FEEDING OF GOATS UNDER CONDITIONS OF ORGANIC FARMING

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Summary. The research was carried out in one of the biggest organic goats farm of Latvia "Līcīši". A total of 30 goats were used in feeding trial to determine the effect of Fodder yeast and Yeast culture Yea-Sacc^{1026} on goats milk yield and in milk composition in 2002 and 2003.

Adding of Fodder yeast and Yeast culture Yea-Sacc^{1026} in ration did not affect goat milk yield, but in organic farm for optimization of protein it is possible to include Fodder yeast in ration. To increase feed intake we recommend use Yeast culture Yea-Sacc^{1026} in organic goat farm. Milk fat content increased for 0.43% by using of Yeast culture Yea-Sacc^{1026} in ration, but content of protein in milk were increased by both – Fodder yeast and Yeast culture Yea-Sacc^{1026}. The research results showed that the biggest effect of these additives was the improving of unspecific resistance indicators in goat's milk. The highest increasing of lysozymes in milk was monitored under the influence of Fodder yeast: 2.5 times more comparing to control group. The highest increasing of CIK was monitored after using of Yeast culture Yea-Sacc^{1026} : 2 times more in comparison with the control group. Also the using of both feed additives allowed obtaining goat milk with decreased content of cholesterol. Including of fodder yeast in feed ration decreased content of milk urea by 7.2%, but most significant decrease in comparison with control group by 19.8 % was found in the 3rd trial group, where Yea-Sacc^{1026} was fed.

Keywords: goats, feeding, milk composition, milk urea.

MIELIŲ PRIEDAI OŽKŲ MITYBOJE

Santrauka. Tyrimas atliktas 2002 ir 2003 metais vienoje iš didžiausių Latvijoje ekologinių ožkų fermų „Līcīši".

Bandymui atrinkta 30 ožkų. Norėta išsiaiškinti pašarinių mielių ir mielių kultūros Yea-Sacc^{1026} įtaką ožkų pieno primilžiui ir sudėčiai.

Pašarinės mielės ir mielių kultūra Yea-Sacc^{1026} įtakos pieno primilžiui neturi, bet ekologiniame ūkyje jomis galima papildyti baltymų sudėtį ožkų racione. Pridėjus Yea-Sacc^{1026} mielių kultūros, pieno riebumas padidėjo 0,43%, tačiau tyrimų rezultatai parodė, kad ir pašarinės mielės, ir mielių kultūra didina baltymų kiekį piene. Gerėja ir nespecifiniai ožkų pieno atsparumo rodikliai. Veikiant pašarinėms mielėms, piene pastebimai padaugėjo lizocimų – 2,5 karto palyginti su kontroline grupe. Didžiausias piene esančio imuninio komplekso (circulated immune complex – CIC) padidėjimas nustatytas panaudojus mielių kultūrą Yea-Sacc^{1026} – du kartus daugiau negu kontrolinėje grupėje. Abu vartojami priedai ožkų piene sumažino cholesterolio kiekį. Pašarinės mielės sumažino baltymų skilimo produktų (urėja piene) 7,2%, bet labiausiai urėja sumažėjo 3-ios bandomosios grupės piene (19,8%).

Raktažodžiai: ožkos, šėrimas, pieno sudėtis.

Introduction. Organic farming is an environmentally friendly production system, which avoids the use of synthetically compounded fertilizers, pesticides, growth regulators and livestock feed additives. To the maximum extent feasible, organic farming systems rely on crop rotation, crop residues, animal manures, legumes, green manures and aspects of biological pest control to maintain soil productivity and tilth, to supply plant nutrients and to control insects, weeds and other pests (Lampkin, 1992). According the rules No. 514 of the Cabinet of Latvia on Principe's of organic farming and certification process, the systems, in which animals are kept, must conform to the highest welfare standards, they must be fed according their physiology, using food largely produced on the farm and veterinary treatment should avoid routine prophylactic drug use. The maximum feed allowance from conventional sources with the Latvia Food and Veterinary Service specifying 10 % for ruminants, also for goats, are calculated on the basis of daily dry matter intake. The non-forage part of ration (concentrates) must not comprise more than 40% of daily dry matter intake.

Goats' milk is more worthwhile in comparison with cows milk. Dry matter of goat milk is from 10,0% to 13,6%, milk fat content – from 2,9% to 5,6%, milk protein – from 3,0% to 3,9%, lactose – from 4,2 to 5,0%. Count of somatic cells is about 10 thousand in 1 ml (Ursova, 1994). According investigations of scientists from Canada, there are more Calcium (by 11%) and Phosphorus (by 18%) in goats' milk in comparison with cows' milk, and also 4,6 times more Cu, 4,5 times more Mn and 1,3 times more K. There are more vitamins in goats milk – 1,4 times more Vit. C, 3 times more Vit. B_3, 1,5 times more Vit. A as it is in cows milk. Goats milk fat content is similar to cows milk fat content, but it is very important, that the level of cholesterol is lower by 20% than it is in cows milk (http://www.ontariogaatmilk.org/frames.htm; Piena lopkopība, 2001). Goats milk is rich with casein and albumin and is easy digestible for people like mothers milk. Goats milk is very healthy for children and people after different health problems. By taste goats milk is similar to cows milk just after milking, but later taste and smell can change (Spruzs, 1996, 2003). Chemical content of goats milk depend on goats feeding. If goats have received optimized feed ration, there are well-balanced content of all aminoacids in goats milk. Total content of aminoacids in milk of Latvia's local goat breed is 33,77 g kg^{-1}, in that of Saanen breed – 27,39 g kg^{1}. The level of cholesterol there is about 0,03g/100g in goats milk, it means, that it is five times less than in cows milk. By studies in Latvia, it is clear that goats milk is

rich with some preventives. One of them is lysozymes, which in man's organism can affect and eliminate different infections. In goats milk of Saanen breed there are 15,2 mkg ml^{-1} lysozymes, but in milk of Latvia local goats breed – 37,0 mkg ml^{-1}. Also as preventive there is Circulated immune complex (CIC), which is very necessary for man helping to raise his immunity (Spruzs, 2003).

Goats milk productivity depends on goats genetic factors, nutrition, welfare and health. The main factor is goats nutrition, because this has impact on animal productivity and health. Important nutrient in goats feed optimization is crude protein and digestible protein. By Latvia recommendations, requirement for protein is from 85 to 100 g digestible protein per 1 feed unit (Spruzs, 1996), but in USA according recommendations of National Research Council the requirement for goats maintenance, growing, pregnancy and milk production is from 130 to 150 g (Nutrient requirements of …, 1981). Feed ration should consist from grass and legume hay, beans, peas, rape, alfalfa, fodder yeast and other protein feeds for providing animals with protein. If it is not possible get all necessary feeds in self-farm, it is allowed to include in daily ration 10% conventional feeds and additives. But although conventional protein supplements are allowable, care should be taken with protein overfeeding. The real problem on organic farms may in fact be insufficient energy rather than protein, especially where lucerne or red clover based forage is used (Lampkin, 1992). Excess of protein can lead to health problems similar to those in conventional systems with a high nitrogen load, such as excess ammonia production, liver and fertility problems, as well as high urea levels in milk. When excess protein is combined with too little energy in ration, this can actually lead to protein deficiency in the goat and reduced protein levels in milk, because of the energy consuming process of deamination (Culleton et al, 2001). But investigations of some scientists demonstrate, that short-lived protein excess in ration don't arise some health problems (Sundrum, 1997).

There is a direct relationship between protein levels in dairy goats rations and the amount of nitrogen excreted in manure. Approximately 75-85% of consumed nitrogen (from dietary protein) is excreted when fed in excess. Milk urea nitrogen (MUN) provides an accurate reflection of how much N is absorbed by the goat but not used for growth or milk protein synthesis. Most of this N is provided by feed. With overfeeding of protein, excess nitrogen is excreted in milk and urine. The MUN assay is a useful tool to tell us when the animal is wasting protein and excreting excessive N, or is fed diets deficient in N. Using MUN helps to reduce feed costs and reduce potential N losses from farm (Myers et al., 2000). Urea is a normal constituent of milk and comprises part of the non-protein nitrogen normally found in milk. Blood urea will fluctuate throughout the day. Concentration will be highest about 4 to 6 hours post feeding, and lowest just prior to feeding. Milk urea will be slightly less volatile than a blood sample. Feeding a total mixed ration (TMR) versus separate feed ingredients will influence the change in urea concentration with feeding. Separate ingredient feeding has tended to increase urea concentration more than TMR feeding following consumption. All the factors, which influence blood urea, will influence the concentration of urea in milk. This includes rumen degradable protein intake, undegradable protein intake, energy intake, water intake, liver function, and urinary output. Concentration of urea in milk are variable from herd to herd and within animals in the same herd. The mean MUN could be used to signal potential problems with our feeding program. It could not be used to identify specific problems. High MUN suggests that more protein is fed than is necessary for production, or that feed intake is not as uniform as you would within that group of animals (Ferguson, 2000). Some investigations showed, that it is a strong positive relationship between the stage of lactation (day in milk) and milk urea concentration. Also milk protein yield have a significantly positive influence on milk urea concentration. The effect of somatic cell count on milk urea is significantly negative. This means that the milk urea concentration will decrease if the somatic cells count increase (Richardt et al., 2001). Investigations of A.J.Schepers and R.G.Meijer prove, that there are close correlation between rumen-degraded protein balance in the ration and urea concentration in milk. The effect of the balance of true protein digested in the small intestine and net energy on milk urea concentration were small. Parity and stage of lactation did not influence milk urea concentration (Schepers et al., 1998). Studies of R.G.Johnson and A.J.Young showed that as the milk protein percentage increased, MUN concentration decreased, but MUN did not decrease significantly until above 3,4% milk protein. Milk fat percentage also decreased as MUN increased (Johnson et al., 2003). Milk urea nitrogen normals unknown for goats. Langston OK study found 9-14 mg dl^{-1} at 12 % crude protein diet (http://www.search.gov.on.ca:8002/…) The benefits of using MUN analyses may be summarized as: economics, reproduction and the environment. There is a potential to save feed costs by reducing protein fed, or reducing lost production due inadequate protein out of the diet. High protein diets impair reproduction because blood urea is toxic to reproductive tissues. There is a need to reduce nitrogen loading to ground water and estuaries. High protein diets result in more manure N. Therefore, reducing manure N reduces N lost from manure to the environment (Kohn et al., 1997).

One of the ways to improve protein and energy feeding is including of yeast culture Yea-Sacc^{1026} in ration of dairy goats. This is the world's leading natural rumen modifier, which removes oxygen in rumen, secretes peptides that stimulate cellulose-degrading bacteria and buffers rumen pH. The result is a more efficient utilization of dietary energy for meat or milk production (Lyons, 2002; Dawson et al, 2002).

Last year we started investigations in organic farming with goats and the main aim of this study was to investigate factors affecting quality and quantity of organic animal products, improvement of nutrition, optimization of feed ration and etc.

Material and methods. Investigations have been made in organic goat farm "Licisi" in Latvia during lactation period at 3 months on 2002 and 3 months on 2003. There are about 60 milking goats in this organic farm, and we selected 30 goats similar by productivity and age. Goats were divided into 3 groups respectively of

age. The 1st control group received feed ration from grass hay, pasture grass, concentrates and milk way, produced in the self-farm. The 2nd trial group received basic feed ration noticed above and 10 g Fodder yeast per animal per day in extra. The 3rd trial group received basic feed ration and 1 g Yea-Sacc^{1026} per animal per day in extra (Table 1).

Table 1. **Trial scheme**

No.	Groups	Animals per group	Feed ration
1.	1st control	10	Hay+grass+concentrates+whey (BF)
2.	2nd trial	10	BF + Fodder yeast 10g per animal per day
3.	3rd trial	10	BF + Yea-Sacc^{1026} 1g per animal per day

Feed ration was calculated according national recommendations of goat feeding, according goats liveweight and milk productivity. Once per month we fixed milk yield with accuracy ±0,05 kg, also we were examining milk protein, milk fat content with tester Milko Scan 133 and count of somatic cells. On the year 2002 we fixed the activity of lysozymes, circulated immune complex (CIC) and cholesterol. On the year 2003 we fixed milk urea in 9 samples of milk.

Also on the years 2002 and 2003 we analyzed feed quality (hay and concentrates) through our University laboratory and made optimization of feed ration. Composition of concentrates were: Barley – 48%, Wheat – 30%, Rye – 20%, Effect Hog – 1%, Bioplex Zn – 1%.

Results and discussions. On 2002, the changes of goats' liveweight were small, but these changes were not disparity, and there were not disparity between groups (Table 2).

Table 2. **Changes of Goats Live Weight, kg**

Groups	Live Weight, kg		LW gain, kg
	at the start of trial	at the end of trial	
1st control	55,3 ± 3,37	58,4 ± 1,20	3,1
2nd trial	54,5 ± 1,74	57,3 ± 1,66	2,8
3rd trial	58,1 ± 1,36	60,0 ± 2,26	1,9

In 3 months on 2002 from the 1st control group we gained 1766 kg of milk or 1,92 kg milk per goat per day. From the 2nd and 3rd trial groups we gained 1748 kg and 1490 kg of milk respectively or 1,90 kg and 1,62 kg of milk per goat per day (Table 3).

Table 3. **Milk yield in trial on 2002**

Group	Milk yield, kg			% to control
	Total per trial	per goat	per goat per day	
1st control	1766	176,6	1,92	100,00
2nd trial	1748	174,8	1,90	98,96
3rd trial	1490	149,0	1,62	84,38

Milk yields of the 2nd and 3rd trial groups were lower by 1,04 % and 15,62 % compare to milk yield of the 1st control group respectively, but these differences were not relevant. As the trial was carried out at the end of summer and first part of autumn, the milk yield from month to month fell, but the smallest falling (-0,52 kg) was observed in the 3rd trial group (Figure).

Optimization of goats ration with fodder yeast or yeast culture Yea-Sacc^{1026} didn't affect content of milk protein and milk fat (Table 4).

Content of milk fat in trial period on 2002 decreased by 1,4 g kg^{-1} in the 1st control group, but increased by 0,5 g kg^{-1} and 4,3 g kg^{-1} in the 2nd and 3rd trial groups respectively, and these changes are not relevant. The greatest increasing of milk protein was in the 2nd and 3rd trial groups, and that increasing is relevant ($p<0,001$). Correlation is negative between milk yield and content of milk fat ($r=/-0,71/>r_{0,05}=0,63$), also between content of milk fat and milk protein ($r=/-0,65/>r_{0,05}=0,63$). Admittedly that correlation between milk yield and content of milk protein was positive ($r=0,71>r_{0,05}=0,63$).

On 2002 goats milk samples were analyzed by content of lysozymes, circulating immune complexes (Table 5) and by content of cholesterol (Table 6) in the laboratory.

Data of analysis showed, that the greatest impact on the content of lysozymes gave optimization of feed ration by fodder yeast (2nd trial group), and content of lysozymes was 2,5 times more compare to control group ($p<0,05$). In the 3rd trial group content of lysozymes in milk was higher by 27% in comparison with control group, but impact of Yea-Sacc^{1026} was not relevant.

The amount of CIC in milk was higher by 35,5% in the 2nd trial group and by 98,4% in the 3rd trial group in comparison with the 1st control group, and the last one difference was relevant ($p<0,01$).

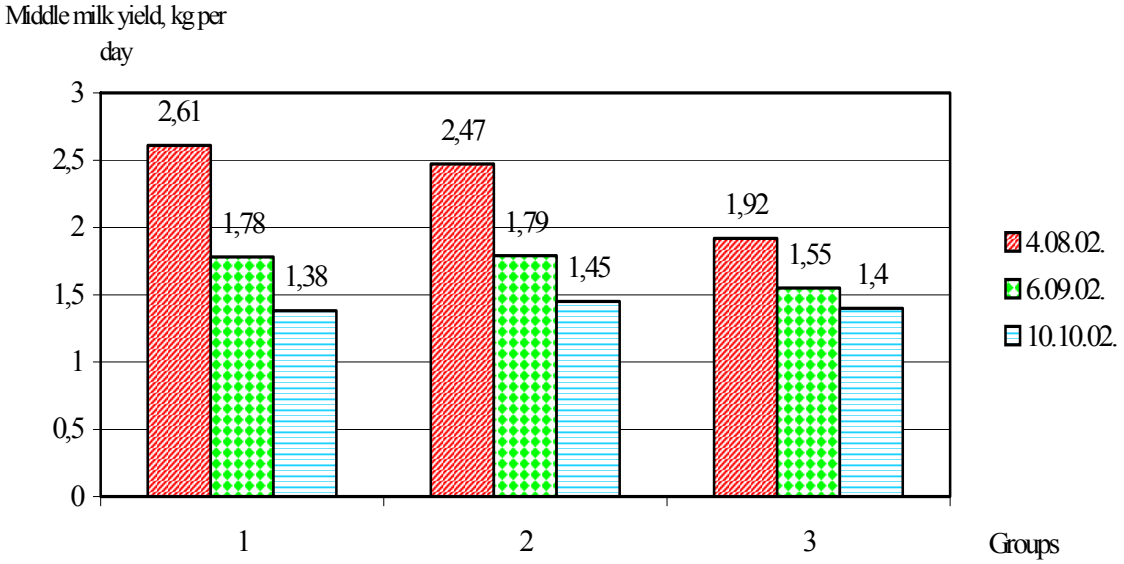

Fig. **Changes of milk yield, kg per day**

Table 4. **Composition of goats milk on 2002, g kg^{-1}**

Group	Milk fat	Milk protein
1st control	48,8 ± 3,9	33,0 ± 1,2
2nd trial	47,1 ± 2,2	32,2 ± 1,0*
3rd trial	51,5 ± 3,5	32,1 ± 0,8*

* p<0.001

Table 5. **Unspecific resistance indicators of goat milk, 2002**

Group	Lysozyme, mkg ml^{-1}	% to control	V%	Circulating immune complex, in accepted units	% to control	V%
1st control	38,17 ± 11,19	100,00	50,78	7,93±0,64	100,00	13,88
2nd trial	93,67 ± 6,83**	245,40	12,64	10,77±0,97	135,81	15,60
3rd trial	48,50 ± 3,79	127,06	13,52	15,78±1,55*	198,36	17,01

* p<0,01
** p<0,05

Table 6. **Content of Cholesterin in goat milk, 2002**

Group	Cholesterin, g 100g^{-1}	% to control	V%
1st control	0,033 ± 0,002	100,00	13,95
2nd trial	0,028 ± 0,003	84,85	19,91
3rd trial	0,030 ± 0,001	90,91	5,77

It is known, that optimal amount of cholesterol in goats milk is 0,03 g% (Химический состав … ,1987). There was decreasing in the content of cholesterol in both trial groups by 15,15 % and 9,09 % respectively in comparison with the 1st control group, but these differences were not relevant.

Milk urea content in goat milk samples was tested in 2003. In the 2nd trial group the content of milk urea was less for 0,41 mmol L^{-1} or 2,43 mg 100ml^{-1} in comparison with 1st control group (Table 7).

Table 7. **Milk Urea in goats milk**

Group	Milk Urea			
	mmol L^{-1}	mg 100ml^{-1}	% to control	V%
1st control	5,71±0,39	34,23±2,20	100,0	10,8
2nd trial	5,30±0,92	31,80±5,50	92,8	30,1
3rd trial	4,58±0,65	27,43±3,90	80,2	24,7

In the 3rd trial group the content of milk urea was less for 2,43 mmol L^{-1} or 6,80 mg $100ml^{-1}$ in comparison with the 1st control group. Including fodder yeast in feed ration decreased content of milk urea by 7,2%, but most significant decrease of milk urea by 19,8 % was found in the 3rd trial group, where Yea-Sacc1026 was fed. It should be mentioned, that goats of the 2nd and 3rd trial groups received better balanced feed ration resulting in optimal relationship between feed protein and carbohydrates.

Conclusions.

1. Addition of fodder yeast and Yea-Sacc1026 didn't increase milk yield in the 2nd and 3rd trial groups in comparison with control groups, because the trial was carried out in late summer and early autumn, when goats productivity normally decreased.
2. It is possible to use fodder yeast as a protein additive in goats ration in organic farming, if it is not GMO.
3. Adding of Yea-Sacc1026 to feed ration helped to increase feed intake, and led to better utilization of feed protein and energy.
4. Additives of fodder yeast and Yea-Sacc1026 increased milk fat content by 0,5 g kg^{-1} and 4,3 g kg^{-1} in comparison with the 1st control group, and content of milk protein by 5,4 g kg^{-1} and 5,1 g kg^{-1} respectively.
5. Additive of fodder yeast had an impact ($p<0,05$) on goats immunity, and 2,5 times more increased content of lysozymes in comparison with control group.
6. Additive of Yea-Sacc1026 influenced immunity of cells, and increased amount of circulated immune complexes in goats milk.
7. The use of both additives allowed obtaining goat milk with decreased content of cholesterol. The decrease was 15,15 % in the 2nd trial group and 9,09 % in the 3rd trial group in relation with control group.
8. Including of fodder yeast in feed ration decreased content of milk urea by 7,2%, but most significant decrease by 19,8 % was found in the 3rd trial group, where Yea-Sacc1026 was fed.

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