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MILK PRODUCTION OF BOVŠKA SHEEP IN CONVENTIONAL AND ORGANIC FARMING SYSTEM

Miran KASTELIC and Dragomir KOMPAN

Univ. of Ljubljana, Biotechnical Fac., Dept. of Animal Science, Groblje 3, SI-1230 Domžale, Slovenia

ABSTRACT

The productivity of Slovenian autochthonous dairy sheep breed Bovška in conventional and organic farming was studied. Bovška breed sheep are concentrated in western part of Julian Alps in Trenta valley. Animals from conventional system produce around eighteen percent more milk, fat, proteins and lactose. The system of production does not affect milk composition with exception of lactose. The flocks which entered organic farming scheme had lower level of production before the organic farming was officially introduced to Slovenia – the organic farming was the choice of low input farmers. In organic and conventional production the most important effect is that of flock. According to mentioned results and results from literature, there are many possibilities for moderate improving of productivity in conventional and organic farming.

Key words: dairy sheep / productivity / milk composition / organic farming / conventional farming / Slovenia

MLEČNOST BOVŠKE OVCE V KONVENCIONALNEM IN EKOLOŠKEM NAČINU REJE

IZVLEČEK

Proučevali smo proizvodnost slovenske avtohtone mlečne pasme bovška ovca v konvencionalni in ekološki reji. Večina ovc je v zahodnem delu Julijskih Alp v dolini Trente. Živali iz konvencionalne reje priredijo približno osemnajst odstotkov več mleka, maščob, beljakovin in laktoze. Način reje ni vplival na sestavo mleka z izjemo laktoze. Tropi iz ekološke reje so imeli manjšo proizvodnost, tudi preden je bila ekološka reja vpeljana v Slovenijo. Ekološki način reje so izbrali rejci, ki so že prej kmetovali ekstenzivno. Tako v ekološki kot v konvencionalni prireji je bil najpomembnejši vpliv črede. Glede na ta rezultat in rezultate iz literature obstaja precej možnosti za izboljšanje proizvodnosti tako v konvencionalni kot v ekološki prireji.

Ključne besede: mlečne ovce / proizvodnost / mleko / sestava / ekološka prireja / konvencionalna prireja / Slovenija

INTRODUCTION

Bovška Sheep is an autochthonous dairy sheep breed. The breed is mostly reared in some Slovenian remote areas in Julian Alps. Animals are traditionally reared on relatively low input production system. Organic farming is nowadays becoming more and more popular also in Slovenia. Many farmers, among them also the Bovška sheep breeders found such management as an opportunity. They joined the Slovenian agricultural environmental program which is supported with the subsidies.

The productivity of dairy sheep reared in organic farming was not very widely studied. Dairy sheep are, especially in poor land conditions, reared in extensive or semi-intensive conditions in traditional way (Stefanakis *et al*., 2007). In such conditions the organic farming is in many cases only "formalization" of the currently used management. In North European countries with better

farming conditions, cattle is used for milk production. The differences between the productivity and milk composition of conventional and organic farming were done on case studies. 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 convertion 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) didn't 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 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 in milk yield and milk composition between the conventional and organic managed flocks of Bovška dairy sheep and how the introduction of organic farming changed the productivity and milk composition.

MATERIAL AND METHODS

The differences between conventional and organic production were studied on the data from Slovenian selection program for sheep. The first set of data contains the data of milk recording for Slovenian autochthonous dairy sheep Bovška from year 2007 according to type of farming - that is conventional and organic farming.

The second data set contains the same data from the same farmers from year 1999. The data is reflecting the initial productivity of the animals before the subsidies for organic production were introduced. They were introduced in year 2000. Many of the farmers from year 2007 were first introduced in selection program after year 1999. Consequently is the data set from year 1999 smaller than the data set from the year 2007. The data, classified as organic in 1999 are in fact from the conventional production, but they are showing the preorganic productivity of flocks which were later introduced in organic program.

Al the recordings with lactation shorter than 110 days were excluded from data evaluation. Studied traits were: milk yield (MY), milked milk in lactation (that is milk yield minus suckled milk - MML), fat quantity in lactation (FQ), fat percentage in lactation (FP), protein quantity in

lactation (PQ), protein percentage (PP), lactose quantity in lactation (LQ), lactose percentage (LP) and percentage of dry matter in milk (DM).

The production of milk, production milk components and milk composition in two separate years were studied with the following model:

$$Y_{ijklm} = \mu + T_i + F_{ij} + L_k + S_l + b\left(\overline{X} - X_{ijklm}\right) + e_{ijklm}$$

where Y_{ijklm} is ijklm-th observation of studied trait; μ is mean of the model; T_i is i-th farming (conventional, organic); F_{ij} is the effect of j-th farm (flock) nested in farming i; L_k is the effect k-th lactation (k = 1–8); S_l is the effect of the l-th month of lambing (season) (l = 1–7); $b\left(\overline{X} - X_{ijklm}\right)$ is linear regression – lactation length on studied variable; and e_{ijklm} is residual for observation ijklm.

Beside that linear statistical model, average values, standard deviations and coefficients of variability were estimated. For that part of evaluations SAS/BASIC procedure MEANS was used. The statistic for linear statistic model was estimated with SAS/STAT procedure GLM.

RESULTS AND DISCUSSION

In Table 1, the number of animals, average values, standard deviations (SD), coefficients of variability (CV) for animals in conventional and organic production in year 2007 for traits lactation length (LL), milk yield (MY), milked milk in lactation (milk yield minus suckled milk - MML), fat quantity in lactation (FQ), fat percentage in lactation (FP), protein quantity in lactation (PQ), protein percentage (PP), lactose quantity in lactation (LQ), lactose percentage (LP) and percentage of dry matter in milk (DM) are presented. The same values in year 1999 were calculated for both groups according to situation in 2007. In year 1999 all the flocks had conventional management.

The average lactation period was in conventional management in year 2007 for 18 days longer than in organic management. Animals in conventional management showed tendency for the production of larger quantities of fat and proteins. The percentage of fat and lactose was larger in milk of sheep from conventional comparing to those from organic management. The same tendency showed the percentage of dry matter. The average percentage of proteins was larger in organic milk. The same tendencies were observed in year 1999. The productivity of flocks which came later in organic farming was at that time point lower than the productivity of the flocks which are still in conventional management. The conventional flocks are showing larger variability in quantitative traits comparing to organic flocks which are more variable in the percentage of ingredients.

In Table 2 the results of analysis of variance are presented for years 2007 and 1999 respectively. The statistics were estimated for every dependent variable from Table 1 with the exception of lactation length which is used as covariable in independent part of the model. The effect of the flock nested in type of management was the most import factor. It influenced the productivity of every single trait in both years. The lactation number influenced every quantitative dependent variables (MY, MML, FQ, PQ, LQ) in both years, but also FP in year 1999 and LP in year 2007. Lactation length influenced (increased) all the quantitative variables in years 1999 and 2007 and FP in year 1999. Every single regression coefficient, including that for FP, was positive.

The management influenced every quantitative trait in year 2007. The differences between the two types of management in quantities of milk in lactation, of milked milk and of fat, proteins and lactose in whole lactation period were statistically significantly larger on conventional comparing to the organic farms. The percentage of proteins was statistically significantly larger

in organic flocks. The differences between the two types of management in FP, LP and DM were not confirmed with statistical proof. The results are in concordance with the results of Toledo *et al*. (2002) where no differences in milk composition between the two production systems in cows were found.

Table 1. Number of animals (n), average values, standard deviations (SD) and coefficients of variation (CV) for lactation length (LL), milk yield (MY), milked milk in lactation (milk yield minus suckled milk - MML), fat quantity in lactation (FQ), fat percentage in lactation (FP), protein quantity in lactation (PQ), protein percentage (PP), lactose quantity in lactation (LQ), lactose percentage (LP) and percentage of dry matter in milk (DM) for years 2007 and 1999 according to the type of management in year 2007. In year 1999 both groups were conventionally managed.

	Conventional				organic			
	n	average	SD	CV, %	n	average	SD	CV, %
year 1999								
LL, days	556	172.6	30.9	17.90	183	171.7	26.7	15.53
MY, kg	556	224.2	93.9	41.89	183	189.4	74.3	39.22
MML, kg	556	154.9	88.1	56.88	183	122.9	63.6	51.78
FQ, kg	555	13.70	5.28	38.53	183	12.72	4.81	37.85
FP, %	555	6.20	0.74	11.96	183	6.78	0.84	12.35
PQ, kg	555	11.31	4.85	42.86	183	9.71	3.61	37.18
PP, %	555	5.04	0.44	8.69	183	5.19	0.61	11.75
LQ, kg	555	9.78	4.28	43.79	183	7.99	3.27	40.90
LP, %	555	4.34	0.28	6.39	183	4.20	0.40	9.44
DM, %	555	15.58	1.00	6.93	183	16.17	1.49	9.23
year 2007								
LL, days	895	190.9	42.3	22.17	375	178.8	20.9	11.68
MY, kg	895	236.7	99.3	41.96	375	192.2	54.8	28.51
MML, kg	895	180.9	100.1	55.31	375	139.1	56.9	40.93
FQ, kg	895	14.98	6.12	40.82	369	12.03	3.69	30.66
FP, %	895	6.41	0.80	12.46	369	6.35	1.19	18.70
PQ, kg	895	12.94	5.51	42.61	369	10.46	2.94	28.13
PP, %	895	5.48	0.49	8.93	369	5.54	1.00	18.13
LQ, kg	895	10.79	4.68	43.37	369	8.35	2.75	32.94
LP, %	895	4.54	0.23	5.13	369	4.34	0.59	13.67
DM, %	895	16.43	1.13	6.86	369	16.23	2.35	14.50

Table 2. Analysis of variance for milk yield (MY), milked milk in lactation (MML), fat quantity in lactation (FQ), fat percentage in lactation (FP), protein quantity in lactation (PQ), protein percentage (PP), lactose quantity in lactation (LQ), lactose percentage (LP) and percentage of dry matter in milk (DM) for years 2007 and 1999 according to the type of management in year 2007. In year 1999 both groups were conventionally managed.

	model					T_i		F_{ij}		L_k		S_k		$b\left(\overline{X} + X_{ijklm}\right)$		
Model 1	Df. m.	df e.	F	P	R^2	df	P	df	P	df	P	df	P	df	P	b
Year 1999																
MY, kg	34	704	60.52	<0.0001	0.7451	1	<0.0001	19	<0.0001	7	<0.0001	6	0.0389	1	<0.0001	1.38
MML, kg	34	704	70.66	<0.0001	0.7734	1	0.0001	19	<0.0001	7	<0.0001	6	<0.0001	1	<0.0001	1.30
FQ, kg	34	703	51.33	<0.0001	0.7129	1	0.0123	19	<0.0001	7	<0.0001	6	0.0360	1	<0.0001	0.090
FP, %	34	703	11.16	<0.0001	0.3506	1	<0.0001	19	<0.0001	7	0.0410	6	0.0076	1	0.0016	0.0043
PQ, kg	34	703	62.19	<0.0001	0.7505	1	0.0003	19	<0.0001	7	<0.0001	6	0.0898	1	<0.0001	0.720
PP, %	34	703	6.02	<0.0001	0.2254	1	<0.0001	19	<0.0001	7	0.3273	6	0.4332	1	0.3374	0.0009
LQ, kg	34	703	50.79	<0.0001	0.7107	1	<0.0001	19	<0.0001	7	<0.0001	6	0.0357	1	<0.0001	0.061
LP, %	34	703	4.23	<0.0001	0.1698	1	0.8946	19	<0.0001	7	0.6319	6	0.8761	1	0.6414	−0.0003
DM , %	34	703	5.92	<0.0001	0.2227	1	<0.0001	19	<0.0001	7	0.2182	6	0.0486	1	0.0234	0.0049
Year 2007																
MY, kg	41	1228	55.52	<0.0001	0.6496	1	<0.0001	27	<0.0001	7	<0.0001	5	0.0053	1	<0.0001	0.51
MML, kg	41	1228	59.97	<0.0001	0.6669	1	<0.0001	27	<0.0001	7	<0.0001	5	0.0023	1	<0.0001	0.52
FQ, kg	41	1222	51.98	<0.0001	0.6356	1	<0.0001	27	<0.0001	7	<0.0001	5	0.0005	1	<0.0001	0.032
FP, %	41	1222	12.36	<0.0001	0.2932	1	0.0773	27	<0.0001	7	0.4217	5	0.0007	1	0.9590	−0.0001
PQ, kg	41	1222	54.73	<0.0001	0.6474	1	<0.0001	27	<0.0001	7	<0.0001	5	0.0043	1	<0.0001	0.027
PP, %	41	1222	5.38	<0.0001	0.1529	1	0.0097	27	<0.0001	7	0.4600	5	0.0785	1	0.5249	−0.0005
LQ, kg	41	1222	47.79	<0.0001	0.6159	1	<0.0001	27	<0.0001	7	<0.0001	5	0.0211	1	<0.0001	0.240
LP, %	41	1222	6.44	<0.0001	0.1469	1	0.2699	27	<0.0001	7	0.0014	5	0.6187	1	0.2868	0.0005
DM , %	41	1222	8.16	<0.0001	0.2149	1	0.0636	27	<0.0001	7	0.1951	5	0.0282	1	0.9638	−0.0001

In year 1999 all the flocks were in conventional management. The results of statistical evaluation are showing interesting projection. The later organic producers produced also in conventional management lower quantities of milk and milk ingredients. It seems that they produced with a lower intensity. After the program of organic farming was introduced they simply formalized their status to start in program which assured same subsidies and better economical situation of single breeder. Those results are in concordance with the results of Nauta *et al*. (2006) on cows. On the other hand we cannot conclude about the reasons for low intensity of production for every single producer, because they are widely spread in the western part of Julian Alps in Trenta valley and the conditions are not uniform. The production conditions vary from farm to farm and the consequences are a wide specter of production systems as described by Stefanakis *et al*. (2007) in Mediterranean area on Crete.

Results are showing for around 18% lower production in organic farming than in conventional farming. Such results are more comparable to the results of Rosati and Aumaitre (2004), Reksen *et al*. (1999) and Sehested *et al*. (2002) than with the results of Nauta *et al*. (2006), Kristensen and Mogensen (2000) or Kristensen and Kristensen (1998). Organic farming is not necessarily low input farming with low productivity. In conditions like in the area of the origin of Bovška sheep the intensification of production is unnecessary. On the other hand some moderate progress in both productivities, organic and conventional is possible, especially because the effect of the flock (breeder) is causing large variability.

CONCLUSIONS

Organic farming is becoming popular also among dairy sheep breeders in Slovenia. The breeders of autochthonous breed Bovška sheep are concentrated in western part of Julian Alps. Sheep from organic production are producing for around 16 percent less milk, fat, proteins and lactose, but the percentage of fat and proteins is the same in both farming systems. The percentage of lactose was lower in milk from organic farming. It is interesting that the farmers which are nowadays part of organic program produced less milk and milk ingredients also in conventional period. Introducing of organic farming didn't change the intensity of production. Organic farming was in this case more attractive for farms with low input production.

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