

Comparative Study on the Effects of Organic and Conventional Production Systems on Sheep Milk Yield and Chemical Composition

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Abstract

Objective of the current research was to evaluate the effects of the production system (conventional vs. organic), on milk yield and major chemical components from milk, in Turcana sheep reared under highland conditions. In the conventional system, the ewes had an average milk production of 76.81±2.99kg, with limits ranging between 64.67kg and 92.01kg. While in the organic production system, the Turcana ewes produced on average 78.95±4.59kg of milk, with variations between 69.29kg and 86.93kg. Differences between the two experimental groups were not significant ($p>0.05$). Although, the ewes reared under organic production outperformed the conventional managed ewes, on average by 2.14kg of milk/lactation. Fat percentage was on average 8.38±0.330%, with limits ranging between 7.25% and 8.97% in the conventional system, and of 7.72±0.261% with limits of 6.95% and 8.65% in the organic system. Protein levels were of 5.91±0.246% in the conventional system, with limits ranging between 5.26% and 6.79%, while in the organic trial the average 5.64±0.184%, ranging 5.11% and 6.31%. Current results suggest that the potential to produce and market organic sheep milk under highlands conditions is high in Romania, and will not have detrimental effects on the overall production or milk quality parameters.

Keywords: chemical composition, highland pastures, organic farming, sheep milk.

1. Introduction

In Eastern and Southeastern Europe the vast majority (>85%) of sheep are being reared in mountainous and disadvantageous areas, called Less Favored Areas, as defined in the EC Directive no 75/268/EEC, playing important economic, social and ecological roles, also contributing to the conservation of the environment [1]. With most of the local breeds

reared belonging to the mountain Zackel and lowland Tsigai groups [2, 3].

Romania ranks 3rd in the EU in terms of sheep numbers (9.8 millions), having a self-sufficiency for sheep lamb meat production of 150% [4]. Furthermore, Romania has a total pasture surface of 4.9 million hectares, which could sustain of up to 16 million sheep [5]. More than 95% of the sheep and goats in the country are being reared under extensive low-input production systems, and the breed structure is being dominated by indigenous, unimproved, low-productive breeds such as Turcana and Tsigai.

The Romanian indigenous Turcana, accounting currently for over 6 million breeding ewes [6], is one of the most representative breed belonging to

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the Zackel group, reared in 14 countries from C-, E- and SE Europe. With adult body weights ranging between 30-50 kg in ewes and between 60-80 kg in adult rams, and growth rates estimates in un-weaned lambs of 110-180 g/day [7], milk yields estimates of 60 to 150 kg/lactation and a litter size of 105-130% [8]. Overall, the production potential of the Turcana breed is modest, making the breed uncompetitive for the current marked demands (specialized breeds, for milk or meat). Furthermore, carcasses from the Turcana lambs, rank in the lowest classes based on EUROP classification system, mainly in 'O' and 'P'.

According to Eurostat [9], Romania ranks among the last 3 EU member countries based on the percentage of total utilized agricultural area on organic farming, with estimates of 2%, compared to the EU average of 6%, and other member states such as Sweden or Austria with roughly 20%.

Objective of the current research was to evaluate the effects of the production system (conventional vs. organic) on the milk yield and major chemical components from milk, in Turcana sheep reared under highland conditions.

2. Materials and methods

The research trial was initiated starting spring (April) 2016 at the Research and Development Station for Sheep and Goats from Caransebes (45°25'N/22°13'E). Caransebes region has an elevation of 280 m above sea level and a total annual precipitation of 737.2 mm, with a mean annual temperature of 12.9°C.

The project herd consisted of 180 multiparous purebred Turcana ewes, managed under conventional (n=90) and organic (n=90) production systems. The organic system met the criteria stipulated by the Council Regulations of the European Commission (2092/91/EEC and 1804/99 EEC) on standards of organic animal husbandry.

The reproduction season started in mid-September 2015, when nutritional flushing was practiced for three weeks before the mating seasons, in addition, all animals had free access to potable water and mineral blocks year around.

Ewes were housed indoors during winter for a period of 120 days, on deep straw bedding, with a space allowance of 1.8 m²/ ewe. Ewes received

high-quality clovers and pastures hays *ad libitum*, with an additional 200 g of concentrates in late gestation and during suckling period (65±5 days). All hays and concentrates were organically produced on farm. Creep feeding of lambs was not practiced, they were solely reliant on the dams milk production.

After weaning of the lambs, ewes were managed exclusively on pastures (organic and conventional), with two milking's per day (starting 6:00 and 17:00).

Milk yield was estimated using the ICAR rules and recommendations, having a number of 4 days for the control of the daily milked milk (morning and evening milking, at intervals of 28-31 days, with lactation being ended in early September.

Milk samples were taken on all 4 control days, from the evening milking, and the following chemical composition traits were evaluated: fat content, protein content, lactose content and total solids non-fat, using Milko Scan S50.

Data were statistically using MiniTab14@ software and differences between groups were analysed by non-parametric Mann-Whitney-Wilcoxon test. All decisions about the acceptance or rejection of statistical hypothesis have been made at the 0.05 level of significance.

The research activities were performed in accordance with the European Union's Directive for animal experimentation (Directive 2010 63/EU).

3. Results and discussion

Data on the effects of the production system (conventional vs. organic) on milk yields in Turcana ewes are shown in Table 1.

In the conventional system, the ewes had an average milk production of 76.81±2.99 kg, with limits ranging between 64.67 kg and 92.01 kg. While in the organic production system, the Turcana ewes produced on average 78.95±4.59 kg of milk, with variations between 69.29 kg and 86.93 kg. Differences between the two experimental groups were not significant (p>0.05). Although, the ewes reared under organic production outperformed the conventionally managed ewes, on average by 2.14 kg of milk/lactation. Moreover, results are encouraging, given that some published works on comparative studies on performances in conventional and

organic systems report lower production levels in organic systems, given the regulations in management of the flocks (no antibiotics or probiotics, lack of curative treatments and vaccines etc).

Current results suggest that the potential to produce and market organic sheep milk and derived products under highlands conditions is high in Romania, and will not have detrimental effects on the overall production levels.

Results of the study on the Turcana milk yields are in accordance with previous estimates for the breed [3, 7, 10].

Results on chemical composition of milk from Turcana ewes reared under organic and conventional production systems are shown in Table 2. Fat percentage was on average $8.38 \pm 0.330\%$, with limits ranging between 7.25% and 8.97% in the conventional system, and of $7.72 \pm 0.261\%$ with limits of 6.95% and 8.65% in the organic system.

Protein levels were of $5.91 \pm 0.246\%$ in the conventional system, with limits ranging between

5.26% and 6.79%, while in the organic trial the average $5.64 \pm 0.184\%$, ranging 5.11% and 6.31%.

Lactose content was on average $4.23 \pm 0.161\%$ for the conventional system, with limits ranging between 3.85% and 4.82%. While for the organic system, the lactose was on average $4.12 \pm 0.124\%$, with limits ranging between 3.70% and 4.42%.

The SNF levels were of $11.52 \pm 0.207\%$ for the conventional managed ewes, with limits ranging between 11.14% and 12.32%, and of $11.32 \pm 0.191\%$ for the organic flock, with limits ranging between 10.61% and 12.03%.

For all major chemical component from milk the differences between the two experimental groups were not statistically significant ($p > 0.05$).

Results suggest that the quality of milk is not influenced by the production system. And the slightly lower levels in protein and fat content of the milk produced by the sheep that were managed under organic production system was attributed to the higher milk yields. Given that milk production is negatively correlated with both fat and protein content [10].

Table 1. Milk yields in Turcana sheep, reared under organic and conventional production systems (kg)

Production system	Milk yield ($\pm S_x$)	SD	CV (%)	Min.	Max.
Conventional	76.81 \pm 2.99	11.23	14.23	64.67	92.01
Organic	78.95 \pm 4.59	6.69	8.71	69.29	86.93
Differences between systems: NS (p=0,927)					

Table 2. Chemical composition of milk from Turcana ewes reared under organic and conventional production systems

Production system	Trait	Media $\pm S_x$	SD	CV (%)	Min.	Max.
Conventional	Fat (%)	8.38 \pm 0.330	0.738	8.81	7.256	8.977
	Protein (%)	5.91 \pm 0.246	0.551	9.31	5.263	6.790
	Lactose (%)	4.23 \pm 0.161	0.361	8.54	3.853	4.823
	SNF (%)	11.52 \pm 0.207	0.464	4.03	11.140	12.323
Organic	Fat (%)	7.72 \pm 0.261	0.639	8.28	6.952	8.651
	Protein (%)	5.64 \pm 0.184	0.450	7.97	5.110	6.319
	Lactose (%)	4.12 \pm 0.124	0.303	7.36	3.702	4.420
	SNF (%)	11.32 \pm 0.191	0.467	4.12	10.615	12.034
Differences between systems						
Conventional vs. Organic	Fat (%)			p=0.1207, NS		
	Protein (%)			p=0.2353, NS		
	Lactose (%)			p=1.0000, NS		
	SNF (%)			p= 0.6481, NS		

4. Conclusions

Current results suggest that the potential to produce and market organic sheep milk and derived products under highlands conditions is high in Romania, and will not have detrimental effects on the overall production levels.

Further larger studies, which to include economic aspects of producing organic sheep milk should be implemented, in order to give in detail insights and advices to both farmers and policymakers.

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