Productivity of Slovenian Alpine goat in the conventional and organic farming system

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Summary

Milk production and milk composition of dairy goats in organic and conventional farming were studied in Slovenian Alpine goat population. The conventional farming shows a tendency to higher production, but the differences between both production systems are due to high variability not statistically significant. The preorganic productivity of both groups was also studied. The group, which was later included in organic production produced less also in preorganic period. Mostly, farms with low production intensity in preorganic period accepted the organic production. It has been established that production was in both groups on a low level, therefore a special selection program for organic farming in Slovenia is not necessary.

***Key words**: Milk recording, Lactation, Variability, Production traits, Milk composition*

Introduction

Goat production can be considered as a valuable part of sustainable farming system. Furthermore, integration of livestock can increase economic and environmental benefits as well as diversity, thereby making important contributions to the farm's sustainability. Goats may fit well into the biological and economic niches in a farm operation that otherwise go untapped. They can well be incorporated into the existing grazing operations with donkeys or horses.

Goats can also be used for the control of weeds and bush to help utilize a pasture's diversity, as long as they are not allowed to overgraze. To produce milk, meat, and fiber livestock uses grass and other plants that cannot be included to human diet. In a balanced agro-ecosystem, both animals and plants are thriving successfully. Livestock eats the excess plant materials, and animal wastes provide nutrients for the plants. Grazed pastures need less fertilizer than those that are hayed. The primary goal of controlled grazing is to use livestock as a tool to manage forage growth. Animals use up very few of the nutrients from the plants they eat; most minerals are returned in animal wastes and can be considered as part of a natural cycling of nutrients. If wastes are evenly distributed throughout the grazing area and biological agents such as earthworms, dung beetles, and soil bacteria are active, the system should be relatively stable.

Many organizations have adopted goal statements that focus on achieving a sustainable future. While these vary widely in specific wording, they show a surprising degree of convergence around several key ideas:

- *Whole-systems thinking:* the integration of social, environmental, and economic forces, also known as the triple bottom-line;
- *Long term thinking:* understanding the consequences of actions over time, and preserving choices and opportunities for future generations;
- *Recognizing limits:* an acknowledgement that people, economies, and the entire life depend on healthy functioning ecosystems; and
- *Improved livelihoods:* a better "quality of life," both today and for future generations.

The principles were created to provide a framework to guide ecology toward sustainable solutions with interdependence between ecological, economic and social factors in achieving sustainability.

Environmental, economic and social goals can be compatible, and interrelated in such a way that one goal cannot be effectively pursued if at the expense of another. In other words, the availability of natural resources and a clean and healthy environment are essential to our production capability, and conversely, our ability to address environmental and social issues often depends on a strong and vibrant economy.

The productivity of dairy goat reared in organic farming was not very widely studied. Some studies were done on dairy cattle and conclusions are maybe applicable also on dairy goats. Results are different from case to case. Nauta *et al*. (2006) found the production of 6 440 kg of milk per cow and lactation in organic and 7 156 kg milk in conventional management in the same geographic area. Farms which are in the phase of conversion from conventional to organic farming had an average production of 6 622 kg per cow and lactation. It is interesting that the average preorganic production was lower (6 991 kg/cow and lactation) than on the conventional farms. After the farms started to convert to organic management, the percentage of proteins dropped. The diet on organic farms is based on fiber forages, but the percentage of fat is a little lower on organic farms. The total production of fat and proteins per cow and lactation in conventional production was larger mostly because of larger milk production and not because of different milk composition. Toledo *et al* (2002) did not find the differences between the milk composition in conventional and organic farming in Swedish conditions. Small differences in milk production and composition were found also in the study of Kristensen and Kristensen (1998) in Danish conditions. Dual purpose dairy cattle produced only 115 kg more energy corrected milk (ECM) in lactation. In the other study in Danish conditions (Kristensen and Mogensen, 2000) the difference between the two production systems was much larger - 7,043 in conventional comparing to 6 627 kg ECM in organic production. Rosati and Aumaitre (2004) compared two French farms. The difference was much larger: the conventional farm produced 7,260 and organic only 5 130 liters of milk per cow and lactation in primiparous Holstein cows. In extensive production (without concentrates) cows produced only 5 030 kg of milk per lactation. When 8 kg of concentrate was daily supplemented in first 24 weeks of lactation the production of milk was 6 664 kg (Sehested *et al*., 2002). The difference between the two production systems was also relatively large in Norway; 4 854 in year 1994, 4 791 in year 1995 and 4 554 kg per cow per lactation in year 1996 in organic production comparing to 6 212, 6 014 and 6 040 for every year respectively in conventional production (Reksen *et al*., 1999). It can be concluded that the productivity of animals in organic farming is mostly determined by the management of every single farm.

The aim of this study is to find out the differences between two production systems and if the special selection program for the organic farming is necessary.

Material and methods

In Slovenia milk recording of goats using A4 method was practiced in the years 1996 to 2002. The AT4 method has been used since 2003. Till the year 2000 there were no officially recognised organic goat farms in Slovenia. The selection procedure and the selection criteria do not differ between the organic and conventional farming system. Our research focuses on goat farms that have been included in selection programme since 1999 or before. In 2002 the rural development programme was initiated, followed by the subsidies offered to certain kinds of sustainable agriculture, among them the ecological farming and subsidies programme for the separate measures of agricultural policy, only some ten or twenty goat farmers decided for it, mostly in 2003 and 2004 when the subsidies substantially increased, especially for organic farming.

In 2007 milk yield and milk composition were compared between the flocks of Alpine goats in organic and in conventional farming system. Another comparative study was conducted in 1999 when flock results were compared between those that stayed in the conventional system, and those that were later changed to organic farming. Data processing included lactations lasting over 199 days. The following statistical model was used:

$$Y_{ijklm} = T_i + F_{ij} + L_k + b(\bar{x} - x_{ijklm}) + e_{ijklm} \qquad (1)$$

where :

Y_{ijklm} = ijklm-th observation of studied trait;
T_i = i–th farming (conventional, organic);
F_{ij} = j-th farm (flock) nested in breed I;
L_k = k-th lactation;
b = regression coefficient
x_{ijklm} = ijklm-th observation of lactation length
e_{ijklm} = residual for observation ijklm.

MEANS and GLM procedures of SAS/STAT programme were used for the statistical evaluation.

Results and discussion

The number of observations, the average values, standard deviations and coefficients of variability for organic and conventional production systems in years 2007 and 1999 are presented in Table 1. Apparently, the farmers with poor production results decided for organic farming. Before the change, milk yield on farms in 1999 was 515 kg (SD=228.6 CV=44.2, lactation 253 days), while milk yield results on farms that did not change to organic farming was 542 kg (SD=185.4 CV=34.2, lactation 247 days) The situation on almost the same farms in 2007 was as follows: milk yield on conventional farms was 574 kg (SD=180, CV=31.5, lactation 243 days), compared to organic farms, where milk yield was 502.5kg (SD=267, CV=53.1, days in lactation 244) (Table 1). Higher variability of the results was observed on organic farms. Presumably, this is the result of different production systems.

Analysis of variance for production traits such as milk yield and milk composition on Slovene Alpine goat farms in years 2007 and 1999 are presented in table 2. Determination coefficients (R^2) are higher for milk yield and other traits closely

related to it, as well as for the total fat, protein and lactose content. Variability of milk components was not well described with the model used in this case, as the determination coefficient was about 0.2, with the exception of fat percentage, which was just slightly above 0.3.

The major variability source was a flock, which had a statistically significant effect on all the studied traits. The lactation number had an impact on milk yield, and on produced quantities of milk components. Milk content was generally not affected by the successive lactation. The same stands for the lactation length.

Different farming system (organic, conventional) statistically significantly affected only the percentage of fat and dry matter in 2007. It is interesting that between farms that changed later to organic farming, and those that stayed in conventional system, the difference was evident already in preorganic period in the year 1999. In the same year a difference between both production systems was present also in milk fat rate and milk fat content. In the conventional system a noticeable tendency for higher productivity was observed (Table 1), but the variability was so high that the

Table 1. Number of lactations (n), average values, standard deviations (SD) and coefficients of variability (CV) for production traits in conventional and organic farming for goats in year 2007 and for the same flocks in year 1999

	Conventional				Organic			
	No.	Mean	SD	CV (%)	No.	Mean	SD	CV (%)
Year 1999								
Lactation (days)	287	252.9	24.7	9.77	131	246.6	33.4	13.53
Total milk (kg)	287	541.7	185.4	34.22	131	514.6	228.6	44.42
Milked milk (kg)	287	419.0	170.0	40.56	131	395.0	215.7	54.61
Fat (kg)	285	16.59	5.59	33.68	130	15.80	6.77	42.83
Fat (%)	285	3.10	0.46	14.88	130	3.15	0.51	16.25
Proteins(kg)	285	15.08	5.04	33.41	130	14.67	6.61	45.03
Proteins (%)	285	2.80	0.25	9.02	130	2.84	0.30	10.49
Lactose (kg)	285	22.86	7.83	34.24	130	21.14	9.93	46.96
Lactose (%)	285	4.23	0.23	5.37	130	4.06	0.31	7.71
Dry matter (%)	285	10.13	0.66	6.51	130	10.05	0.83	8.29
Year 2007								
Lactation (days)	240	242.9	19.7	8.11	250	243.7	23.9	9.82
Total milk (kg)	240	574.0	180.9	31.52	250	502.5	267.0	53.13
Milked milk (kg)	240	464.2	178.4	38.43	250	402.5	267.0	66.33
Fat (kg)	239	18.54	6.06	32.68	246	13.82	7.61	55.09
Fat (%)	239	3.26	0.56	17.17	246	2.77	0.58	21.02
Proteins(kg)	239	17.17	5.60	32.61	246	14.69	7.88	53.63
Proteins (%)	239	3.00	0.36	11.96	246	2.94	0.38	13.00
Lactose (kg)	239	24.87	8.19	32.92	246	21.19	11.90	56.17
Lactose (%)	239	4.31	0.39	9.08	246	4.19	0.43	10.25
Dry matter (%)	239	10.58	1.08	10.20	246	9.90	1.13	11.39

Table 2. Analysis of variance for productivity and milk composition of Slovenian Alpine goat according to model (1) in years 2007 and 1999.

	Model					T_i		F_{ij}		L_k		b(X…..-X_{ijklm})		
	DF mod.	DF err.	F ratio.	*P*	R^2	DF	*P*	DF	*P*	DF	*P*	DF	*P*	b
Year 1999														
Total milk (kg)	21	396	38.60	<0.0001	0.6717	1	0.4968	12	<0.0001	7	<0.0001	1	<0.0001	2.75
Milked milk (kg)	21	396	39.92	<0.0001	0.6792	1	0.8698	12	<0.0001	7	<0.0001	1	<0.0001	2.33
Fat (kg)	21	393	28.50	<0.0001	0.6036	1	0.3815	12	<0.0001	7	<0.0001	1	<0.0001	0.077
Fat (%)	21	393	8.85	<0.0001	0.3211	1	0.2514	12	<0.0001	7	0.0948	1	0.1894	-0.0013
Proteins(kg)	21	393	40.66	<0.0001	0.6848	1	0.2128	12	<0.0001	7	<0.0001	1	<0.0001	0.079
Proteins (%)	21	393	5.69	<0.0001	0.2332	1	0.3376	12	<0.0001	7	0.0002	1	0.7611	0.0002
Lactose (kg)	21	393	38.47	<0.0001	0.6728	1	0.7038	12	<0.0001	7	<0.0001	1	<0.0001	0.113
Lactose (%)	21	393	4.29	<0.0001	0.1866	1	<0.0001	12	0.0002	7	0.4672	1	0.6746	-0.0003
Dry matter (%)	21	393	3.32	<0.0001	0.1506	1	0.0172	12	0.0002	7	0.0109	1	0.4081	-0.0014
Year 2007														
Total milk (kg)	22	467	52.92	<0.0001	0.7137	1	0.2600	13	<0.0001	7	<0.0001	1	<0.0001	1.76
Milked milk (kg)	22	467	54.69	<0.0001	0.7204	1	0.8099	13	<0.0001	7	<0.0001	1	<0.0001	1.63
Fat (kg)	22	462	44.30	<0.0001	0.6784	1	<0.0001	13	<0.0001	7	<0.0001	1	<0.0001	0.058
Fat (%)	22	462	12.61	<0.0001	0.3751	1	<0.0001	13	<0.0001	7	0.0009	1	0.4220	0.0011
Proteins(kg)	22	462	49.41	<0.0001	0.7017	1	0.3104	13	<0.0001	7	<0.0001	1	<0.0001	0.056
Proteins (%)	22	462	4.98	<0.0001	0.1917	1	0.7176	13	<0.0001	7	0.3208	1	0.0830	0.0017
Lactose (kg)	22	462	50.99	<0.0001	0.7083	1	0.0838	13	<0.0001	7	<0.0001	1	<0.0001	0.078
Lactose (%)	22	462	3.43	<0.0001	0.1404	1	0.0048	13	0.0002	7	0.4375	1	0.0616	0.0021
Dry matter (%)	22	462	5.07	<0.0001	0.1944	1	0.0003	13	0.0001	7	0.0885	1	0.1001	0.0049

differences were not statistically significant. High variability and lower average values on organic farms were most probably caused by not so well balanced animal nutrition and by poor health condition in the flocks in organic system, mostly due to parasites. These may not be treated preventively. The parasites have to be diagnosed prior to treatment. Because the analyses represent additional costs, farmers usually avoid it as long as possible.

Interestingly, the farms which later changed to organic system had on average lower production results already in 1999. This may be the result of production conditions or might be even more probably caused by producers. The change to organic system was performed mostly by producers who already had poor production results beforehand. The entry to organic system made the production method »formal«, although it had been practiced previously, but not formally yet.

Conclusions

Milk recording results, as well as the composition of milk indicate that some traits such as milk yield and milk fat content are lower in organic farming system compared to the conventional one, although in most parameters the differences are not significant. Apparently, even the conventional systems have low input (lower quantities of concentrates). It is evident that mostly those farms with relatively extensive production decided to change to organic farming. According to our results we can conclude that the recording methods and breeding goals can be the same for both production systems. Therefore, the differentiation of selection index is not necessary. To our opinion, better management is required regarding nutrition and parasite control on organic farms. Proper management could improve the production economy.

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