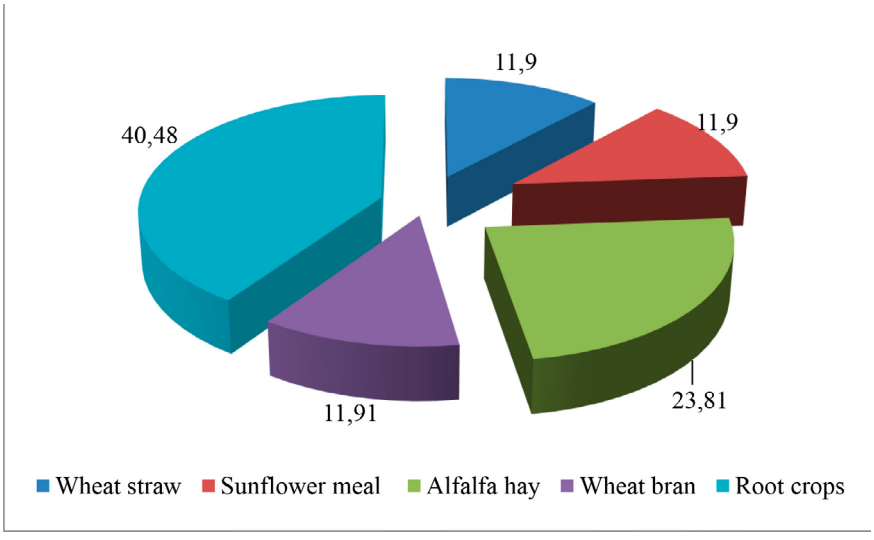

Fig. 1. The diet structure of lactating experimental goats

Table 2 – Dairy goat productivity during the equalization period, X ± Sx

Group, n = 10	The daily yield, kg	Mass fraction in milk, %			
		fat	protein	MSNF	density, 0A
1st control	2.34 ± 1.33	3.72 ± 0.029	3.12 ± 0.058	7.48 ± 0.012	27.48 ± 0.006
2nd experimental	2.34 ± 1.19	3.71 ± 0.044	3.10 ± 0.047	7.50 ± 0.015	27.47 ± 0.007

– 334.80 g (111.60%). The diet of goats from the experimental groups was balanced in accordance with generally accepted norms.

The total weight of the complete food mixture was 4.20 kg for lactating goat per day. The total nutritional value of the food mixture for Saanen breed lactating goats in the second half of lactation was at the level of 3.5 energy feed units, and the exchange energy was 22.92 MJ on average.

According to the minimum requirements for productivity indicators of Saanen goats aged 2–2.5 years, the live weight of animals should be at least 42 kg, and if older – 50 kg. The assessment results indicated a sufficient level of goats' development on the farm.

Comparative assessment of milk productivity of goats during the equalization period showed that the average daily yield of goats from the experimental groups was the same, and the differences were only in the error which was relative to the average value and amounted to 2.34 kg (Table 2).

The fat mass fraction in milk was quite high and was at the level of 3.71 and 3.72%, respectively, in terms of groups. Milk protein also had insignificant group differences and ranged from 3.10 to 3.12%, i.e. characterized by high stability. The same pattern was observed for MSNF and milk density.

Dairy productivity of experimental animals during the experiment is shown in Table 3.

Comparative assessment of milk productivity of lactating goats according to these criteria showed that goats from the control group with an average duration of lactation of 305 days were inferior to goats of the experimental group in milking by 137.3 kg or 15.9% (P > 0.99), in milk protein content by 0.11 abs. percent. However, the goats from the control group had the advantage in milk fat content by 0.09 abs. percent (P > 0.999). The maximum average daily milk yield of 3.55 kg was observed in the second experimental group of goats, which received «VitaHum» feed supplement to their main diet.

However, because of the significant advantage in milk yield of goats from the experimental group, a significantly higher amount of

Table 3 – Dairy productivity of Saanen goats, X ± Sx

Index	Group, n = 10	
	1st control	2nd experimental
Milking for 305 days of lactation, kg	866.2 ± 30.10	1003.5 ± 33.75
Milk fat, %	4.03 ± 0.05	3.94 ± 0.04
Milk fat, kg	34.91 ± 6.54	39.54 ± 5.76
Milk protein, %	3.52 ± 0.03	3.63 ± 0.04
Milk protein, kg	30.49 ± 1.32	36.43 ± 1.13
Average daily yield, kg	2.84 ± 0.21	3.09 ± 0.019
Maximum daily yield, kg	3.15 ± 0.52	3.55 ± 0.46

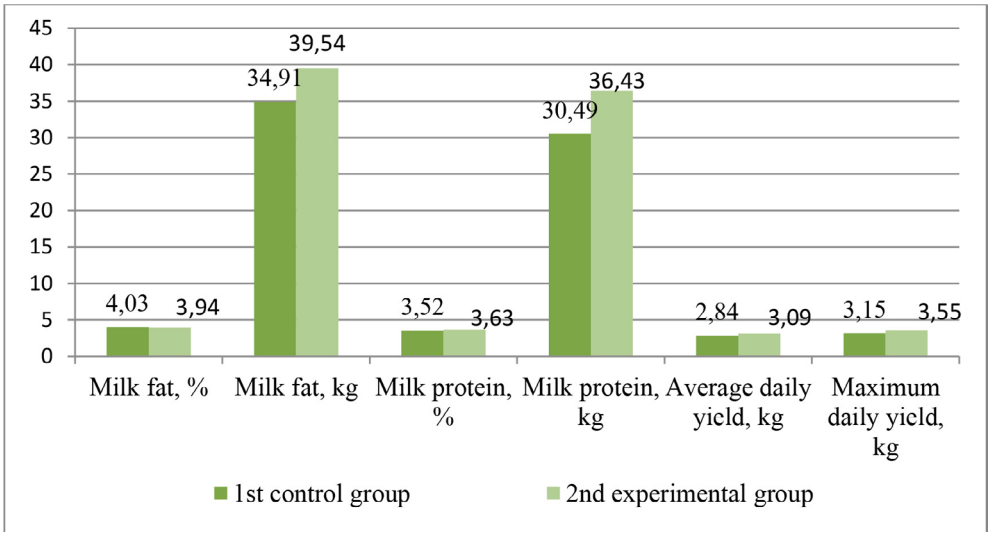

Fig. 2. The content of milk fat and protein in the goat milk of the experimental groups

Table 4 – Physical and chemical parameters of goat's milk, n = 10

Index	Group	
	1st control group	2nd experimental group
Density, kg/cm³	1.0281 ± 0.63	1.0285 ± 0.91
Acidity, °T	14.6 ± 1.7	14.4 ± 1.5
Dry matter, %	12.48 ± 0.126	12.52 ± 0.104
Fat, %	4.03 ± 0.05	3.94 ± 0.04
Protein, %	3.52 ± 0.03	3.63 ± 0.04
Lactose, %	4.44 ± 0.021	4.51 ± 0.015
MSNF (milk solids non-fat), %	8.45 ± 0.032	8.58 ± 0.027
Content of somatic cells, thous and/cm³	468	435

milk protein by 5.94 kg were obtained, as well as a milk fat mass fraction was higher by 4.63 kg.

Analysis of the milk qualitative composition of experimental goats showed that the percentage of milk solids non-fat (MSNF) was in the range of 8.45–8.58%, and the content of somatic cells in the milk of control animals was higher by 7.05%.

The qualitative milk composition was quite satisfactory for this breed of goats, as the mass fraction of fat in milk was 3.94-4.03% and protein 3.52–3.63%. The ratio of fat and protein at the level of 1.15–1.09 units indicated a good physiological state of the digestive system of Saanen breed goats.

Discussion

Currently, according to various data, there are about 1,000 breeds of goats in the world. However, only cultural breeds of all directions are well adapted to the conditions of industrial and large-scale production, which show high productivity and cost of production. The leading place in the world belongs to dairy and combined dairy-meat breeds – 37% and 20%, respectively, of the total number of breeds.

Notably, 66.4% of dairy and 15.9% of meat goat breeds predominate in Europe, while combined breeds predominate in Asia and meat breeds in Africa.

Goat husbandry in European countries is developing due to the introduction of modern technologies in animal management and mechanized milking of goats, improving the technical equipment of farms, creating a network of enterprises for processing goat's milk (Broderick, 2017). Also in the EU intensive breeding work is conducted, it is aimed at increasing the goat milk productivity (Sandrucci, et al., 2019). Goat producing good amount of milk or quick growth one for more meat requires additional amount of leguminous fodders and concentrate feed (Amit Kumar Singh, 2018).

According to the FAO, the number of goats in the CIS was 14.7 million. Uzbekistan has the largest number of goats – 3.83 million, Turkmenistan – 2.37 million, Kazakhstan – 2.28 million, Russia and Kyrgyzstan about 2 million, where goat farming is developing rapidly.

Most of the world dairy goat production and consumption is in Asia, but a global view of the dairy goat sector reveals important lessons about building successful modern dairy goat industries (Lu, 2017).

As for our country in general, goat husbandry in Ukraine is in a state of formation. The main obstacles to the successful development of the industry are the small number of livestock, insufficient level of technological equipment, and lack of state support.

Goat farming, especially with milk goats can be quite profitable regardless of the country if intensive types of management are practiced (Haenlein, 2017).

Goat milk has played a very important role in the health and nutrition of the young and elderly. Goat milk has also been known for its beneficial and therapeutic effects on people who have cow milk allergies. This nutritional, health, and therapeutic benefits enlighten the potentials and values of goat milk and its specialty products (Ribeiro, 2009; Pirova et al., 2017).

Conclusion

The use of organic feed supplement of humic origin «VitaHum» in the diets of Saanen breed goats contributed to the overall increase in milk productivity of goats during lactation by 137.3 kg or 15.9% ($P > 0.99$), in milk protein content by 0,11 abs. percent and in quality of milk.

As a result of a significant advantage in milk yield from goats of the experimental group, a noticeably higher amount of milk protein by 5.94 kg and milk fat mass fraction by 4.63 kg were obtained during the study.

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