Biotechnology in Animal Husbandry 32 (2), p 145-161 , 2016
Publisher: Institute for Animal Husbandry, Belgrade-Zemun

ISSN 1450-9156
UDC 636.082'638
DOI: 10.2298/BAH1602145P

FACTORS INFLUENCING PRODUCTIVE TRAITS OF AWASSI CROSSBREEDS IN MACEDONIA

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Original scientific paper

Abstract: The purpose of the survey was to determine a bond between certain factors that affect most of the production traits in crossbreeds between Awassi and Ovchepolian indigenous sheep in Macedonia. We implemented 1145 individual lactation controls in two years of production (2012 and 2013). The impact of individual factors is studied using F-test and the analyses are made using SPSS set of programs. Many factors (lactation, lambing month and number of milk controls) had highly significant impact (P<0.001) on daily milk production (morning, evening and total milk, fat percentage and fat kg) in this breed of sheep. Only fertility had no impact on any of the examined factors, with the exception of total daily milk, on which manifested with highly significant impact (P<0.01). The average milk yield in examined crossbred sheep was 109 ± 0.479 l in two years of production, while the production of milked milk was 72 ± 0.421 l for the same period of time. The length of lactation period in these sheep was average 203 ± 0.61 days, for two analysed years. In relation to the age, in second lactation sheep was determined somewhat higher daily milk yield (0.478 ±0.01 l.), compared to sheep in first lactation (0.475 ± 0.01 l.). This is quite logical, keeping in mind the lactation curve in sheep, especially those of dairy breeds to which Awassi breed belongs.

Key words: Awassi crossbreeds, production traits, impact of factors, daily milk yield

Introduction

The attempts for advancing the genetic potential of certain sheep production traits in Macedonia exist for 60 years now. Awassi breed of sheep has special significance in this context. It is the first dairy sheep breed used for crossbreeding in order to increase the production of milk in indigenous and other breeds of sheep in Macedonia. This breed is imported in Macedonia for the first time in 1969. Since then it has been assumed that the percentage of crossbreeds between Awassi with Ovchepolian sheep is around 4% of the current number of sheep in Macedonia (689.938 sheep), while the percentage of purebreed Awassi in the state in this moment is 0.3% (*www.fva.gov.mk*).

The Awassi is a fat-tailed breed found extensively in Syria, Lebanon, Iraq, Jordan, Southern Turkey, Israel and to a lesser extent in some other WANA countries (West Asia and North Africa), (*Gursoy et al., 2001*). The breed adapts to a wide range of environmental conditions from the steppe to the highly intensive system (*Galal et al., 2008*).

The improved type of Awassi sheep found on intensive dairy farms in Israel has been selected for increased milk production for over 50 years (*Epstein, 1985*). The use of improved type of Awassi sheep has become widespread in many countries, but very few of the environments where they are kept, are the same as found in Israel (*Gursoy et al., 2001*). The intensively managed dairy ewe flocks in Israel have somewhat different characteristics to the majority of other dairy flocks in the Mediterranean region (*Pollott and Gootwine, 2001*).

The Awassi breed has proliferated, for breeding purposes, into at least 30 countries in all continents. The great majority of these proliferations were from Israeli Improved Awassi, Turkish Awassi and the Syrian Awassi either directly or indirectly through a third country. Some of the countries introducing Awassi used it as an improver breed (*Galal et al., 2008*).

Awassi is present in Spain, imported in 1971 (*De la Fuente et al., 2006*), in Bulgaria in 1977, in Romania in 1973, in Hungary in 1989 and also present in Greece and Albania (*Kukovics et al., 2006*).

In Australia Awassi has been imported in 1987 (*Jassim et al., 2006*), and in Turkey the number of Awassi in 90s was around 1 million heads (*Pekel et al., 1994*).

In the intensive dairy flocks found in Israel, the ewe's milk is collected from birth until drying off, with no lamb suckling. This milking regime allows the study of the complete lactation of dairy sheep and coupled with the complete pedigree recording in such flocks, makes a study of the genetics of complete dairy ewe lactations possible (*Pollott and Gootwine, 2001*).

According the same authors (*Pollott and Gootwine, 2001*), there is widespread interest in using Israeli Awassi genes in different environments and in grading-up programmes. Given the high level of permanent effects found in many studies, we might expect to see recombination losses in milk yield in Awassi crosses. Some evidence for this has been presented by *Gootwine et al., (2001)* when introgressing the Booroola Merino into the Awassi.

However, besides diffuseness and results, in our scientific and specialist work, attitudes and opinions are divided in relation to this breed of sheep. According to some authors, this breed is suitable for cross-breeding with Macedonian indigenous breeds of sheep, because its origins are from Middle East and it adapts easily to the dry and hot climate in Macedonia, while significantly affects the increase of milk production in offspring. According to others, this breed is not the most appropriate for cross-breeding, because lambs from these half-breeds have increased percentage of fat tissues in tail, which is an undesirable trait among the largest consumers of Macedonian lamb (Italy and Greece).

However, our intention was to determine average annual and milked milk yield in these crossbreeds using proper monitoring and measurement and the degree of advancing the crossbreeds in milk production. At the same time, the goal was to determine the impact of certain factors (year, lactation, lambing month, month of milk controls, number of milk controls and fertility), affecting the traits of daily milk yield.

Materials and Methods

We took crossbreeds from F1 generation as analysis material, generation derived from Awassi rams and Ovchepolian sheep population, located on a farm near Gevgelija, southeastern Macedonia.

The analyses lasted 2 years (2012 and 2013). There were 89 heads included in 2012 and 88 in 2013 (Table 1).

Table 1. Number of tested sheep per year

Population	Year		Total
	2012	2013	
Crossbreeds F_1 generation	89	88	177

Sheep controlled during 2012 were in first lactation, while in 2013 were in second. Table 2 shows the age structure of tested sheep per year.

Table 2. The age structure of the tested sheep per year

Year	Lactation (Parity)		Total
	I	II	
2012	89	/	89
2013	/	88	88
Total	89	88	177

During the experiment there were 575 lactation controls performed in these crossbreeds in first lactation and 570 controls in second lactation or a total number of 1145 individual lactation controls (Table 3).

The farming system was combined (stall and pasture) with usage of available vegetation on pastures the most of the year (7-8 months). Besides pasturing, sheep had alfa-alfa hay (500 gr. daily) during the period from November to February and concentrated product (300 gr./daily) during the period from November to April.

Milking period began after refusing the lambs (2 months after lambing) and lasted from August to October, depending on individual milk production.

Individual milk yield was controlled according A4 standard method (*ICAR, 2009*) which includes daily milk measurement that lasted 28 to 34 days. Milk recordings were initiated 10 days after lambing and lasted until the moment of drying, in the middle of October. The measurement of the milked milk was carried out with laboratory jigger with an accuracy of 10 milliliters.

During the suckling period, milk control regarding the specificity of the moment (lamb suckling), was carried out in such way that before morning milk control, lambs were separated from their mothers for 12 hours. Afterward, the lambs were returned to their mothers for 24 hours and the next morning were separated again, 12 hours before evening milk control.

The average number of performed controls was 7. Total individual sample of milk was taken in each milk control. Milk samples were collected in 50 ml plastic bottles, (25ml from the morning and evening milking) for the analyses of milk fat.

Based on these measurements of milk yield, the following was calculated:

- Total milk production in one lactation, in liters (l);
- Total milked milk of one lactation, in liters (l);
- Amount of milk consumed by lambs, in liters (l);
- Suckling period length in days;
- Length of lactation, in days.

Concerning the statistical processing, the traits of daily milk production (morning, evening and total amount of milk, % of fat and kg fat) were analysed using the following model:

$Y= \mu+Yj+Lk+MBl+TDm+TMn+Fo+ejklmno$

where:

Y is the individual observation of each trait during a test (daily) control (morning, evening and total amount of milk, % of fat and kg fat);

μ is the general common average of the tested traits;

Yj is the effect of the j-th year with (j=2012 and 2013);

Lk is the effect of the k-th lactation with (k=1,2);

MBl is the effect of the l-th lambing month (l= January, February);

TDm is the effect of the m-th recording month, with (m= February, March, April, May, June, July, August);

TMn is the effect of the n-th recording day, with (n= 1, 2, 3, 4, 5, 6, 7);

Fo is the effect of the o-th number of newborn lambs, with (o=1, 2);

ejklmno is the residual influence

The impact of certain effects was studied using the F-test, while statistical analyses were performed with the Statistical Package SPSS, version 13, (2004).

Results and Discussion

According to data in Table 3, the lactation yield for two analysed years in crossbreeds from F1 generation between Awassi rams and Ovchepolian indigenous ewes was average 109±0.479 l, while the amount of milk consumed by lambs was average 37±0.253 l. The production of milked milk in this population is average 72±0.421 l for two analysed years, while the average length of suckling period is 54±0.377 days. The length of lactation period in this population is average 203±0.61 days for two analysed years. The table shows large variation between minimal (59.37 l) and maximal (169.33 l) amount of lactation yield in these crossbreeds, which points to disagreement. This is quite logical for crossbreeds from F1 generation.

Table 3. Descriptive statistics data of tested sheep population, LS–mean ± SE

Parametar	N	Mean	Min	Max	Std. deviation	Cv
Lactation milk (litres)	89	109±0.479	59.37	169.33	20.17	18.50
Suckling milk (litres)	89	37±0.253	17.83	68.87	10.25	27.70
Milking milk (litres)	89	72±0.421	13.97	126.84	18.23	25.32
Length of suckling period (days)	89	54±0.377	33.5	86	13.54	25.07
Length of lactation (days)	89	203±0.61	198	235	29.46	14.51
Morning milk yield (litres)	1145	0,254±0.002	0.1	0.8	0.05	19.69
Evening milk yield (litres)	1145	0,282±0.002	0.12	0.65	0.082	29.08
Total daily milk yield (litres)	1145	0,536±0.04	0.22	1.45	0.028	5.22
Fat (%)	1145	7,36±0.02	5.41	9.22	0.678	9.21
Daily fat yield (kg)	1145	0,039±0.003	0.017	0.112	0.010	25.64

The determined annual milk production in our analyses was slightly lower (109 l), compared to the analyses of *Tokovski et al., (1977)* where it was determined 128.5 l milk yield in crossbreeds from F1 generation between Awassi rams and Ovchepolian ewes. In the same analyses, in other group of crossbreeds in first lactation, these authors determined lower milk yield (83.98 l) compared to the amount of milk yield from our analyses. Like us, these authors determined large variations between minimal and maximal lactation yield, ranging from 26.57 l to 114.75 l.

Todorovski et al. (1979) found significant variations between minimal (84 l) and maximal (195 l) annual milk yield in crossbreeds between Awassi and Kosovo sheep. These authors found lactation milk yield between 128 l and 261 l in the same crossbreeds in second lactation. They also found highly significant lactation yield of 193 kg in crossbreeds between Awassi and Domestic sheep population. In some analyses the same authors found higher milk yield compared to our findings *(Todorovski et al., 1979; Todorovski et al., 1985)* where average lactation yield in these crossbreeds is 180 l.

Comparing the milk yield in our analyses (109 l) with the common one to Ovchepolian sheep as the largest indigenous breed of sheep (68.31 l), according to many authors (*Tashkovski et al., 1968; Shokarovski, 1957; Tashkovski, 1961; Tashkovski and Tokovski, 1969; Tokovski et al., 1977; Shokarovski et al., 1992*), we come to a conclusion of significant increase of milk yield, using Awassi as breed for advancement of this trait.

Seeing that Macedonia is not the only country where Awassi is used as breed improver, the milk yield in crossbreeds between Awassi and Kazakh fat-tailed sheep was 119.2 l, while in indigenous Kazakh sheep is only 42.6 l (*Malmakov et al., 2006*).

According to *Iniguez et al. (2006)*, in crossbreeds between Turkish and Syrian Awassi the milk yield is 119.18 kg, while in similar feeding conditions the milk production in Syrian sheep was 109.41 kg. *Gursoy et al. (2001)*, found an increase of 14% milked milk in first 120 days of lactation in F1 ewes, between Israeli Improved Awassi rams and pure Ceylanpinar Turkish ewes. To study the effect of crossbreeding Awassi with Romanov sires on litter size and milk production, *Kutluca et al. (2011)*, in crossbreeds was determined average milk yield of 104.3 kg in 157.2 days of lactation. Keeping in mind the milk production of Romanov sheep (44 kg milk), (*Boylan, 1998*), we found an increase of 137 % of lactation milk in these crossbreeds in relation to Romanov sheep.

Analysing these results, we come to a conclusion that they are close to ours, which indicates the degree of genetic improvement in low yield capacity sheep, when Awassi is used as breed improver. Herewith goes the assertion of *Galal et al. (2008)* that using Awassi as an improver breed outside the countries of origin had generally favorable effect on milk production with varied effects on fertility and lamb production.

Impact of factors

The results from these analyses are obtained on the basis of determined individual impact of mentioned factors (year, lactation, lambing month, month of milk recording, number of milk recordings and fertility) on daily milk production.

By appointing the impact of the year, it is the impact of diet that is actually determined, while lactation represents the impact of age on milk yield.

By determining the impact of lambing month, from the aspect of annual milk production in sheep it is actually the most convenient moment for lambing that is determined. The knowledge of oestrus control and fertilization in sheep is additionally enriched, using artificial methods to determine the moment of partus (mating of sheep) and thus influence directly on the amount of obtained lactation milk.

The number of milk recording represents the stage of lactation and this factor is especially important for obtaining knowledge about lactation curve in each head, but on the other side represents important information in individual selection of sheep.

The month of milk recordings also determines the influence of diet, climate and other paragenetical conditions affecting sheep productivity.

While determining the impact of fertility on milk production, we tried to obtain additional knowledge about whether the number of lambs per sheep, affects daily milk yield in this genotype of sheep.

Analysing the results in Table 4, we can conclude that most of the factors (lactation, lambing month and number of milk recordings) had highly significant influence (P<0.001) on daily milk production (morning, evening and total amount of milk, % of fat and kg fat) in tested crossbreeds. The year also manifested with highly significant impact on most of the traits (P<0.001), with the exception of level influence on morning milking which was lower (P<0.05). The month of milk recording also had highly significant influence (P<0.001) on all traits, with the exception of milk fat percentage, on which this factor had no impact at all (P>0.05).

Table 4. Factors influencing daily milk production in F_1 crossbreeds, F-test and its significance (F-statistics)

Factor	Df	Morning	Evening	Total	Fat (%)	Fat (kg)
Year	1	3.694*	18.240***	5.525***	79.164***	13.829***
Lactation	1	98.114***	156.477***	140.096***	29.597***	116.759***
Month of lambing	1	10,361***	9.367***	10.763***	9.503***	11.123**
Month of milk recording	6	54.256***	35.890***	49.180***	1.004^{ns}	30.941***
No of milk recordings	6	52.572***	50.380***	56.046***	9.304***	33.870***
Fertility	1	0.00^{ns}	0.273^{ns}	0.078**	1.117^{ns}	0.446^{ns}
R^2 – Coef. determination	/	0.646	0.685	0.689	0.326	0.627

ns – P>0.05, * - P<0.05, ** - P<0.01, *** - P<0.001

Only fertility had no impact on variation of parameters, with the exception of total daily milk on which manifested with high significant influence (P<0.01).

The determination coefficient of examined factors in these sheep, ranged from 0.326 for milk fat percentage, to 0.689 for total daily milk. *Pacinovski et al. (2012)* found highly significant impact on almost all factors, with the exception of fertility, that had no impact on daily milk production in indigenous Ovchepolian sheep in Macedonia. Same authors (*Pacinovski et al., 2014*), in other analyses found similar impact on almost all factors mentioned, with the exception of fertility on daily milk production in Awassi sheep.

Kastelic et al. (2013) found significant impact on milk production and milk fat in Istar sheep as indigenous breed in Slovenia and Croatia. *Pacinovski et al. (2013)* found similar year impact on lactation peak in East Friesian ewes in Macedonia.

The poor control of diet, typical of dairy sheep production systems based on grazing, can substantially limit the ability of sheep producers to control and modify the quantity and quality of milk (*Pulina et al., 2006*).

As housing, flock management, especially feeding (*Bencini, 2001; Pulina et al., 2006*), all strongly affect the quantity and composition of ewes' milk, it is possible to improve characteristics of produced milk by manipulating the above mentioned factors.

The impact of all these factors is particularly shown in the following tables (Tab. 5 – Tab.10).

Impact of year on daily milk production in tested sheep population

The year had highly significant impact (P<0001) on most analysed traits of daily milk production in tested crossbreeds, except on morning milk where it had lower influence (P<0.05), (Tab. 4).

According to data in Tab. 5, the average daily milk yield in these sheep is somewhat higher in 2013, (0.546±0.01l.), unlike in 2012 with lower daily milk yield (0.526±0.01l). This is quite logical if we take in consideration that with sheep ageing (to certain level) also increases the annual milk production, and the crossbreeds in our experiment in 2012 were in first lactation, while in 2013 in second lactation.

Same refers to morning and evening milking as for the amount of milk fat obtained, which showed certain degree of higher values in 2013 compared to 2012. Only the percentage of milk fat was in opposite tendency as a result of logic consequence by increasing milk production, decreasing the percentage of milk fat, which is observed in this case.

Table 5. The impact of the year on daily milk production in F_1 crossbreeds, LS-mean ± SE

Year	N	Morning (litres)	Evening (litres)	Total (litres)	Fat (%)	Fat (kg)
2012	89	0.247±0.004	0.279±0.01	0.526±0.01	7.27±0.03	0.038±0.001
2013	88	0.261±0.004	0.285±0.01	0.546±0.01	7.46±0.03	0.041±0.001

Effect of year on composition of milk as reported by *Ploumi et al. (1998)* for Chios sheep, while *Macciotta et al. (2005)*, for Sarda goats, proved the effect of year on fat and protein content.

Hassan (1995), did not find any significant effect of the year on composition of milk of Ossimi and Saidi sheep and their crosses with Chios. Also, any significant effect of the year on fat content of milk did not find *Matutinovic et al. (2011)*, at Dalmatian Pramenka (indigenous sheep breed in Croatia).

Analysing the daily milk yield in crossbreeds between Awassi and Ovchepolian sheep, *Tokovski et al. (1977)* found average daily milk yield of 714 ml, for 180 days of lactation. In the same analyses they found average milk yield of 515 ml for another group of crossbreeds.

Todorovski et al. (1979) found significantly higher daily milk yield (1.15 l) compared to the milk yield from our analyses in first lactation in crossbreeds between Awassi and Kosovo sheep, while still higher in second lactation 1.49 l.
Same authors *(Todorovski et al., 1985)* found 1 liter of daily milk yield in crossbreeds between Awassi and Ovchepolian sheep, which is also significant advantage compared to our analyses.

Impact of lactation (parity) on daily milk production in tested sheep population

Lactation (parity) had highly significant impact (P<0.001) on all tested traits of milk production (Tab. 4) in these analyses. The average daily milk yield in these crossbreeds insignificantly increases or grows from first (0.475±0.01l) to second lactation (0.478±0.01l), (Table 6). Same happens with morning milk and the amount of daily milk fat obtained. Only a slight decline was observed in evening milk, but the difference was not significant. The percentage of milk fat is quite illogical, which instead of decreasing in some value according to the amount of total milked milk during the day, it has increased from first (7.45±0.05l) to second lactation (7.67±0.06l). For such inconsequence, the most likely cause is the paragenetical factor – diet, which can significantly influence on the content of milk fat and thus on the quality of milk.

Table 6. The impact of the lactation on daily milk production in F_1 crossbreeds, LS-mean ± SE

Lactation	N	Morning (litres)	Evening (litres)	Total (litres)	Fat (%)	Fat (kg)
1	575	0.224±0.01	0.251±0.01	0.475±0.01	7.45±0.05	0.035±0.001
2	570	0.230±0.01	0.248±0.01	0.478±0.01	7.67±0.06	0.037±0.001

In relation to the increase of milk production and age, similar results are obtained in other breeds of sheep from Mediteranean region, such as Massese and Comisana sheep, as Italian indigenous breeds of sheep (*Sevi et al., 2000; Carnicella et al., 1989*) and Latxa sheep as Spanish indigenous breed (*Ruiz et al., 2000*). *Sevi et al. (2000)* found tendency to increase the amount of milk fat produced by increasing lactation, same authors (*Sevi et al., 2004*) observed similar results during the study of effects of stage of lactation on ewe's milk composition in other analyses.

Gootwine and Goot (1996) and *Pollot and Gootwine (2001)* found significant influence of lactation (age) on average milk production in Awassi, concluding that age and lactation increase.

Impact of lambing month on daily milk production in tested sheep population

In relation to all tested traits of daily milk production, the month (season) of lambing had highly significant influence (P<0.001), (Tab.4).

Analysing this factor, higher daily milk yield is recorded in tested sheep population in those who lambed in January (0.496±0.01), (Tab. 7). Same happens with the morning and evening milk. Analogously, sheep lambed in February had higher (7.59±0.07%), and sheep lambed in January had lower percentage of milk fat (7.53±0.04%). The amount of milk fat produced is 0.037 kg daily in sheep lambed in January or 0.035 kg in sheep lambed in February.

Table 7. The impact of month of lambing on daily milk production in F_1 crossbreeds, LS-mean ± SE

Month of lambing	N	Morning (litres)	Evening (litres)	Total (litres)	Fat (%)	Fat (kg)
1	924	0.236±0.01	0.260±0.01	0.496±0.01	7.53±0.04	0.037±0.001
2	221	0.218±0.01	0.238±0.01	0.456±0.02	7.59±0.07	0.035±0.001

In *Kastelic et al. (2013)* and *Pollot and Gootwine (2001)* analyses is determined impact of month or season of lambing on milk production.

Sevi et al. (2004), observed similar results during studying of effects of lambing season on ewe"s milk composition in the region of Southern Italy. Also similar results were observed by *Carta et al. (1995)* who studied the effects of seasonal changes on Sarda dairy sheep whose diet is also based on pasture.

According to *Maria and Gabina (1993)* effect of lambing season is one of the most significant effects on quantity and composition of produced milk.

In *Pacinovski et al. (2014)* analyses is determined similar impact of lambing month factor on daily milk production.

Impact of month of milk recording on daily milk production in tested sheep population

Month of milk recording showed highly significant impact (P<0.001), compared to almost all traits in crossbreeds tested. Only this factor had no impact on milk fat percentage (P>0.05), (Tab. 4).

Analysing the period from second (February) to eighth (August) month of milk control, the amount of total daily milk was constantly growing from second to sixth month, when reached maximal daily lactation (0.518±0.02l), and decreased in next two months (July and August), (Table 8). Analogous to total amount of milk, same happened with morning and evening milk.

Unlike this, the percentage of milk fat was constantly growing from February to April and had identical value in June and July (7.51±0.06%), to reach the highest value in August (7.59±0.09kg). Concerning the produced amount of milk fat per head, it ranges from (0.030±0.02kg) in February to 0.039±0.001kg in June (Table 8).

Table 8. The impact of the month of milk recording on daily milk production in F1 crossbreeds LS-mean ± SE

Month of test	N	Morning (litres)	Evening (litres)	Total (litres)	Fat (%)	Fat (kg)
2	103	0.193±0.02	0.202±0.02	0.395±0.03	7.67±0.14	0.030±0.002
3	152	0.217±0.01	0.227±0.01	0.444±0.03	7.58±0.11	0.034±0.002
4	178	0.222±0.01	0.252±0.01	0.474±0.02	7.56±0.09	0.036±0.001
5	178	0.238±0.01	0.263±0.01	0.501±0.02	7.51±0.07	0.038±0.001
6	178	0.247±0.01	0.271±0.01	0.518±0.02	7.51±0.06	0.039±0.001
7	178	0.243±0.01	0.266±0.01	0.509±0.01	7.51±0.07	0.038±0001
8	178	0.232±0.01	0.264±0.01	0.496±0.02	7.59±0.09	0.038±0.001

According to *Matutinovic et al. (2011)* the content of milk fat was lowest in April and May during the early stages of vegetation growth, while pasture is rich in easily soluble nitrogen components, but poor in fibre and energy (*Kalit, 2008; Mikolayunas et al., 2008*). *Pollot and Gootwine (2001)* determined significant influence of month of milk control on milk production.

Impact of the number of milk recordings on daily milk production in tested sheep population

The number of milk recordings had highly significant impact (P<0.001), on all analysed parameters in crossbreeds between domestic sheep population and Awassi (Tab. 4).

According this factor, the total milk production was constantly decreasing from the first to the last (seventh) milk control. Same happens with morning and evening milk.

Analogous on daily milk production, the percentage of milk fat is lowest in first milk control (6.87±0.09%) and highest in last (seventh) milk control (8.23±0.14%). The produced amount of milk fat ranges from 0.021±0.002 kg in seventh, to 0.054±0.001 kg in first milk control (Tab. 9).

In similar analyses, *Pacinovski et al. (2014)*, found highly significant impact on previous factors (month and number of milk control) in relation to all traits of daily milk production.

Table 9. The impact of the number of milk recordings on daily milk production in F1 crossbreeds, LS-mean ± SE

Number of milk control	N	Morning (litres)	Evening (litres)	Total (litres)	Fat (%)	Fat (kg)
1	178	0.387±0.01	0.397±0.01	0.784±0.02	6.87±0.09	0.054±0.001
2	178	0.309±0.01	0.344±0.01	0.653±0.02	7.20±0.07	0.047±0.001
3	178	0.253±0.01	0.273±0.01	0.526±0.02	7.36±0.06	0.039±0.001
4	178	0.208±0.01	0.232±0.01	0.440±0.02	7.56±0.07	0.033±0.001
5	178	0.167±0.01	0.200±0.01	0.367±0.02	7.73±0.09	0.028±0.001
6	152	0.142±0.01	0.167±0.01	0.309±0.03	7.97±0.11	0.025±0.002
7	103	0.126±0.02	0.130±0.02	0.256±0.03	8.23±0.14	0.021±0002

Impact of fertility on daily milk production in tested sheep population

Fertility or the number of lambs per sheep, had no impact on any of the tested traits of daily milk production, with the exception of total daily milk with impact value of P<0,01 (Tab. 4).

Those who gave birth to one lamb from these sheep had higher daily lactation (0.503±0.01l), unlike those who gave birth to two lambs (0.451±0.02l), (Tab. 10).

Same happens with morning and evening milk. The percentage of milk fat is in opposite situation, which is quite logical that there is higher value in those who gave birth to two lambs (7.69±0.08), while lower value in those with one lamb (7.43±0.03l). The produced amount of milk fat ranges from 0.035±0.001kg in crossbreeds with two lambs, to 0.037±0.001 in crossbreeds with one lamb, (Tab. 10).

Table 10. The impact of the fertility on daily milk production in F1 crossbreeds, LS-mean ± SE

Number of lambs	N	Morning (litres)	Evening (litres)	Total (litres)	Fat (%)	Fat (kg)
1	1083	0.239±0.01	0.264±0.01	0.503±0.01	7.43±0.03	0.037±0.001
2	62	0.216±0.01	0.235±0.01	0.451±0.02	7.69±0.08	0.035±0.001

Pollot and Gootwine (2001) found significant impact of fertility or litter size on total milk production

Conclusion

Awassi breed represents a suitable breed for improving lactation with cross-breeding of indigenous population of sheep in Macedonia. Keeping in mind the percentage of blood in these crossbreeds (50% blood – Awassi and 50% blood – indigenous breed of sheep) the question whether to increase the percentage of blood in Awassi with cross-breeding of crossbreeds with purebred Awassi ewes or selection in F1 population is often challenging.

Our suggestion is that further keeping shall be in direction of selection in F1 population in order to avoid an increase in percentage of fat in lamb tails, a trait which is a big problem in selling traditional Macedonian lamb, exported more than 50 years in several European countries where the same trait is considered as disadvantage by consumers.

Out of analysed factors, lambing month is quite important for longer lactation and bigger amount of annually obtained milk, and the number of milk recordings which represents the course of lactation curve, and the basis on which further selection of sheep shall be based.

Acknowledgments

The authors would like to thank the Ministry of Agriculture, Forestry and Water Economy (MAFWE) of the Republic of Macedonia for its financial support.

Uticaj faktora na proizvodna svojstva kod meleza Awassi ovce i ovčepoljske pramenke u Makedoniji

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Rezime

Cilj ovih istraživanja, bio je da se utvrdi veza izmedju nekih faktora koji imaju uticaj na proizvodna svojstva kod meleza izmedju rase Awassi i autohtone ovčepoljske ovce u Makedoniji. Uključili smo ukupno 1145 individualnih laktacijskih kontrola, u toku dve proizvodne godine (2012 i 2013).

Uticaj posebnih faktora ispitivan je pomocu F-testa, dok su analize dobijenih podatka uradjene pomocu programskog paketa SPSS. Veći broj faktora (laktacija, mesec jagnjenja i broj kontrole mlečnosti) imali su visoko značajan uticaj ($P<0.001$) na dnevnu proizvodnju mleka (jutarnje, večernje i ukupno mleko, % mlečne masti i kg mlečne masti). Jedino plodnost nije imala nikakav uticaj na ispitivane faktore, osim na ukupnu dnevnu produkciju mleka, gde je manifestovan visoko značajan uticaj ($P<0.01$).

Prosečna laktacijska mlečnost kod ispitivanih meleza, bila je 109 ±0.479 l za dve proizvodne godine, dok je proizvodnja muznog mleka u istom periodu bila 72 ± 0,421 l. Dužina laktacijskog perioda u toku dve ispitivane godine u proseku je bila 203 ± 0,61 dana.

U odnosu na uzrast, kod meleza u drugoj laktaciji je utvrdjena nešto veća dnevna mlečnost (0.478 ±0.01 l.) u poredjenju sa melezima u prvoj laktaciji (0.475 ± 0.01 l.). Ovo je sasvim logično imajući u vidu laktacijske krive kod ovce, posebno kod mlečne rase, gde pripada i Awassi rasa.

References

BENCINI R. (2001): Factors Affecting the Quality of Ewe’s Milk. Proceedings of the 7th Great Lakes Dairy Sheep Symposium, Eau Claire, Wisconsin, USA, 1–3 November, 52–83.

BOYLAN W.J. (1998): Sheep Dairying in the US. Proceedings of the 1st Great Lake Dairy Sheep Symposium, Madison, March 30, 1995.

CARNICELLA D., DARIO M., AYRES C.C.M. (1989): Quantitative and Compositional Variations of Massese Sheep Milk by Parity and Stage of Lactation. Small Ruminant Research, 2: 47–62.

CARTA A., SANNA S.R., CASU S. (1995): Estimating Lactation Curves and Seasonal Effects for Milk, Fat and Protein in Sarda Dairy Sheep with a Test Day Model. Livestock Production Science, 44: 37–44.

DE LA FUENTE F.L., GABINA D., CAROLINO N., UGARTE E. (2006): The Awassi and Assaf Breeds in Spain and Portugal. Book of Abstracts of the 57-th Annual Meeting of the European Association for Animal Production (EAAP). No 12. 17-20 September, Antalya, Turkey.

EPSTEIN H. (1985): The Awassi Sheep with Special Reference to the Improved Dairy Type. FAO Animal Production and Health Paper. No 57. FAO, Rome, 1-282.

GALAL S., GURSOY O., SHAAT I. (2008): Awassi Sheep as a Genetic Resource and Efforts for their Genetic Improvement—A review. Small Ruminant Research, 79: 99–108.

GOOTWINE E., GOOT H. (1996): Lamb and Milk Production of Awassi and East-Friesian Sheep and their Crosses under Mediterranean Environment. Small Ruminant Research 20: 255-260.

GOOTWINE E., ZENU A., BOR A., YOSSAFI S., ROSOV A., POLLOTT G.E. (2001): Genetic and Economic Analysis of Introgression the B Allele of the FecB (Booroola) Gene into the Awassi and Assaf Dairy Breeds. Livestock Production Science, 71: 49–58.

GURSOY O., POLLOTT E.G., KIRK K. (2001): Milk Production and Growth Performance of a Turkish Awassi Flock when Outcrossed with Israeli Improved Awassi rams. Livestock Production Science, 71: 31–36.

HASSAN H.A. (1995): Effects of Crossing and Environmental Factors on Production and some Constituents of Milk in Ossimi and Saidi Sheep and their Crosses with Chios. Small Ruminant Research, 18: 165–172.
JASSIM A.R., RAADSMA H., BENCINI R., JOHNSTON G. (2006): The Awassi Sheep in Australia. Book of Abstracts of the 57^{th} Annual Meeting of the European Association for Animal Production (EAAP), N^{o}12, 17-20 September, Antalya, Turkey.
ICAR. (2009): International Agreement of Recording Practices. Guidelines Approved by General Assembly held in Niagara Falls. 18 June 2008. Rome: International Commitee for Animal Recording, 1-486.
INIGUEZ L., HILALI M., JESSR G. (2006): Evaluation of Awassi Genotypes for Milk Production Improvement. Book of Abstracts of the 57^{th} Annual Meeting of the European Association for Animal Production (EAAP). N^{o}12, 17-20 September, Antalya, Turkey.
KALIT S. (2008): I Keep Doing Everything the Same Way, but the Cheese is Different Every Time. Proccedings of Tenth Symposium for Sheep and Goat Breeders in Republic of Croatia. Sibenik, 16-17 October. 65–71.
KASTELIC M., ŠPEHAR M. BARAĆ Z. (2013): Productivity of Milk and Milk Composition of Istrian Sheep in Croatia and Slovenia. Slovenian Veterinary Research 50, 4: 149–156.
KUKOVICS S., DIMOV D., KUME K., PACINOVSKI N. (2006): Exploatation of Awassi Sheep Breed in the Central, Eastern and South European Country. Book of Abstracts of the 57^{th} Annual Meeting of the European Association for Animal Production (EAAP), N^{o}12, 17-20 September, Antalya, Turkey.
KUTLUCA M., EMSEN E., KOYCEGIZ F., GIMENEZ-DIAZ A.C., ASLAN A.F. (2011): Reproductive Performance and Milk Traits of F1 Romanov Ewes. Small Ruminant Research, 100: 34– 36.
MACCIOTTA N.P.P., FRESI P., USAI G., CAPPIO-BORLINO A. (2005): Lactation Curves of Sarda Breed Goats Estimated with Test Day Models. Journal Dairy Research, 72: 470–475.
MALMAKOV N., KANAPIN K., SPIVAKO A.V., SETIPAN K., GOOTWINE E. (2006): Lamb and Milk Production in Improved Awassi Crosses with the Kazak Fat Tail and the Kazakh Fine Wool Breeds. Book of Abstracts of the 57^{th} Annual Meeting of the European Association for Animal Production (EAAP), N^{o}12, 17-20 September, Antalya, Turkey.
MARIA G., GABINA D. (1993): Non-Genetic Effects on Milk Production of Latxa Ewes. Small Ruminant Research, 12: 61–67.
MATUTINOVIC S., KALIT S., SALAJPAL K., VRDOLJAK J. (2011): Effects of Flock, Year and Season on the Quality of Milk from an Indigenous Breed in the Sub-Mediterranean Area. Small Ruminant Research, 100: 159–163.
MIKOLAYUNAS C.M., THOMAS D.L., ALBRECHT K.A., COMBS D.K., BERGER Y.M., ECKERMAN S.R. (2008): Effects of Supplementation and Stage

of Lactation on Performance of Grazing Dairy Ewes. Journal of Dairy Science, 91: 1477–1485.
PACINOVSKI N., CILEV G., EFTIMOVA E., PACINOVSKI A. (2012): Influence of Non-Genetic Factors on the Annual Milk Production of Ovchepolian Sheep in the Republic of Macedonia. Krmiva, 54, 4: 115-122.
PACINOVSKI N., DIMOV G., EFTIMOVA E., MATEVA N., CILEV G. (2013): Some Factors of the Maximum Test Day Milk Yield in the Dairy Population of Sheep in Macedonia. Proceedings of the 10th International Symposium Modern Trends in Livestock Production, October 2-4, Belgrade, 936–941.
PACINOVSKI N., EFTIMOVA E., MATEVA N., PALASEVSKI B., CILEV G., ADAMOV N. (2014): Influence of Some Factors on Daily Milk Production in Awassi Breed of Sheep in Macedonia. Macedonian Journal of Animal Science 4, 1: 1–9.
PEKEL E., GURSOY O., OZCAN L., TORUN O. (1994): Breeding Strategies for Turkish Awassi Sheep. In: Galal, E. S. E. and Gursoy, O. (Eds.). Strategies for the Development of Fat-Tail Sheep in the Near East. EAAP Publication, 68: 32–36. Wageningen Pers.
PLOUMI K., BELIBASAKI S., TRIANTAPHYLLIDIS G. (1998): Some Factors Affecting Daily Milk Yield and Composition in a Flock of Chios Ewes. Small Ruminant Research, 28: 89–92.
POLLOTT E.G., GOOTWINE E. (2001): A Genetic Analysis of Complete Lactation Milk Production in Improved Awassi Sheep. Livestock Production Science, 71: 37–47.
PULINA G., NUDDA A., BATTACONE G., CANNAS A. (2006): Effects of Nutrition on Contents of Fat, Protein, Somatic Cells, Aromatic Compounds, and Undesirable Substances in Sheep Milk. Animal Feed Science Technology, 131: 255–291.
RUIZ R., OREGUI M.L., HERRERO M. (2000): Comparison of Models for Describing the Lactation Curve of Latxa Sheep and an Analysis of Factors Affecting Milk Yield. Journal Dairy Science, 83: 2709-2719.
SEVI A., TAIBI L., ALBENZIO M., MUSCIO A., ANNICCHIARICO G. (2000): Effect of Parity on Milk Yield, Composition, Somatic Cell Count, Renneting Parameters and Bacteria Counts of Comisana Ewes. Small Ruminant Research, 37: 99–107.
SEVI A., ALBENZIO M., MARINO R., SANTILLO A., MUSCIO A. (2004): Effects of Lambing Season and Stage of Lactation on Ewe Milk Quality. Small Ruminant Research, 51: 251–259.
SHOKAROVSKI J. (1957): Contribution to the Knowledge of Production Capabilities and Mortality of the Sheep Flock in University Economy, vil. Trubarevo, Skopje. Socialistic Agriculture, 7-8: 63–70. (In Macedonian).
SHOKAROVSKI J., KOZAROVSKI N., KOSTADINOVA J., KOCAREV P. (1992): Production Results of Some Bigger Social Sheep Farms in Macedonian

Conditions. Annual Glossary of Agricultural Institute of University Ss. Cyril and Methodius in Skopje, 12: 25–35. (In Macedonian).

SPSS. (2004): The Statistical Package for the Social Sciences. SPSS Inc. Chicago, Ilinois, 1–176.

TASHKOVSKI M.(1961): Knowledge about Ovchepolian Sheep. Annual Glossary of Agricultural – Forestry Faculty on the University in Skopje, 15: 5–87. (In Macedonian).

TASHKOVSKI M., TOKOVSKI T., ILKOVSKI R., LAZAREVA D. (1968): Contribution to the Knowledge of the Milk Productivity and Milk Quality of Ovchepolian Sheep. Socialictic Agriculture, 20: 19–25. (In Macedonian).

TASHKOVSKI M., TOKOVSKI T. (1969): About the Accuracy of the Milk Productivity in Sheep Through Month Controls. Annual Glossary of Agricultural – Forestry Faculty, 21: 99–103. (In Macedonian).

TODOROVSKI N., TOKOVSKI T., LAKICEVIC S. (1979): Lactation and Milk Fat in Half-Breeds from F1 Generation Obtained by Cross-Breeding between Ovchepolian and Kosovo Sheep and Awassi. Consultation Mostar, 21-22 November. 293-296.

TODOROVSKI N., PESEVA V., PETEV A., DJABIRSKI V., ABD AHMED H. (1985): Lactation and Milk Fat in Awassi and its Half-Breeds in New sheep Farm RIK “Sileks” Kratovo. Stockbreeding, 39: 11 -12. 387–398.

TOKOVSKI T., SHOKAROVSKI J., JORDANOVSKI N. (1977): Contribution to the Milk Productivity Knowledge in F1 Generation Between Ovchepolian Ewes and Awassi Rams. Socialistic Agriculture 7–9: 63–67. (In Macedonian).

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Received 19 April 2016; accepted for publication 24 May 2016