EFFECTS OF ADDITIONAL FEEDSTUFFS ON MILK QUALITY AND HEALTH STATUS IN ORGANIC GOATS

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Summary. The present study was designed to assess the role of additional feedstuff (wheat bran, sunflower meal and rapeseed meal) on milk quality and health status in organic goats. The feeding trial was performed in farm "Bērzi", Latvia and lasted for 92 days. Four experimental diets were formaluted: Diet 1 consisted of basic feed (BF), which included pasture grass and hay with added oat meal, and minerals with vitamins; Diet 2 was based on BF with added wheat bran; Diet 3 on BF with added sunflower meal ; and Diet 4 on BF with added rapeseed meal (Diet 4). Twenty-four goats were selected and randomly divided into 4 groups (Groups 1 - 4) each of 6 goats. The animals in Groups 1, 2, 3 and 4 were fed by the Diet 1, 2, 3 and 4, respectively.

The experiment demonstrated that in organic goats on Diet 2 had increased milk yield by 4.3 %, reduced feed units and consumption of digestible protein on 4.2 % and 0.6 % compared to goats on Diet 1. In addition, goats on Diet 2 increased milk fat, protein and sugar content in milk on 22.8 %, 13.3 % and 1.1 %, respectively, compared to controls (Diet 1).

Further, goats on Diet 3 had increased goat milk yield and digestible protein consumption on 1.8 %, and 8.0 %, and reduced level of milk fat on 1.6 % compared to controls on Diet 1. In addition, goats on Diet 3 had on 3.9 % increased protein content and on 0.2 % sugar content in milk compared to controls. Goats on Diet 4 had increased milk yield on 12.64 %, reduced feed units and digestible protein consumption on 10.4 % and 3.1 % compared to Diet 1. In goats on Diet 4 milk fat increased on 3.2 %, and protein and sugar content in milk decreased on 1.1 % and 1.6 %, respectively, compared to control group. In milk of experimental goats (Groups 2-4) statistically significantly increased number of nucleous cells and of leucocytes, and significantly reduced number of lymphocytes was obtained compared to Group 1 ($P<0.05$). In addition, in Groups 2-4 statistically significantly increased T – B – A cell and phagocytes relative number was registered compared to controls ($P<0.05$).

The results from this study demonstrate that diets supplemented with additional feedstuffs such as wheat bran, sunflower and rapseed meals have potential value to increase milk production, have significant positive influence on liveweight gain and health status in organic goat production system.

Key words: organic farming, wheat bran, sunflower and rapreseed meals, milk production, goats.

PAPILDOMŲ MAISTO MEDŽIAGŲ ĮTAKA OŽKŲ PIENO KOKYBEI IR SVEIKATINGUMUI

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Santrauka. Šėrimo bandymas atliktas Latvijos ūkyje „Bērzi" ir truko 92 dienas. Eksperimento laikotarpiu pirmosios (kontrolinės) grupės ožkos buvo šeriamos pagrindiniais pašarais (PP), pagamintais ūkyje. Antrosios grupės ožkos buvo šeriamos racionu, papildytu kviečių sėlenomis. Trečiosios grupės ožkų racionas buvo papildytas saulėgrąžų miltais, o ketvirtoji grupė kaip pašarinį priedą gavo rapsų miltus.

Kartu su paveldimais ypatumais ir gyvulių selekcija ožkų pieno produkcijai įtakos turi tinkamai sudaryti, vertingi racionai. Per palyginti trumpą laikotarpį jie darė įtaką ne tik organizmo būklei, bet ir gyvulio sveikatai bei pieno produkcijai. Vietinių Latvijos ožkų organizme šėrimas kviečių sėlenomis vasarą pieno produkciją padidino 4,33 proc., pašarinių vienetų sumažino 4,2 proc., o lengvai virškinamų proteinų kiekis sumažėjo 0,6 proc. Atitinkamai padidėjo pieno riebumas, baltymų ir cukraus kiekis piene – 22,8; 13,3 ir 1,1 proc., palyginti su kontroline karvių grupe.

Saulėgrąžų miltai vasaros laikotarpiu padidino pieno produkciją 1,8 proc., virškinamų proteinų suvartojimą – 8,0 proc. ir 1,6 proc. sumažino pieno riebumą bei 3,9 proc. padidino proteinų kiekį ir 0,2 proc. cukraus kiekį piene palyginti su kontroline grupe. Rapsų sėklų miltai vasaros laikotarpiu padidino pieno produkciją 12,64 proc., pašarinių vienetų suvartojimas sumažėjo 10,4 proc., virškinamų proteinų – 3,1 proc., pieno riebumas padidėjo 3,2 proc., o proteinų ir cukraus kiekis piene sumažėjo atitinkamai 1,1 ir 1,6 proc. palyginti su kontroline grupe. Bandomosiose grupėse statistiškai patikimai padidėjo branduolio ląstelių segmentų ir leukocitų kiekis, o santykinis limfocitų kiekis sumažėjo. Taip pat bandomųjų gyvūnų organizme statistiškai patikimai padidėjo T – B – A ląstelių bei santykinis fagocitų kiekis, o tai turi įtakos organizmo sveikatos būklei.

Raktažodžiai: ožka, šėrimas, pieno sudėtis.

Introduction. Goat husbandry has been part of agriculture since almost the first use of domestic animals and presently its popularity is increasing throughout the world. This increase is reflected to a greater degree by the rise in the number of small herds, also organic herds, maintained by individuals either as a source of income or as an avocation. Because of this increased interest especially from organic farmers, it is valuable to be aware of the factors affecting the composition and nutritional value of organic goat milk.

Goats fed on high-quality and valuable forage provide the production of high quality milk and dairy products. Improper and poor feeding during lactation period reduce milk yield, weaken animals organism, has an influence on breeding and fertility ability and metabolic processes in goats.

Goat milk yield is determined by energetic potential, level of feeding and health status of an animal. Feeding is a significant factor as it has direct influence on both productivity and health of goats. Ruminant animals, including goats, have a definite need for energy (feed units), protein and biologically active substances, but at the same time they have another need˜ supplying the rumen microorganisms with energy and nitrogen-containing substances. The rumen microorganisms degrade the structure of plant feed and on its basis form components˜ volatile fatty acids, which, in its turn, supply animals with most of energy but the mass of microbes itself makes a significant amount of protein in goat feed, which is digested and absorbed in small intestine.

These processes are normal if both requirements of microorganisms and animals are met. One of the major nutrients in goat feed is crude protein and digestible protein. Forage low in protein or ingested protein low in value cause protein starvation in goats. Inclusion of grass-legume hay, alfalfa, fodder beans, field pea, rape, fodder beet, fodder carrot, fodder yeast, etc. in feed ration provide goats with full value protein, particularly in organic animal production.

Till now in Latvia few experiments and research on animal products assessment, nutritive base improvement, optimizing feed ration, etc. have been conducted in organic farming. Valuable feed for goats is one of essential factors, which has an influence on quality indices of milk, which is so useful and healthy for people, such as vitamins, amino acids, fatty acids, enzymes, crude protein, albumen, casein, lysozyme content in milk. For that reason the goal of our research was to ascertain the influence of balanced feed on goat milk productivity and quality indices.

Material and methods. The feeding trial was carried out in Latvia farm "Bērzi", Talsi district from June 1 to August 31, 2005, i.e. for 92 days totally.

In the preparatory period, which was lasting for two weeks, feeding, keeping and rearing conditions were equal for all Latvian local goats included in the trial. During accounting period, goats of the 1st group (control) were fed basal feed (BF) produced in the farm. Goats of the 2nd trial group received BF supplemented with wheat bran. The goat feed of the 3rd trial group was supplemented with sunflower meal but the goats of the 4th trial group received rapeseed meal as feed additive (Table 1).

Table 1 **Trial scheme**

No.	Groups	Number of animals per group	Feed ration
1	1st group – control	6	Pasture grass + hay + oat meal (BF)
2	2nd group – trial	6	BF (pasture grass + hay) +0.7 kg oat meal + 0.3 kg wheat bran
3	3rd group – trial	6	BF (pasture grass + hay)+ 0.8 kg oat meal + 0.2 kg sunflower meal
4	4th group – trial	6	BF (pasture grass + hay)+ 0.8 kg oat meal + 0.2 kg rapeseed meal

Nutrient requirement in goats was determined according to animal live weight and milk yield following the normative regulations adopted in Latvia.

By the amount of feed units, crude protein, digestible protein, calcium, amino acids and main biologically active substances feed rations for the goats of the 1st, 2nd 3rd and 4th groups were practically of equal value (Tables 2, 3, 4 5).

Table 2 **Daily feed ration in the 1st group of goats**

Animal feedstuffs	Amount, kg	Feed units, kg	Digestible protein, g	Ca, g	P, g	Carotene, mg
Pasture grass	6	1.20	100	10.2	4.8	150
Hay	1	0.47	45	8.9	2.2	50
Oat meal	1	1.00	90	1.0	3.0	-
Total	x	2.67	235	20.1	10.0	200

Table 3 **Daily feed ration in the 2nd group of goats**

Animal feedstuffs	Amount, kg	Feed units, kg	Digestible protein, g	Ca, g	P, g	Carotene, mg
Pasture grass	6	1.20	100	10.2	4.8	150
Hay	1	0.47	45	8.9	2.2	50
Oat meal	0.7	0.70	63	0.7	2.1	-
Wheat bran	0.3	0.30	39	0.3	1.8	0
Total	x	2.67	247	20.1	10.9	200

Table 4 **Daily feed ration in the 3rd group of goats**

Animal feedstuffs	Amount, kg	Feed units, kg	Digestible protein, g	Ca, g	P, g	Carotene, mg
Pasture grass	6	1.20	100	10.2	4.8	150
Hay	1	0.47	45	8.9	2.2	50
Oat meal	0.8	0.80	72	0.8	2.4	-
Sunflower meal	0.2	0.22	40	0.3	2.0	-
Total	x	2.69	257	20.2	11.4	200

Table 5 **Daily feed ration in the 4th group of goats***

Animal feedstuffs	Amount, kg	Feed units, kg	Digestible protein, g	Ca, g	P, g	Carotene, mg
Pasture grass	6	1.20	100	10.2	4.8	150
Hay	1	0.47	45	8.9	2.2	50
Oat meal	0.8	0.80	72	0.8	2.4	-
Rapeseed meal	0.2	0.22	40	1.2	1.8	-
Total	x	2.69	257	21.1	11.2	200

*Goats from all groups during trial received mineral supplement Fero – phosphat U.A.B.
Composition of the mineral supplement Fero – phosphat U.A.B. : micronutrients : phosphorus – 10%, calcium – 21%, magnesium – 5%, sulphur – 1%, micronutrients in 1 kilogram : zinc – 7000 mg, copper 1600 mg, magnesium – 4000 mg, iodine – 80 mg, cobalt - 50 mg and selenium – 24 mg.

During trial, milk yield produced by each goat was measured with a precision to ±0.05 kg. Milk fat, protein, lactose content and somatic cell count were determined by a daily average sample once a month using *Milko Scan 133*.

Cytological and immunological tests as well as natural resistance tests were performed in milk samples of the Latvian local goats. 10 ml milk was centrifuged at 1500 rev/min. After 10 minutes incubation at +4° C temperature, with the help of pincette and lignin fat was released from the walls of the test tubes and supernatant was re-pumped. Cells were re-suspended in 8 ml Eagle culture medium and centrifuged at 1500 rev/min for 15 minutes. Supernatant was re-pumped and backwashed cells were re-suspended in 0.5 ml Eagle culture medium. From milk cell suspension swabs were made on slides. Preparations were used for cytological tests with the help of a microscope. In milk the count of all cells was determined and the composition of milk cells was characterized.

Cell suspension was used for immunological tests. At first 0.1 ml cell suspension was used in phagocytosis reaction [1]. 3.0 ml Eagle culture medium was added to the rest of cell suspension and with the help of verificole mononuclears were isolated [2]. These were stimulated with phytohemagglutinin [3] and further used in rosette formation reaction to determine T – and B – lymphocyte amount [4], and in immune adherence reaction (to determine A- cell count). The prepared cytological and immunological preparations were coloured with Majgrinvald colour on menthol base for 7 minutes. Besides washing in tap water and colouring with Gimz-Romanovsky colour for 25 minutes was done. The prepared preparations were accessed using a microscope, with immersion magnification 10 x 90.

Humoral immunity in organism was characterized using natural resistance indices – amount of lysozyme and circulating immune complex (CIC) in milk. For analysis, milk samples of 40 ml were centrifuged at 3000 rev/min for 25 minutes. Lysozyme was determined by nephelometric method using test-microbe *Micrococus lysodeictiens* [6]. The CIC level was determined spectrophotometrically by precipitation reaction with polyethylenglucole [7].

Results were statistically processed using student t – criteria.

Results and discussion. During trial, the live weight of goats remained constant. There were not observed significant differences in live weight between control and trial groups.

During trial the highest yield of milk 1722.24 kg or 3.12 kg per day or by 12.64 % more compare to control group was reached with the goats of the 4th trial group, which were fed rapeseed meal (Table 6).

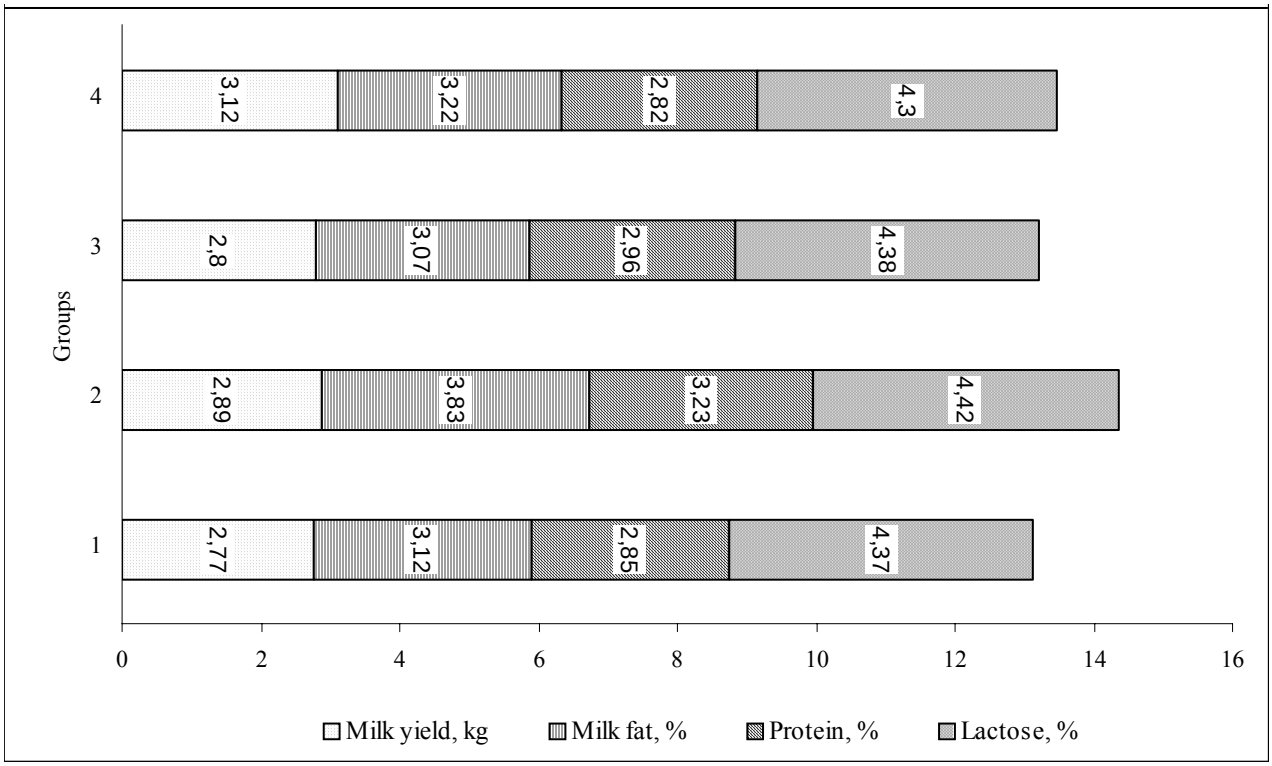

Table 6. **Milk yield and composition**

In goat milk of the 2nd trial group, supplementing feed ration with wheat bran, milk fat increased by 0.71 %, protein by 0.38 % and that of lactose by 0.05 % compare to control thus indicating that wheat bran in combination with oat meal is a valuable feed additive, which considerably improves chemical composition as well as nutritive value of goat milk.

In goat milk from the 4th trial group milk fat increased by 0.10 %, but protein decreased by 0.03 % and that of lactose by 0.07 % compare to control.

In goats of the 3rd trial group milk fat decreased by 0.05 %, but protein increased by 0.11 % and that of lactose by 0.01 % compare to control thus indicating that in organic farming sunflower meal is a valuable feed additive, which considerably improves chemical composition as well as nutritive value of goat milk.

Table 7 **Consumption of feed units and digestible protein for 1 kg milk production**

Trial group	Daily milk yield, kg	Feed units		Digestible protein	
		kg	%	g	%
1st group - control	2.77	0.96	100.0	85.0	100.0
2nd group - trial	2.89	0.92	95.8	85.5	100.6
3rd group - trial	2.80	0.96	100.0	91.8	108.0
4th group - trial	3.12	0.86	89.6	82.4	96.9

Consumption of feed units and digestible protein necessary for 1 kg goat milk production is presented in Table 7.

Animals of the 2nd and 3rd trial groups used the least amount of feed units and digestible protein for 1 kg milk production.

In its turn, the best results were achieved with the goats of the 4th trial group. These goats received rapeseed meal as feed additive using only 0.86 feed units and 82.4 grams digestible protein for I kg milk production.

Good results were obtained in the 2nd trial group where goats consumed 0.92 feed units and 85.5 grams digestible protein for 1 kg milk production.

In control group, 0.96 feed units and 85.0 grams digestible protein were consumed for 1 kg milk production, but in the 3rd trial group 0.96 feed units and 91.8 grams digestible protein were consumed for 1 kg milk production thus indicating that feed taken up by goats was well utilized.

Feed additives used in the trial had a positive effect on cytological and immunological indices in goat milk.

Somatic cell count responded to norms adopted for Latvian local goat milk, however it should be noted that lower somatic cell count was observed in goat milk obtained from the trial groups (Table 8).

Table 8 **Somatic cell count in goat milk**

Groups	Somatic cell count, thou.	% to control
1st group - control	388	100.0
2nd group - trial	349	89.9
3rd group - trial	225	60.0
4th group - trial	198	51.0

Table 9 **Cytological indices in goat milk**

Groups of animals	Citoloģiskā indices, %					Epithelial cells		
	Foamy cells	Segment -nucleus	Lympho-cyte	Mono-cyte	Histio-cyte	Cubic	Cylindri-cal	Level
1st group - control	4±0.7	60±0.7	27±0.7	7±0.3	1.0±0.3	0.5±0.1	0.4±0.1	0.1±0
2nd group - trial	4±0.8	66±1.4*	21±1.4*	8±0.3	0.2±0.3	0.3±0.2	0.4±0.2	0.1±0
3rd group - trial	4±1.0	65±1.0*	19±0.7*	9±0.7	0.7±0.3	0.6±0.5	1.0±0.3	0.7±0.3
4th group - trial	4±0.8	70±1.0*	14±0.7*	9±0.7	0.9±0.2	0.7±0.1	0.5±0.1	0.9±0.2

Note: *difference with control at $p<0.05$

Results of goat milk cytological tests are presented in Table 9.

In all trial groups (2nd, 3rd, 4th), in goat milk statistically significantly ($p<0.05$) increased relative number of segment nucleus as well as leukocytes and at the same time statistically significantly decreased ($p<0.05$) relative number of lymphocytes.

Relationship between segment nucleus cells, leukocytes and lymphocytes in goat milk indicate beneficial reaction of a goats organism to different feed additives (wheat bran, sunflower meal, rapeseed meal).

The decrease in lymphocytes relative number in trial group animals was in its turn accompanied by immunocyte activation and increase of circulating immune complex (CIC). All above-mentioned clearly indicate on immune stimulating effect of the aforementioned feed additives.

In the 2nd, 3rd and 4th trial groups statistically insignificantly ($p<0.05$) increased T – B – A – cell and phagocytes relative number in goat milk (Table 10).

Table 10 **Immunological indices in goat milk, %**

Groups	T - lymphocytes	B - lymphocytes	A - cells	Phagocytes
1st group - control	7.0 ± 0.7	5.0 ± 0.7	4.0 ± 0.3	5.0 ± 0.7
2nd group - trial	13.0 ± 1.4*	10.0 ± 1.0*	6.0 ± 0.7**	14.0 ± 1.0*
3rd group - trial	11.0 ± 1.0 *	9.0 ± 0.7 *	8.0 ± 1.0*	12.0 ± 0.3*
4th group - trial	17.0 ± 1.0 *	13.0 ± 0.7*	11.0 ± 1.0*	16.0 ± 0.7*

Note : *difference with control at $p<0.05$
**difference with control at $p<0.1$

Concurrent decrease in lysozyme concentration in trial goats milk indicates on relative increase of lysozyme associated T – lymphocyte helpers, which also give signals about cell immune system activation.

Conclusions.

1. Without inherited traits and animal selection, milk ability of goats is influenced by proper and valuable feed. In a rather short time it helps to influence not only body condition of goats but health as well and increase milk production ability in goats.

2. In Latvian local goats, wheat bran fed in summer increased milk yield by 4.33 %, reduced feed units by 4.2 % and by 0.6 % reduced consumption of digestible protein as well as increased milk fat, protein and sugar content in goat milk by 22.8 %, 13.3 % and 1.1 %, respectively compare to control.

3. Sunflower meal fed in summer period increased goat milk yield by 1.8 %, digestible protein consumption by 8.0 % and by 1.6 % reduced milk fat as well as by 3.9 % increased protein content and by 0.2 % sugar content in milk compare to control.

4. Rapeseed meal fed in summer resulted in milk yield increase by 12.64 %, reduced feed units by 10.4 % and by 3.1 % digestible protein consumption, as well as increased milk fat by 3.2 % and decreased protein and sugar content in goat milk by 1.1 % and 1.6 %, respectively compare to control.

5. In trial groups, statistically significantly increased segment nucleous cells as well as leucocytes number and concurrently lymphocytes relative number significantly reduced in goat milk

6. In trial groups, statistically significantly increased T – B – A cell and phagocytes relative number, which indicates on animal health.

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