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## Association of Ewe's Age, Premating Weight on Litter Size and Birth Weight of Lambs

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### SUMMARY

The aim was to examine the effect of premating age, premating weight of ewes Mis sheep breed on lamb's birth weight, birth type, gender and the interaction between subject effects. 70 ewes of Mis breed of sheep and their F1 generation lambs produced (Mis x Ile de France) were used in the evaluation.

Data concerning the ewes premating age (PMA), premating weight of ewes (PMW), lambs birth weight (LBW), type of birth of lambs (BT), gender of lambs were collected from 122 lambs born.

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70  
" " F1 (  
" " " )  
(PMA),  
(PMW),  
(LBW), (BT),  
122

PMA7  
 4.72 kg, -  
 PMA5. 4.18 kg  
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 -  
 -  
 61  
 kg.  
 ;  
 -  
 (5.61 kg),  
 -  
 (3.65 kg).  
 -  
 55.74%,  
 a  
 - 22.13%. PMA,  
 PMW, BT  
 PMA\*PMW,  
 (LBW).  
 ,  
 PMA\* , PMW\* , PMA\*BT, PMW\*BT  
 (LBW).  
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The ewes PMA7 had the heaviest lambs with an average birth weight of 4.72 kg and the lightest was 4.18 kg from ewes PMA5. Some of the extreme values of body weight of mother corresponded to lambs with less weight. The pre-mating weight of Mis sheep mothers with 61 kg was optimal in this regard.

The order of birth weight of lambs corresponded with the type of birth of such; the single born lambs had the heaviest birth weight (5.61kg) while the triplets had the lightest birth weight (3.65 kg). According to the number of lambs, born the twin lambs have the highest percentage with 55.74% whereas an equal percentage acquired both for single and triplets with 22.13%. PMA, PMW, BT and the interaction effect between PMA\*PMW significantly influence lambs birth weight (LBW).

However, the Gender of lambs and the interaction effect between PMA\*Gender, PMW\*Gender, PMA\*BT, PMW\*BT found no influence on lambs birth weight (LBW).

**Key words:** ewes, age, body weight, lambs, birth weight, birth type, gender

## INTRODUCTION

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 (Assan and Makuza,  
 2005).  
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 (Demiroren  
 et al., 1995).  
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 (Gabr

The genetic and non-genetic factors affected sheep breeding and knowledge of these factors is essential for efficient management and for the accurate estimation of breeding values. Furthermore, the birth weight as an early measurable trait is of great interest because of its positive genetic correlation with further live weights (Assan and Makuza, 2005). Reproduction is the greatest single factor affecting the economic efficiency of sheep breeding (Demiroren et al., 1995).

The major factors that affect profitability in sheep breeding are the total number and the total weight of lambs produced per

et al., 2016).  
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 (Snyman, 2010).  
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 (Notter, 2000)  
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 (Chniter et al.,  
 2009).  
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 (Gama et al.,  
 1991).  
 (Aktas et al., 2015).  
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 F1 (" " x "  
 ").  
 . 122  
 2018,  
 (PMA),  
 (PMW),  
 (LBW),  
 (BT)

- ewe (Gabr et al., 2016). Reproductive performance is the most important trait in determining the income from all livestock enterprises (Snyman, 2010). An adjustment of prolificacy records for effects of ewe age is therefore necessary in genetic evaluation programs (Notter, 2000).  
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 - The knowledge of factors affecting variation in birth weight is especially important in regard to the relationship of birth weight with the neonatal and adult health (Chniter et al., 2009).  
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 - The age of dam, litter size, and birth weight all had important, effects that differed among breeds (Gama et al., 1991). The effect of live weight and age of the ewe have found to be important for the reproductive performance of ewes (Aktas et al., 2015).  
 -  
 - The study aim was to examine the effect of pre-mating age, pre-mating weight of ewes Mis sheep breed on lamb's birth weight, birth type, gender, and the interaction between subject effects.

**MATERIAL AND METHODS**

- The study has performed at the experimental farm of the Institute for Animal Husbandry in Zemun, Serbia. The records of 70 ewes of Mis breed of sheep and their F1 generation lambs produced (Mis x Ile de France) were used in the evaluation. All the animals had kept under intensive system condition with same animal husbandry management. Data concerning the ewes pre-mating age (PMA), pre-mating weight of ewes (PMW), lambs birth weight (LBW), the type of birth of lambs (BT), gender of lambs were collect from 122 lambs born in March 2018. To determine the relationship and different effects of the aforementioned data, a statistical analysis was performed by using the General Linear Model, Descriptive Statistics, of the SPSS

SPSS 20.

software program version 20.

## RESULTS AND DISCUSSION

The pre-mating age of ewes and the birth weight of their lambs are presented in Table 1. It shows that the ewes PMA7 got the heaviest lambs with an average birth weight of 4.72 kg while the lightest was 4.18 kg from ewes PMA5.

It can be noticed that within the ewes pre-mating ages, there were high variations of lamb's birth weights. Our results also show interesting biological sustainability of species. Some of the extreme values of body weight correspond to lambs with less weight. It seems that the pre-mating weight of Mis sheep mothers with 61 kg is optimal in this regard (Figure 1).

1. PMA7  
 4.72 kg, PMA5. 4.18  
 61 kg (1).

### (PMA)

**Table 1. Average birth weight of lambs according to pre-mating age of ewes (PMA)**

/PMA, Years	N	Mean kg	Std. Deviation	Std. Error	95% Confidence Interval for Mean	
					Lower Bound	Upper Bound
2	11	4.20	.97	.29	3.55	4.85
3	41	4.66	1.02	.16	4.34	4.98
4	10	4.62	.99	.31	3.91	5.33
5	28	4.18	.94	.18	3.82	4.55
6	19	4.22	.97	.22	3.75	4.69
7	13	4.72	.72	.20	4.28	5.15
Total	122	4.44	.97	.08	4.27	4.62

-0.46 kg, -0.42 kg, 0.02 kg, -0.02 kg, -0.52 kg  
 7; 0.04 kg, 0.48 kg, 0.44 kg, -0.06 kg  
 3 7; 0,44 kg, 0,40 kg, -0,1 kg  
 4 7; -0.04 kg, 0.54 kg  
 5 7, -0.50

The mean differences of average lambs birth weight according to pre-mating ages of ewes were -0.46 kg, -0.42 kg, 0.02 kg, -0.02 kg, -0.52 kg between lambs of PMA2 to PMA7; 0.04 kg, 0.48 kg, 0.44 kg, -0.06 kg between lambs of PMA3 to PMA7; 0.44 kg, 0.40 kg, -0.1 kg between lambs of PMA4 to PMA7; -0.04 kg, 0.54 kg between PMA5 to PMA7 while there was a difference of -0.50 kg

kg

PMA6 PMA7.

( <0,05).

(PMW)

1

(LBW)

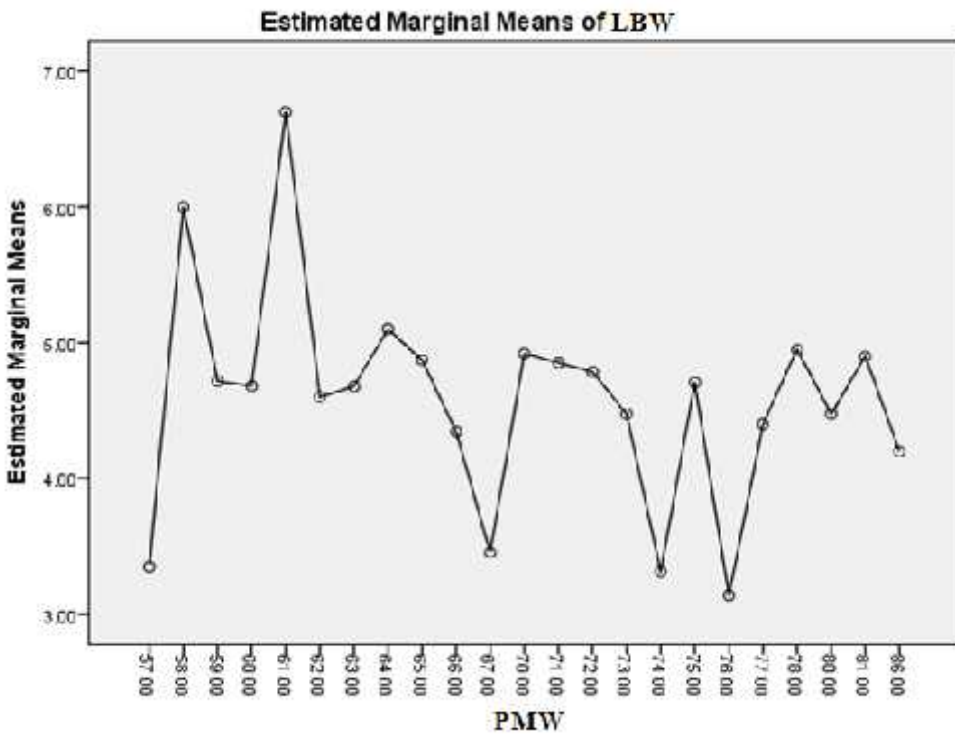
PMW 61 kg,

LBW

PMW 76kg.

average birth weight between lambs of PMA6 and PMA7. The result obtained in multiple comparisons of mean difference among lamb birth weight according to pre-mating age of ewe was significant at (P<0.05).

The pre-mating weight of ewes (PMW) and the estimated marginal means of the lambs shown in Figure 1, indicates that the highest lamb birth weight (LBW) detected on PMW 61kgs while the lowest LBW has established/reported in PMW76kgs.



. 1.

, kg

Fig. 1. Estimated marginal means of lambs birth weight according to pre-mating weight of ewes, kg

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**Table 2. Average birth weight, standard deviation and standard error of mean according to lambs' gender**

Gender	Mean kg	N	Std. Deviation	Std. Error of Mean	Variance	Minimum	Maximum
Male	4.45	64	.97	.12	.95	2.80	6.70
Female	4.44	58	.97	.13	.94	3.00	6.70
Total	4.44	122	.97	.09	.94	2.80	6.70

2)  
0.01 kg

PMA7 4.85 kg  
PMA3 4.77 kg,

3).  
3.54 kg PMA2 3.95 kg  
PMA7.

The result obtained (Table 2) shows a very minimal difference of 0.01 kg on average birth weight in both sexes of lambs and had already considered as a similar value.

The lambs of PMA 7 and PMA 3 present an average weight of 4.85 kg and 4.77 kg, and are the heaviest male and female lambs born (Table 3). The lightest male is 3.54 kg from lambs of PMA 2 and 3.95 kg for female of PMA 7.

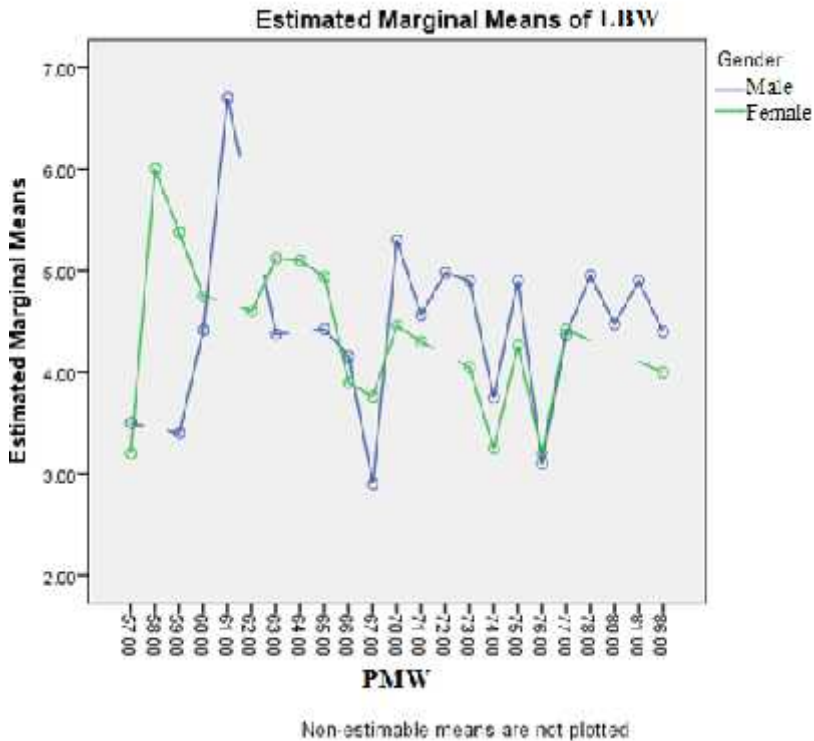
3.

**Table 3. Lambs average birth weight and gender according to prematuring age of ewes**

PMA, years	/Gender	Mean	N	Std. error
2	/Male	3.54	5	.31
	/Female	4.75	6	.27
3	/Male	4.53	19	.22
	/Female	4.77	22	.23
4	/Male	4.77	6	.27
	/Female	4.40	4	.31
5	/Male	4.29	14	.39
	/Female	4.07	14	.49
6	/Male	4.31	9	.27
	/Female	4.14	10	.31
7	/Male	4.85	11	.39
	/Female	3.95	2	.69

2  
 : - ;  
 PMW 61 kg; -  
 PMW 58 kg;  
 PMW 67 kg; PMW 57 kg.

It can be observed in Figure 2 that the heaviest male; female lamb birth weight found in PMW 61kg; PMW 58 kg while the lightest male; female lambs birth weight is established in PMW 67 kg; PMW 57 kg.



. 2.

**Fig. 2. Gender of lambs and the estimated marginal means of birth weight according to pre-mating weight of ewes**

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 ( 4).  
 - (5.61 kg),  
 - (3.65 kg).  
 , ,  
 - 55.74%,  
 22.13%.

The results we obtained show that the weight and order of birth of lambs correspond with the type of birth (Table 4). The single born lambs had the heaviest birth weight (5.61kg) while the triplets born got the lightest birth weight (3.65 kg). With regards to the number of lambs born, it has found that the twin born lambs have the highest percentage with 55.74% whereas an equal percentage acquired both for single and triplets with 22.13% each.

4.

(BT)

**Table 4. Average birth weight of lambs according to birth type (BT)**

Birth type	N	Mean kg	Std. Deviation	Std. Error	95% Confidence Interval for Mean	
					Lower Bound	Upper Bound
					Single	27
Twin	68	4.29	.64	.08	4.14	4.44
Triplets	27	3.65	.54	.10	3.43	3.87
Total	122	4.44	.97	.09	4.27	4.62

(PMA)

(BT)

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The pre mating age (PMA) of ewe, lamb birth type (BT) and their average birth weight can be viewed in Table 5.

**Table 5. Lambs birth type and average birth weight according to pre mating age of ewe**

PMA	Lambs Birth Type	Mean, kg	N	Std. Deviation	Std. Error of Mean
2	/Single	5.60	3	.46	.26
	/Twins	4.05	2	.21	.15
	/Triplets	3.55	6	.31	.13
3	Single	5.79	12	.74	.21
	Twins	4.39	20	.59	.13
	Triplets	3.74	9	.72	.24
4	/Single	4.63	6	1.24	.51
	/Twins	4.60	4	.63	.31
5	/Single	6.23	3	.64	.37
	/Twins	4.11	16	.63	.15
	/Triplets	3.63	9	.53	.17
6	/Single	6.10	2	.14	.10
	/Twins	4.08	14	.78	.21
7	/Triplets	3.63	3	.58	.34
	/Single	6.60	1	.	.
	/Twins	4.56	12	.47	.14

6.6 kg; 4,63 kg  
; 3.74 kg  
PMA7; PMA4; PMA3.  
PMA4  
4.63 kg,

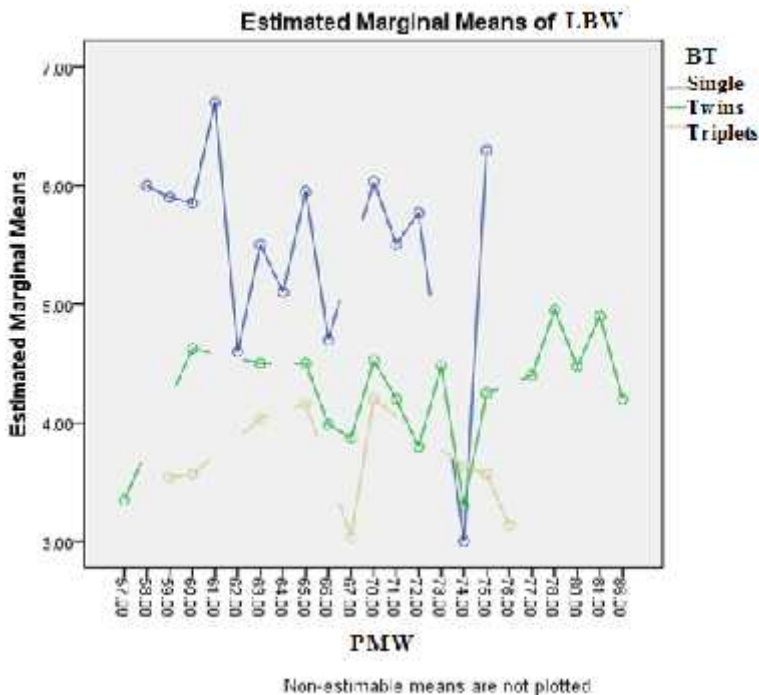
The result we obtained shows that the heaviest average birth weights of lambs were 6.6 kg single born; 4.63 kg twins born; 3.74 kg born triplets from lambs of PMA7; PMA4; PMA3, respectively. The lambs of PMA4 got the lightest average birth weight of 4.63 kg for single born while PMA2 got the lowest



PMA2  
kg.  
PMW  
LBW  
BT  
4.  
PMW 61 kg;  
PMW 78 kg;  
74 kg PMW  
PMW 67 kg

average birth weight of lambs both for twins and triplets born with 4.05 kg and 3.55 kg, respectively.

The corresponding PMW of ewes with the marginal means of LBW according to BT of lambs have illustrated in Figure 4. It shows that the heaviest birth weight were on lambs of PMW 61kg for single born lambs; PMW 78kg for twin born; PMW 70kg for born triplets. The lambs of PMW 74kg got the lightest weight both for single and twin born lambs while PMW 67kg got the lightest weight for lambs born triplets.



. 3.

Fig. 3. Lambs birth type and average birth weight according to pre-mating weight of ewes

, PMA, PMW, BT  
PMA \* PMW

Based on the results we obtained in the present study, the PMA, PMW, BT and the interaction effect between PMA\*PMW significantly influenced on lambs birth weight (LBW). However, the

(LBW).  
PMA\*BT, PMW\*BT  
(LBW).  
Ali et al. (2006),  
Fazlul and Curran (1992); Babar et al. (2004)  
Akta and Do an (2014); Aktas et al. (2015)  
Hussein et al. (2000),  
Petrovic et al. (2011); Haque Bhuiyan Fazlul and Curran (1992); Babar et al. (2004)  
Gaskins et al. (2000)  
Babar et al. (2004)  
Gabr et al. (2016)  
(P<0.01),

Gender of lambs and the interaction effect between PMA\*Gender, PMW\*Gender, PMA\*BT, PMW\*BT found no influence on lambs birth weight (LBW).

The results of our present study were similar with those of other authors, such as Ali et al. (2006). According to them, the age of dam at service had a significant relationship with the birth weight of lambs.

Fazlul and Curran (1992); Babar et al. (2004) reported that the age of the dam had also significant effect on birth weight of the lamb. Akta and Do an (2014); Aktas et al. (2015) found significant effect of ewe's live weight at mating on the birth of the lambs.

Partly agreeable with us that by Hussein et al. (2000) indicated a positive relationship of dam weight on birth weight of lambs. Petrovic et al. (2011); Haque Bhuiyan Fazlul and Curran (1992); Babar et al. (2004) indicated that the birth weight significantly affected by the type of birth and the single born lambs were heavier than multiple born lambs. Gaskins et al. (2000) found a higher percentage of multiple births (Polypay breed).

Babar et al. (2004) reported different results in comparison with ours. According to them, the younger ewes produced lighter lambs, and the sex of lambs affected on birth weight. Gabr et al. (2016) found that the birth-weight of lambs was increased significantly with increasing weight of their dams which is absolutely a contradiction with the result we acquired.

Regarding the result obtained on the test between subjects effects; the birth type significantly influenced on lambs birth weight (P<0.01) but in the interaction effect between PMA\*BT did not show significant effect (P>0.05) on

	PMA*BT (P>0.05)	-	lambs birth weight.
(1995),	Demiroen et al.	-	Considering the frequency of birth type we are amenable with Demiroen et al. (1995) informed that there was an important influence of age of ewe on the frequency of single, twin, and multiple births.
	Talore (2009),	-	According to Talore (2009), the lambs which are heavier at birth are usually singles or are those produced by ewes with larger body sizes moderately true with the result we obtained in our study. Definitely, there is matching between our results and those reported/indicated by Csizmar et al. (2013), namely singles were significantly heavier than twins but sex did not affected on birth weight.
	Csizmar et al. (2013)	-	(2013), namely singles were significantly heavier than twins but sex did not affected on birth weight.
	Idris et al. (2011)	-	Slightly the results reported by Idris et al. (2011) were slightly similar to ours. Male lambs were heavier than females and single lambs recorded heavier weight than twins.
	LW ( 65 kg)	-	The ewes with the highest LWs ( 65 kg) had the highest multiple birth rates (Akta and Do an, 2014) relatively agreeable with ours. However, with regards to the PMW*BT, it was not observed interaction effect on lambs birth weight.
(Akta and Do an, 2014),	PMW*BT	-	
(2000)	Michels et al.	-	The investigation/study of Michels et al. (2000), is interesting and probably can consider as partly confirmation of ours. According to their study, there was a clear cut relationship between litter weight components and ewe weight cannot be generalized but may vary among differentially selected breeds and lines within them. Also the one by Gardner et al. (2007) reported that heavier birth weight could be obtained at late parities due to heavier dam weight and larger size and physiological imprint in the uterus during the first pregnancy which will facilitate relatively greater fetal growth in the subsequent pregnancies.
et al. (2007),	Gardner	-	

## CONCLUSIONS

PMA7  
 4.72 kg,  
 4.18 kg PMA5.  
 ( <0,05).  
 (LBW) PMW  
 61 kg, LBW  
 PMW 76 kg.  
 22.13%  
 27 9  
 34  
 55.74%.  
 (3.65 kg).  
 PMA, PMW, BT,  
 PMA\*PMW  
 (LBW).  
 PMA\* , PMW\* , PMA\*BT, PMW\*BT  
 (LBW).

The result of our study can cease that the ewes PMA7 got the heaviest lambs with an average birth weight of 4.72 kg while the lightest was 4.18 kg from ewes PMA5. The result obtained in multiple comparisons of mean difference among lamb birth weight according to pre-mating age of ewe was significant at ( $P < 0.05$ ).

The highest lamb birth weight (LBW) was found on PMW 61kgs while the lowest LBW was reported in PMW76kgs. Almost similar value on the average birth weight was obtained in both sexes of lambs. Identical percentage was acquired both by single and triplets born with 22.13% each of the total lambs born by 27 and 9 ewes respectively, but those lambs born twins by 34 ewes had the highest total number of lambs born with 55.74%. Lambs born single had the heaviest birth weight (5.61kg) while the triplets born were having the lightest birth weight (3.65 kg).

Based on the test between – subjects effects the PMA, PMW, BT, and the interaction effect between PMA\*PMW significantly influenced on lambs birth weight (LBW). On the contrary the Gender, PMA\*Gender, PMW\*Gender, PMA\*BT, PMW\*BT did not show interaction effect on lambs birth weight (LBW). Based on the above results the pre-mating age and pre-mating weight of ewes is clearly interrelated on lambs' birth weight.

TR 31053,

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1 , 5600 ,  
2 , 6000 ,

## Biological value of milk fat in Koprivshtenska and Srednostaroplaninska sheep breeds

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### SUMMARY

In 2018, an experiment was conducted on biological value of milk fat in Srednostaroplaninska and Koprivshtenska ewes that were raised in the regions of the towns of Gabrovo and Koprivshtitsa.

Average milk samples of each group were obtained and examined three times during the lactation period – in May, June and July. The amount of saturated and unsaturated fatty acids, the groups of fatty acid and their proportions, atherogenic index and lipid preventative score were determined and analyzed.

The total content of saturated fatty acids in milk of Srednostaroplaninska sheep was higher – 71.207%, compared to the milk of Koprivshtenska breed – 64.362%.

The ratio of saturated/polyunsaturated fatty acids was 15.149 in the milk of

15,149

13,860

- 2,71,

- 2,22.

Srednostaroplaninska sheep and 13.860 in Koprivshenska breed.

The latter data is indicative of a better oxidation capacity in the former.

Atherogenic index of milk of Srednostaroplaninska sheep breed had higher values (2.71) compared to Koprivshenska breed (2.22). This makes the milk of Koprivshenska breed a better product for healthy eating.

The milk of Koprivshenska breed had closer values of the lipid preventative score and the total fat content. The results are indicative for a better balance of the fatty acids in the milk of Koprivshenska breed.

**Key words:** sheep, milk, saturated and unsaturated fatty acids, atherogenic index, lipid preventative score

## INTRODUCTION

Depending on the breed background and under the impact of a number of genetic and non-genetic factors, milk fat in sheep milk varies from 5.0 to 12%. Fat globules in the sheep milk have a diameter of 5-6µm, and in 1 cm<sup>3</sup> there are 3-6 billion (Peichevski and Chomakov, 1988; Michailova et al., 2004).

For many years, the increased fatty acid content in milk and dairy products has been associated with an increase in serum cholesterol (Talpur, 2007).

Contemporary studies are not only focused on the negative effects of the fatty acid profile of milk. It also contains unsaturated fatty acids, including conjugated linoleic acid (CLA), the benefit of which is the reduction of total blood cholesterol as well as the presence of anticarcinogenic, antidiabetic and immunomodulatory effects (Mills et al., 2011).

5,0 12%.

5-6µm,

1 cm<sup>3</sup> 3-6 (Peichevski and Chomakov, 1988; Michailova et al., 2004).

(Talpur, 2007).

(CLA),



(Mills et al., 2011).

Ulbright and Southgate(1991).

2002).

Ivanova et al. (2017)  
CLA

,  
- It is also important to compare the content of saturated and unsaturated fatty acids by calculating the atherogenic index recommended by Ulbright and Southgate (1991).

- Another way to evaluate the biological value of milk fat is the ratio between omega 6/omega 3 fatty acids as well as the content of conjugated linoleic fatty acid (CLA) (Simopoulos, 2002).

- The omega-3 fatty acids in sheep's milk usually do not exceed 2 g/100g of fat, the omega-6 fluctuates from 3.42 g/100g to 2.39 g/100g of fat.

- CLA is a natural component of milk fat and one of the anticarcinogenic sources in human diet.

- The highest CLA values were found in sheep's milk. Ivanova et al. (2017) studies show that the level of CLA in sheep's milk and cheese is influenced by the amount of concentrated fodder, the type of roughage and the growing stage of harvesting.

- The aim of this study is to investigate the biological value of fat – the content of saturated and unsaturated fatty acids, the correlations between them, the atherogenic index and the lipid preventive score of milk from Koprivshtenska and Srednostaroplaninska sheep breed.

## MATERIAL AND METHODS

In 2018, an experiment was carried out with 50 ewes in the region of Gabrovo and Koprivshtenska respectively to examine the biological value of milk fat in Srednostaroplaninska and Koprivshtenska sheep breeds.

Mean total samples of milk from each group were obtained and tested, three times, during lactation period in May, June and July. The research was conducted at the Central Research Laboratory of the

Faculty of Agriculture, Trakia University - Stara Zagora using standard methodologies.

The fat extraction of milk samples was carried out according to the method of Rosse-Gottlieb (BDS 1671/80), after which the solvents were vaporized by a vacuum rotary evaporator. The methyl esters of fatty acids were analyzed by a Gas-Chromatograph (GC) Pay-Unicam 304 with Flame Ionization Detector (FID). The analysis was performed with a capillary column ECTM WAX (Alltech; 30 m x 0,25 mm, I.d.; 0,25µm film) and H2 as a carrier gas. The fatty acid groups and the ratios between them are determined by calculation.

The atherogenic index was defined by the formula of Ulbriht and Southgate (1991):

$$AI = \frac{12:0 + 4x C14: + C16:0}{MUFAs + PUFAs}$$

where: AI – atherogenic index  
 12:0 – lauric fatty acid  
 C14: 0 – myristic acid  
 16:0 – palmitic acid  
 MUFAs – monounsaturated fatty acids  
 PUFAs – polyunsaturated fatty acids

Lipid Preventive Score was determined by calculation, according to the Richard and Charbonnier equation (1994).

$$LPS = LPS + 2xSFA - MUFAs - 0.5xPUFAs$$

where: LPS – lipid preventive score  
 MFC – milk fat content  
 SFA – saturated fatty acids  
 MUFAs – monounsaturated fatty acids  
 PUFAs – polyunsaturated fatty acids

The results were processed by the methods of variation statistics by means of the software Statistica for Windows 2015, and graphically by Excel.

Faculty of Agriculture, Trakia University - Stara Zagora using standard methodologies.

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 PUFAs – polyunsaturated fatty acids

The results were processed by the methods of variation statistics by means of the software Statistica for Windows 2015 and graphically by Excel.

## RESULTS AND DISCUSSION

The content of saturated fatty acids for both breeds is presented in Table 1.

1.

Fourteen saturated fatty acids were found. There is a significance of differences with respect to the content of saturated fatty

6:0 – ( p<0,05),  
8:0 – ( p<0,05),  
15iso – ( p<0,01),  
7:0 – ( p<0,001),  
15:0 – ( p<0,05),  
17iso – ( p<0,01),  
17:0 – ( p<0,001).

- acids in favour of Koprivshenska breed  
- for C6:0 – caproic acid (at p<0.05), C8:0 –  
- caprylic (at p<0.05), C 15iso –  
- isopentadecanoic (at p<0.01), and in  
- favour of Srednostaroplaninska breed for  
- C7:0 – enanthate at p<0.001), C15:0 –  
- pentadecanoic (at p<0.05), C17iso – iso-  
- margaric (at p<0.01) and C17:0 –  
- margaric (at p<0.001).  
- Differences in the content of other  
- saturated fatty acids between both breeds  
- are small and unproven mathematically.

1.  
- %

**Table 1. Saturated fatty acids in fat of sheep milk, for both breeds – in %**

Saturated fatty acids		/Breeds			
		Srednostaroplaninska		Koprivshenska	
		x ± Sx	C	x ± Sx	C
4:0 –	/ butyric	2.083 ± 0.182	12.34	2.313 ± 0.167	10.17
6:0 –	/ caproic	1.753 ± 0.126*	10.17	2.043 ± 0.122*	8.43
7:0 –	/ enanthate	1.153 ± 0.069***	8.49	0.783 ± 0.057***	10.27
8:0 –	/ caprylic	2.300 ± 0.166*	10.17	2.850 ± 0.230*	11.38
10:0 –	/ capric	3.100 ± 0.315	14.31	3.456 ± 0.301	12.30
12:0 –	/ lauric	3.473 ± 0.298	12.10	3.793 ± 0.281	10.43
14:0 –	/ myristic	11.770 ± 1.428	17.11	10.990 ± 1.182	15.17
15iso –	/ isopentadecanoic	0.710 ± 0.042**	8.43	0.780 ± 0.056**	10.12
15:0 –	/ pentadecanoic	1.453 ± 0.104*	10.23	1.343 ± 0.081*	8.47
16:0 –	/ palmitic	27.627 ± 2.762	14.10	24.733 ± 2.161	12.32
17iso –	/ iso-margaric	0.596 ± 0.040**	9.41	0.545 ± 0.043**	11.10
17:0 –	/ margaric	0.716 ± 0.041***	8.17	0.590 ± 0.040***	9.47
18iso –	/ isostearic	3.183 ± 0.251	11.14	2.843 ± 0.209	10.38
18:0 –	/ stearic	11.290 ± 1.121	13.28	10.300 ± 0.889	12.17

n = 3

:\* – < 0,05; \*\* – < 0,01; \*\*\* – < 0,001

Significance of differences: \* – at p < 0.05; \*\* – at p < 0.01; \*\*\* – at p < 0.001

( 14:0),  
-  
- 11,77%.  
- 10,99%  
- 12% (Sawaya  
et al., 1984)

The amount of myristic acid (C14:0), which is believed to be most associated with choline plaque formation, was higher in Srednostaroplaninska sheep breed – 11.77%. There is a slight difference, however, in its content in the milk of Koprivshenska breed – 10.99% and it is mathematically unproven. The values, we have found, are similar to the milk of Naumy sheep breed – 12% (Sawaya et al., 1984) and higher than those found by Slavov (2007) in fine-fleeced sheep and their crossbreeds –

Slavov (2007) – 8,71-9,80%.

( 16:0).

27,63%.

ú

– 24,73%.

Fegeros et al. (1995)

27,13% Slavov (2007)

– 21,22-24,30%

Mihaylova and Odjakova (2006)

8.71-9.80%.

Palmitic acid had the highest amount of saturated fatty acids (C 16:0). Its content was higher in Srednostaroplaninska sheep – 27.63%. Koprivshhtenska breed showed a different content of 24.73%, which was not mathematically proven.

The amounts found by us correspond to those obtained from Fegeros et al. (1995) for sheep milk of Karogoniko breed – 27.13% and the results obtained from Slavov (2007) in fine-fleeced sheep – 21.22-24.30% and Mihaylova and Odjakova (2006) in local sheep breed.

The total content of saturated fatty acids in the milk of Srednostaroplaninska sheep was higher – 71.207%, compared to the milk of Koprivshhtenska breed – 64.362%.

The content of unsaturated fatty acids in the milk fat of both sheep breeds is shown in Table 2.

2.

2.

**Table 2. Unsaturated fatty acids in milk fat of sheep milk according to different breeds – % (g/100 g of fat)**

e	Unsaturated fatty acids	/Breeds			
		Srednostaroplaninska		Koprivshhtenska	
		x ± Sx	C	x ± Sx	C
<b>/ Monounsaturate</b>					
14:1 –	/ myristoleic	0.655 ± 0.039***	8.43	0.785 ± 0.041***	7.29
16:1 –	/ palmitoleic	0.880 ± 0.046	7.39	0.856 ± 0.056	9.17
17:1 –	/ heptadecyl	0.440 ± 0.030***	9.54	0.555 ± 0.045***	11.38
18:1 –	/ oleic	22.122 ± 1.321	8.42	25.569 ± 1.476	8.14
<b>/ Polyunsaturated</b>					
18:2 –	/ linoleic	2.210 ± 0.160*	10.24	1.920 ± 0.165*	12.10
18:3 –	/ linolenic	1.286 ± 0.089	9.72	1.320 ± 0.107	11.48
LA –	/ conjugated linoleic	1.200 ± 0.103**	12.13	1.623 ± 0.121**	10.52

n = 3

: \* - < 0,05 \*\* - < 0,01 \*\*\* - < 0,001

Significance of differences: \* - at p < 0.05 \*\* - at p < 0.01 \*\*\* - at p < 0.001

(p<0,001)

The milk of Koprivshhtenska breed had reliably higher content (p < 0.001) of monounsaturated myristoleic acid (C

( 14:1) – 0,785%,  
 0,655%.  
 14:1 - ,  
 Mihaylova et al. (2004) - 0,31% ,  
 Slavov (2007) - 0,23-0,42%.

3. , -  
 , .  
 -  
 11,45%, - 10,39%,  
 - 48,32%.

16:1). -  
 ( 17:1). -  
 - 0,440%,  
 ( p<0,001).  
 ( 18:1) -

- 14:1) – 0.785%, compared to  
 - Srednostaroplaninska breed – 0.655%.  
 - The values obtained for C 14:1 were  
 higher than those obtained from  
 Mihaylova et al. (2004) for Stara Zagora  
 sheep breed – 0.31% and those obtained  
 from Slavov (2007) for fine-fleeced breed  
 and their crossbreeds – 0.23-0.42%.

The relative share of fatty acid groups is presented in Table 3. In both breeds, the highest amount of saturated fatty acids was followed by medium and long-chain fatty acids. The sum of short-chain fatty acids was higher in the milk fat of Koprivshitsa breed – 11.45%, but the difference compared to Srednostaroplaninska breed – 10.39% is not mathematically proven. The sum of medium-chain fatty acids was higher in Srednostaroplaninska breed – 48.32%. Despite the wider range of variation compared to short-chain fatty acids, the established inter-breed difference is not mathematically proven. A similar lack of credibility between both studied breeds exists in terms of the amounts of long-chain, saturated, unsaturated, monounsaturated, polyunsaturated and essential fatty acids. Figure 1 presents the relative share of saturated, unsaturated, monounsaturated, polyunsaturated, short-chain, medium and long-chain fatty acids in milk fat of Srednostaroplaninska and Koprivshitska breed.

Both studied breeds were similar in terms of monounsaturated palmitoleic fatty acid content (C 16:1).

Heptadecyl fatty acid had the lowest content of all monounsaturated fatty acids (C17:1). It was higher in Srednostaroplaninska breed – 0.440%, with a significant difference (at p <0.001).

Oleic monounsaturated fatty acid (C 18:1) had the highest content and the highest share of unsaturated fatty acids in the milk of the studied breeds. Its content was higher in Koprivshitska breed –

			25.569%.
			There wasn't a mathematically proven difference with its level in the milk of Srednostaroplaninska breed – 22.122%.
22,122%			
			The results we have found are higher than those obtained from Mihailova and Slavov (2006) and Slavov and Mihaylova (2006) in the milk of fine-fleeced sheep and their crossbreeds – 18.02-23.09%.
Mihailova and Slavov (2006) and Mihaylova (2006)	Slavov		
18,02-23,09%.			
	( 18:2) – -6,		The polyunsaturated fatty acid linoleic acid (C 18:2) – omega-6 was higher in the milk fat of Srednostaroplaninska breed – 2.210%, compared to the milk of Koprivshenska breed. The difference is mathematically proven (p<0.05).
		– 2,210%,	
		(p<0,05).	
18:3) – -3,		(	Concerning the second polyunsaturated fatty acid – linolenic (C 18: 3) – omega-3, the difference between groups is in favour of Koprivshenska breed – 1.320%, compared to 1.286% in Srednostaroplaninska breed, but it is not mathematically proven. The results obtained by us correspond to those of Ivanova (2017) in the milk fat of Karakachan sheep – 2.72 g/100 g – 1.99 g/100 g of fat.
– 1,320%,		1,286%	
Ivanova (2017)		– 2,72 g/100 g –	
1,99 g/100 g			
( )		(CLA)	The content of conjugated linoleic acid (CLA) was higher with 1,623% in milk of Koprivshenska breed. The difference in its content in the milk of Srednostaroplaninska breed – 1.200% is mathematically proven. The results obtained by us are lower than those established for CLA by Ivanova (2017), when we examined milk samples from Karakachan sheep raised in the region of Smolyan – 2.42-2.63 g/100 g of fat.
		– 1,623%.	
ú		– 1,200%	
CLA	Ivanova (2017),		
		– 2,42-2,63 g/100 g	
3.			The relative share of fatty acid groups is presented in Table 3. In both breeds, the highest amount of saturated fatty acids was followed by medium and long-chain fatty acids.

11,45%,

- 10,39%,

- 48,32%.

The sum of short-chain fatty acids was higher in the milk fat of Koprivshitsa breed – 11.45%, but the difference compared to Srednostaroplaninska breed – 10.39% is not mathematically proven.

The sum of medium-chain fatty acids was higher in Srednostaroplaninska breed – 48.32%. Despite the wider range of variation compared to short-chain fatty acids, the established inter-breed difference is not mathematically proven.

A similar lack of credibility between both studied breeds exists in terms of the amounts of long-chain, saturated, unsaturated, monounsaturated, polyunsaturated and essential fatty acids.

3.

, % (g/100 g

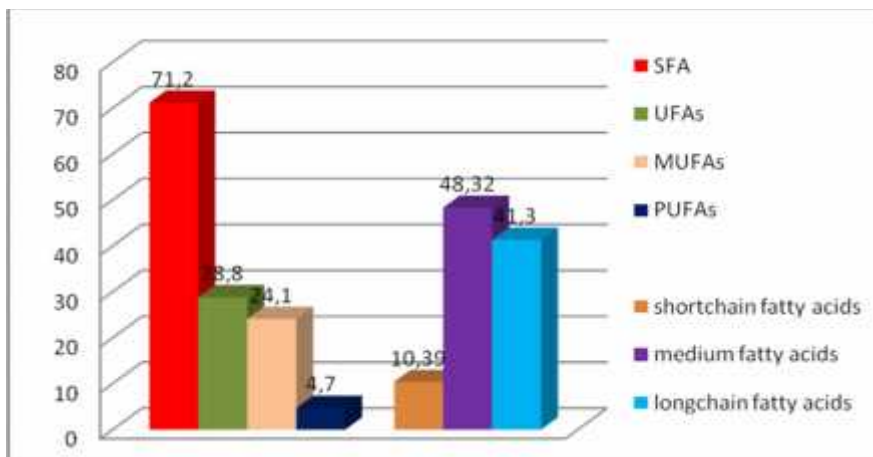
)

**Table 3. Fatty acid groups in sheep milk, % (g/100 g fat)**

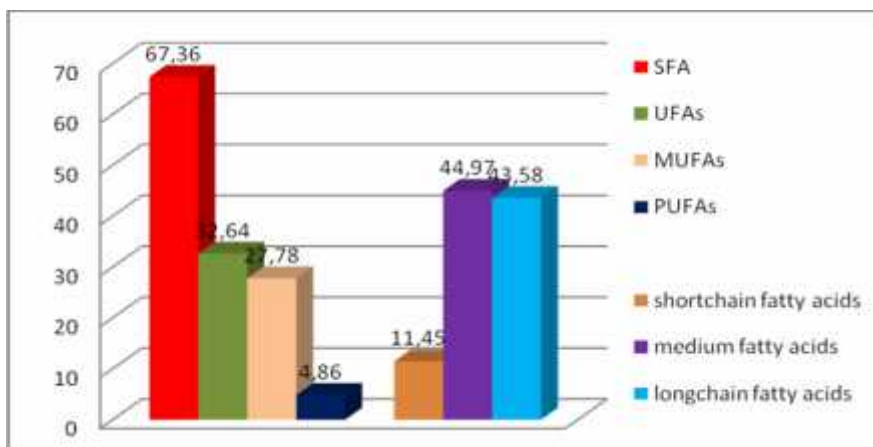
Groups of fatty acids	/Breeds			
	Srednostaroplaninska		Koprivshitska	
	x ± Sx	C	x ± Sx	C
4 – C 10	10.39 ± 0.779	10.58	11.45 ± 1.275	11.14
12 – C 17	48.32 ± 4.228	12.34	44.97 ± 3.425	10.74
18	41.30 ± 3.506	11.97	43.58 ± 4.048	13.10
/Saturated	71.20 ± 5.211	10.32	67.36 ± 5.030	10.53
/Unsaturated	28.80 ± 1.907	9.34	32.64 ± 1.891	8.17
/Monounsaturated	24.10 ± 2.239	13.10	27.76 ± 2.082	10.58
/Polyunsaturated	4.70 ± 0.291	8.74	4.86 ± 0.314	9.13
/Essential ( 18:2 + 18:3)	4.70 ± 0.338	10.14	4.86 ± 0.429	12.45

1

Figure 1 presents the relative share of saturated, unsaturated, mono-unsaturated, polyunsaturated, short-chain, medium and long-chain fatty acids in milk fat of Srednostaroplaninska and Koprivshitska breed.



/ Srednostaroplaninska breed



/ Koprivshenska breed

1. , , ,  
 , % (g/100 g )  
**Fig. 1. Content of saturated, monounsaturated, polyunsaturated, short-chain, medium chain and long-chain fatty acids in milk of both breeds, in% (g/100 g fat)**

4. -  
 18:0/ 16:0; 6:0/ 8:0; 4:0/ 6:0;  
 16:0/ 14:0. -  
 : 16:0/ 8:0 - 3,332, 18:1/  
 18:2 - 3,308 18:1/ 18:3 - 2,168.

The proportions of fatty acids in both breeds are presented in Table 4. The smallest interbreeding differences were found in the proportions C 18:0/C 16:0; C 6:0/C 8:0; C 4:0/C 6:0; C16:0/C 14:0. The highest values and differences between breeds are found in the ratios: 16:0/ 8:0 - 3,332, 18:1/ 18:2 - 3,308 18:1/ 18:3 - 2,168.



( -6/ -3) 18:2/ 18:3 -  
 - 1,718,  
 - 1,454 (0,264).  
 (Simopoulos and Salem, 1989;  
 Simopoulos, 2002).  
 /  
 15,149 -  
 13,860  
 -  
 .

The ratio C 18:2/C 18:3 (omega-6/omega-3) was higher in the milk of Srednostaroplaninska sheep – 1.718, which was a slight difference compared to Koprivshenska breed – 1.454 (0.264). The values obtained are within the limits of the optimal in terms of modern requirements for healthy eating (Simopoulos and Salem, 1989; Simopoulos, 2002).

The ratio of saturated/polyunsaturated fatty acids was 15.149 in the milk of Srednostaroplaninska sheep and 13.860 in those of the Koprivshenska breed. The latter data is indicative of a better oxidation capacity in the former.

#### 4.

**Table 4. Ratio of fatty acids in milk fat of sheep milk by breeds**

		/Breeds		
Ratios		Srednostaroplaninska	Koprivshenska	Difference between breeds
4:0 /	6:0	1.188	1.132	0.056
6:0 /	8:0	0.762	0.716	0.045
7:0 /	8:0	0.501	0.274	0.226
10:0 /	8:0	1.347	1.212	0.134
12:0 /	8:0	1.510	1.331	0.179
12:0 /	10:0	1.120	1.098	0.122
14:0 /	12:0	3.384	2.897	0.491
16:0 /	8:0	12.011	8.678	3.332
16:0 /	14:0	2.347	2.250	0.096
18:0 /	16:0	0.408	0.416	0.008
18:1 /	16:0	0.811	1.034	0.223
18:1 /	18:0	1.959	2.482	0.523
18:1 /	18:2	10.009	13.317	3.308
18:1 /	18:3	17.202	19.370	2.168
18:2 /	18:3	1.718	1.454	0.264
SFA / UFAs		2.472	2.063	0.408
UFAs / SFA		0.404	0.484	0.080
SFA / PUFAs		15.149	13.860	1.289

( 14:0) ( 12:0), ( 16:0)  
 ,  
 2,71,  
 - 2,22. -

The atherogenic index is determined on the basis of lauric (C12: 0), myristic (C14: 0), and palmitic (C16: 0) acids, MUFAs, and PUFAs.

The atherogenic index of milk from Srednostaroplaninska was higher – 2.71, compared to Koprivshenska sheep – 2.22. The lower atherogenic index of milk fat in sheep from Koprivshenska breed is mainly due to the relatively lower content

( 16:0)  
( 14:0),

(2017)  
(1,85-2,06).

Ivanova  
– 1,91

of palmitic (C 16: 0) and myristic acid (C 14: 0) as well as the relatively higher total content of MUFAs and PUFAs.

This makes sheep's milk a better product for healthy eating.

The results obtained for atherogenic index levels are higher than those obtained from Ivanova (2017) in Karakachan sheep – 1.91 (1.85-2.06).

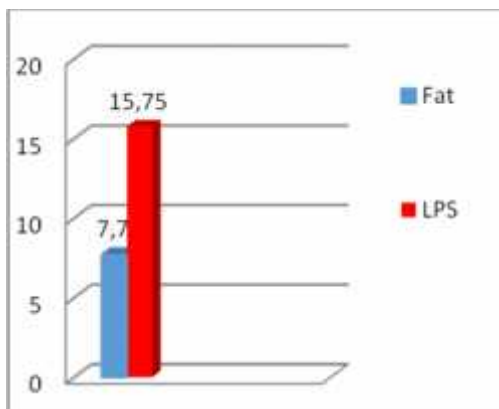
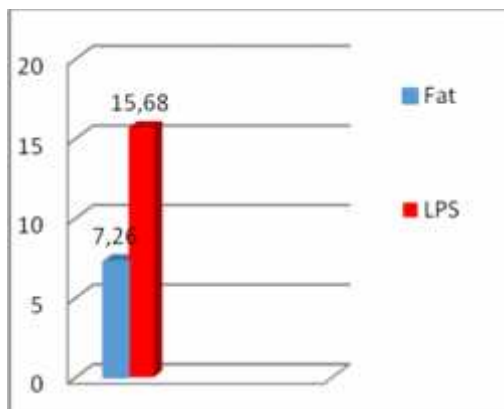
Based on the milk fat content and the major fatty acid groups, we determined the lipid preventative score (LPS). This is an indicator that is used to characterize the biological value and properties of milk fat.

An optimally balanced fatty acid composition of the milk is obtained when SFA, MUFAs, and PUFAs values are such that the lipid pre-test score is close to or equal to milk fat content (MFC).

Fat consumption where LPS and MFC values are equal (LPS = MFC) or with maximum values is useful in view of its preventive action against the risk of cardiovascular disease.

This is of utmost importance for the evaluation of the products, in the case of sheep's milk, in terms of their nutritional value and safety, for which the fatty acid balance is important. Closer values of LPS and MFC have the milk of Koprivshtenska sheep (Figure 2).

The difference in the values of both indicators is 8.05, and in the milk of the sheep of Srednostaroplaninska breed it is 8.42. The results obtained are indicative of a better balance of the fatty acids in the milk of Koprivshtenska sheep.



Srednostaroplaninska breed

/Koprivshtenska breed

**Fig. 2. Lipid Preventive Milk Score**

- 71,207%,

- 64,362%.

/

15,149

13,860

- 2,71,

- 2,22.

( 16:0)

( 14:0),

## CONCLUSIONS

The total content of saturated fatty acids in the milk of Srednostaroplaninska sheep breed is higher – 71.207%, compared to the milk of Koprivshtenska sheep breed – 64.362%. The ratio of saturated/polyunsaturated fatty acids was 15.149 in the milk of Srednostaroplaninska sheep breed and 13.860 in those of Koprivshtenska breed. The latter is indicative of better oxidation capacity in the former.

The atherogenic index of milk from Srednostaroplaninska sheep breed is higher – 2.71, compared to that of Koprivshtenska breed sheep – 2.22. The lower atherogenic index of milk fat in sheep from Koprivshtenska breed is mainly due to the relatively lower content of palmitic (C 16:0) and myristic acid (C 14:0) as well as the relatively higher total content of MUFAs and PUFAs.

This makes sheep's milk a better product for healthy eating.

The milk of Koprivshtenska had closer values of the lipid preventive score and the total fat content.

The difference in the values of both

8,05,

8,42.

- indicators is 8.05 and the fat in the milk of Srednostaroplaninska breed is 8.42.
- The results obtained are indicative of a better balance of the fatty acids in the milk of Koprivshenska sheep.

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, 2232 ,

## Effect of the Type of Lambing on the Milk Production in Dairy Sheep

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### SUMMARY

The aim of the study was to determine the effect of the type of lambing on the milk production for the suckling period as well as the milking milk production in sheep of Bulgarian Dairy Synthetic Population. The trial was carried out with the same 16 sheep on first and second lactation in two consecutive years, as they gave births to single lambs in one of the years and then gave birth to twins in the other year. The animals were reared in the experimental farm of the Institute of Animal Science - Kostinbrod. The milk production for a suckling period was determined after weaning and control milking after 12 hours for each sheep. The milk for the control day was acquired as the amount of the individually milked milk multiplied by two. The standard 120 days milking milk production was determined individually according to the AC method of ICAR. The data were statistically evaluated by the software package Data Analysis of Excel 2016, Microsoft. One way ANOVA was applied as the

16

12

120-

ICAR.

Data Analysis, Excel 2016, Microsoft.  
ANOVA

F- . . . . .

t- . . . . .

(F=9,331\*\*)

120- . . . . .

72,375 l 88,026 l,

108,825\*\* l 110,232 l.

;

,

,

Djorbineva (1984)

,

,

al. (1994) , Gonzalo et

(F=12,0\*\*\*),

0,893 l, - 0,932

l (P<0,05). Pollott and Gootwine (1999)

,

,

-

1,95 l,

1,92 l.

Scharch et al. (2000).

significance of the effects was determined through F-criterion. The significance of the difference between the studied groups was determined through t-test. The type of lambing affected significantly the milk production during the suckling period (F=9.331\*\*), however, there was no effect on the 120 days milking milk production. The average milk production for the suckling period and the milking milk production in the single lambs were respectively 72.375 l and 88.026 l, while in the twins they were 108.825\*\* l and 110.232 l.

**Key words:** effect of the type of lambing, suckling milk production, milking milk production.

## INTRODUCTION

In the available literature there are studies on the effect of the type of lambing in sheep on their milk production for a suckling period as well as on the milking milk production. Djorbineva (1984) does not find significant effect of the type of lambing on the milk production in local Stara Zagora sheep when studying the variability of the selection traits of this breed. When examining the factors influencing the milk production of dairy Churra sheep, Gonzalo et al. (1994) determine highly significant effect of the type of lambing on the milk yield (F=12.0\*\*\*) as the average milk production of the mothers giving birth to single lambs was 0.893 l, and of those that gave birth to twins it was 0.932 l (P<0.05). Pollott and Gootwine (1999) analyze the records of the milk controls in Awasi sheep milked twice without suckling period and do not find significant effect of the type of lambing on the daily milk production – the milk production of the sheep that gave birth to two and more lambs was at average 1.95 l, while the sheep that had single lambs it was 1.92 l. There was no significant influence of the type of lambing on the milk production of East Frisean sheep in the study of Scharch et al. (2000). The authors report

(1,07 l

(

1,15 l  
)  
(Ivanova, 2013)

50

a tendency towards higher daily milk production during the first 50 days of lactation (milk production for suckling period) in the sheep that had more than one lamb (1.07 l for the sheep that gave birth to single lambs and 1.15 l for the sheep that had two or more lambs). In a previous study (Ivanova, 2013) showed that the mothers of twins had significantly higher milk production during the suckling period, but the differences in the milking period are insignificant. The existing idea that the sheep having twins have higher milk production provoked us to do the present analysis.

The aim of the study was to determine the effect of the type of lambing on the milk production for the suckling period as well the milking milk production in sheep of Bulgarian Dairy Synthetic Population.

16

## MATERIAL AND METHODS

The study was carried out with the same 16 sheep on first and second lactation in two consecutive years, as they gave births to single lambs in one of the years and then gave birth to twins in the other year. The database aims to confirm earlier results showing that the mother of twins display higher milk production during the suckling period, but not during the milking period. The animals were kept in the experimental farm of Institute of Animal Science - Kostinbrod in one flock receiving the same diet.

12

The suckling milk production was determined as in the evening before the control day, the lambs were weaned from the sheep and they were milked. The control milking was done after 12 hours individually for each sheep. The milk for the control day was obtained as the quantity of the individually milked milk was multiplied by two. The milk production for a control period is the product of the milk for the control day and the number of days for the control period. The milk for the suckling period is calculated as the

( )  
 120- 60±5  
 ICAR.  
 120-  
 30±3  
 ( , 2003).  
 Data Analysis,  
 Excel 2016, Microsoft.  
 ANOVA  
 F-  
 t-

30- sum of the milk production for two control periods, each lasting 30 days.. The suckling period (from birth to weaning) in the sheep was 60±5 days.

The standard 120 days milking milk production was determined individually by the quantity of the milk for each milking control according to the method of ICAR. The milk production for the control day was calculated multiplying the quantity of the milk of the individual control by flock coefficient, determined for the control day by the ratio between the quantity of morning and evening milk to the morning milk in double milking. The milk production of the sheep for the standard 120 days milking period was calculated as sum of the milk production for the individual control periods of each sheep.

The control period had average duration of 30±3 days. The milk production for one control period was the product of the milk for the control day and the number of the days in the control period (Instruction for control of production traits, 2003).

Data were evaluated though the statistical package of Data Analysis, Excel 2016, Microsoft. One way ANOVA was applied as the significance of the effects was determined through F-criterion. The significance of the difference between the studied groups was determined through t-test.

**RESULTS AND DISCUSSION**

The examination of the effect of the type of lambing on the milk production during the suckling period showed significant value of the F-criterion (F=9.331\*\*) (Table 1).

(F=9,331\*\*) ( 1).



1.

, n=32

**Table 1. Effect of type of lambing on the suckling milk production, n=32**

/Source of Variation		/Milk production for suckling period		
	DF	MS	F	
/ Between Groups	1	10628.82	9.331**	
/ Within Groups	30	1139.08		
/ Total	31			

Note: Significance: \*\*\* – P<0.01

(F=20,976\*\*\*) (Ivanova, 2013), Gonzalo et al. (1994) (F=12,0\*\*\*). Pollott and Gootwine (1999) Scharch et al. (2000) 120- ( 2).

Similar result for significant effect of the type of lambing on the suckling milk production (F=20.976\*\*\*) we observed in our previous study (Ivanova, 2013) with sheep of the same flock at first, second and third lactation. Significant influence of the type of lambing on the milk production is reported by Gonzalo et al. (1994) in Churra sheep (F=12.0\*\*\*), while in the studies of Pollott and Gootwine (1999) in sheep of the improved Awasi and Scharch et al. (2000) in East Frisean sheep no significant effect of the type of lambing is shown. Contrary of the suckling milk production, the 120 days milk production was not significantly affected by the type of the lambing (Table 2).

2.

120-

n=32

**Table 2. Effect of type of lambing on the 120 days milking milk production, n=32**

/Source of Variation 120-		/120 days milking milk production		
	DF	MS	F	
/ Between Groups	1	3944.94	NS	
/ Within Groups	30	1278.04		
/ Total	31			

Note: Significance: NS – not significant

Ivanova (2013).

The results of the trial with the experimental design including the data of the same sheep at first and second lactation in two consecutive years in one of which the sheep had single lambs and then in the other – twins, confirms the results of the study of Ivanova (2013). The effect of the type of lambing on the milking and lactation milk production has been studied by Pacinovski (2011), who

Pacinovski (2011),  
 F- Djorbineva (1984) –  
 3  
 120-  
 l), e (108,825  
 - (72,375 l) (P<0,01).

report significant values of F-criterion, and by Djorbineva (1984) – who reported non-significant.

Table 3 presents the average suckling and 120-day milking milk production according to the type of lambing. The milk production for the suckling period of the mothers of twins (108.825 l) is significantly higher when compared to that of the mothers of the single lambs (72.375 l) (P<0,01).

3.

120

**Table 3. Average suckling and 120-day milking milk production according to the type of lambing**

/ Traits	n	/ Single		/ Twins		Sign.
		$\bar{x} \pm SE$	n	$\bar{x} \pm SE$	n	
Milk production for suckling period, l	16	72.375 ± 6.571	16	108.825 ± 9.961		**
120 days milking milk production	16	88.026 ± 7.111	16	110.232 ± 10.449		NS

Note: Significance of the difference: \*\* – P<0.01; NS – non-significant

(Ivanova, 2013)  
 e (101,657 l),  
 - (80,062 l)  
 (P<0,001).

In our previous study (Ivanova, 2013) the milk production for the suckling period in all the sheep at first, second and third lactation that gave birth to twins (101.657 l) was also significantly different from that of the mothers of the single lambs (80.062 l) (P<0.001). Similar trend of change of the milk production for the suckling period according to the type of lambing was observed by Pacinovski (2011) and Pollott and Gootwine (1999) in Awasi sheep and Scharch et al. (2000) in East Frisen sheep.

Pacinovski (2011) Pollott and Gootwine (1999)  
 Scharch et al. (2000)  
 120-  
 ( 3).

The average milk production for 120 days period does not differ considerably in the sheep having single lambs or twins (Table 3).

Ivanova (2013)  
 Othmane et al. (2002) Gonzalo et al. (1994), Pacinovski (2011)

Similar results showing dependence of the milking milk production on the type of lambing were reported by Ivanova (2013) with sheep from the same flock and also in Churra sheep (Othmane et al., 2002 and Gonzalo et al., 1994), and by Pacinovski (2011) in Awasi sheep.

## CONCLUSIONS

(F=9,331\*\*)  
120-

72,375 l 88,026 l,  
108,825\*\* l  
110,232 l.

The present study shows significant effect of the type of lambing on the milk production during the suckling period (F=9.331\*\*) and the lack of such on the 120 days milk production.

The average milk production for the suckling period and the milking milk production in the single lambs were respectively 72.375 l and 88.026 l, while in the twins they were 108.825\*\* l and 110.232 l.

The results of the trial confirm the conclusion that the mothers of twins have higher milk production during the suckling period but their milk production during the milking period does not differ significantly from the sheep that have single lambs.

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## PGF 2

, 2232

# Synchronization of Estrus through Various Shorter Progestagen Treatments and Synthetic Analogue of PGF 2 in Ewes from Ile de France Breed

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### SUMMARY

The aim of the present study was to induce synchronized estrus through various shorter progestagen treatments and synthetic analogue of PGF 2 in ewes from Ile de France breed. The experiment was carried out with 46 sheep, aged 2-5 years. The intravaginal sponges (30mg FGA (Synchropart®) were put on day 1 of the onset of the breeding campaign.

Depending on the duration of the sponge stay, 3 groups were formed: Group 1 – 5 days (n=16), Group 2 – (n=15) Group 3 – 7 days (n=15). At the time of the placement of the sponges, the ewes were treated with a synthetic analogue of PGF 2 (1.0 ml Alfabedyl®). At the time of the sponge removal, 300 UI PMSG (Synchropart® PMSG) was put i.m. At 48h after sponge removal the ewes were tested for presence of a heat with an estrous detector (Draminski Ltd). All ewes that had electrical resistance 350 units

350  
49-  
50-  
68,75%  
2  
1 2  
54,54% 200%).  
3  
63,63%,  
171,43%.

(Abecia et al., 2011).

(FGA MGA)  
(Danko, 2003; Menchaca and Rubianes, 2004; Abecia et al., 2011).

12 14  
( ),  
48  
(Abecia et al., 2011).

were considered to be in estrus. Between 49th and 50th hour after sponge removal, the ewes in a heat were inseminated once, naturally, according pre-established breeding plan. The synchronized effect was 68.75% for Group 1 and the same for Group 2 and Group 3 – 73.33%. The fertility and the fecundity for Group 1 and Group 2 was the same (54.54% and 200%, respectively). In Group 3, the fertility was highest – 63.63%, but the fecundity was the lowest – 171.43%. Based on the results obtained, we recommend the three schemes as a suitable alternative to the long term progestagen treatments for estrus synchronization.

**Key words:** ewes, estrus, synchronization, progestagens

## INTRODUCTION

A major element of effective reproductive management in small ruminants is the synchronization of oestrus. Synchronization of estrus allows control and shortening of lambing and kidding, with synchronization of weaning and uniform batching of animals to slaughter; it also allows more efficient use of labor and animal facilities (Abecia et al., 2011). In Europe, the most common hormonal method for ES of small ruminants is with intravaginal sponges, impregnated with progestagen (flurogestone acetate FGA or medroxy-progesterone acetate MGA) (Danko, 2003; Menchaca and Rubianes, 2004; Abecia et al., 2011).

In the traditional protocols for synchronization of oestrus with intravaginal sponges, they stay in the vagina for 12 to 14 days (so-called long term treatments), followed by a PMSG injection during the removal of sponges and after about 48 hours an oestrus occurs and the sheep can be inseminated (Abecia et al., 2011). The long-term progesterone treatments efficiently synchronise oestrus, but with variable

(Menchaca and Rubianes, 2004).

(Vi oles et al, 2001).

LH , LH -

(Menchaca and Rubianes, 2004).

(14 ) -

(Suarez et al, 2006; Martins et al., 2009), -

(Maritnez-Ros et al., 2018).

( , 5-7 ), (Menchaca and Rubianes, 2004) -

5-7 -

(Menchaca and Rubianes, 2004).

(Ungerfeld and Rubianes, 1999; Ataman et al., 2006; Maritnez-Ros et al., 2018), (Vi oles et al., 2001; Ataman et al., 2006; Ustuner et al., 2007; Karaca et al., 2009; Metodiev and Karaca et al., 2009, Metodiev and Raicheva, fertility (Menchaca and Rubianes, 2004). Long progestagen treatments induce ovulation of old follicles in ewes as a consequence of low progesterone concentrations at the end of the treatment (Vi oles et al., 2001).

Subluteal progesterone concentrations increase the LH pulses frequencies, but the LH surge does not occur and as a consequence of that the largest follicle persists (Menchaca and Rubianes, 2004). Maintenance of intravaginal progestagens for such a long period of 14 days is also related to the development of vaginitis and problems with lack of sponge retention (Suarez et al., 2006; Martins et al., 2009), which are not consistent with what is desired from an animal welfare and health perspective (Maritnez-Ros et al, 2018).

According to the new concepts of follicular growth (the wave model, and that each follicular wave appears every 5-7 days), a working group of scientists (Menchaca and Rubianes, 2004) developed various alternative, short-term progestagen treatments in sheep and goats, consisting of the induction of 5-7 days progesterone background. In order to obtain good results in estrus induction after short treatment during the estrus season, it is necessary to provide regression of the corpus luteum. If luteolysis is induced at the beginning of short treatments, all females will maintain similar and adequate serum levels of exogenous progesterone during treatment (Menchaca and Rubianes, 2004).

Short progestagen treatments followed by the injection of PMSG are effective both during the anestrus season (Ungerfeld and Rubianes, 1999; Ataman et al., 2006; Maritnez-Ros et al., 2018) and during the estrus season (Vi oles et al., 2001; Ataman et al., 2006; Ustuner et al., 2007; Karaca et al., 2009; Metodiev and Raicheva, 2011; Cox et al., 2012;

2011; Cox et al., 2012, Metodiev et al., 2014, Metodiev et al., 2018).

Ros et al., 2018).

(Maritnez-

PGF

2

5

2017 46

e

300 g/

1

1 – 5 (n=15); 3 – 7 (n=15); 2 – 6 (n=15).

2

3)

(70-75 kg),

( = 3,0-3,5),

(30mg FGA

(Synchropart®, CEVA SANTE ANIMAL))

PGF2 - Alfabedyl CEVA

ANIMAL HEALTH ( . . . alfaprostolum).

Metodiev et al., 2014; Metodiev et al, 2018). Short-term protocols are more and more frequently used for sheep artificial insemination under field conditions but even with the advantages with use of this protocol there is still less use of this progestogen treatment regimen than that of the classical long-term treatments (Maritnez-Ros et al, 2018).

The aim of the present study was to induce synchronized estrus through various shorter progestagen treatments and synthetic analogue of PGF 2 in ewes from Ile de France breed.

## MATERIAL AND METHODS

The experiment was carried out in May 2017 with 46 Ile de France sheep, aged 2-5 years, raised in the EB of IAS-Kostinbrod. The sheep are fed on grazing with supplemented feed of concentrated mix with 17% CP at a dose of 300g/per head per day. At the end of the experiment, the animals were sheared and transported to highland pasture.

The intravaginal sponges were put on day 1 of the onset of the breeding campaign. Depending on the length of stay of the tampons, 3 experimental groups were formed: Group 1-5 days, (n=16); Group 2 – 6 days, (n=15); Group 3 – 7 days, (n=15). In the beginning of experiments, in all groups there were 16 animals, but sponges of two animals (one from Group 2 and one from Group 3) had fallen before the end of the treatment, and these animals were excluded from the experiment. The animals in the groups were equal by age, live weight (70-75 kg), body condition (BCS= 3.0-3.5), clinically healthy and normal deliveries in the previous lambing. At the time of the placement of the sponges, the ewes were treated with a synthetic analogue of PGF 2 (1.0 ml Alfabedyl®).

At the time of the sponge removal, 300 UI PMSG (Synchropart® PMSG) was put

(Synchropart® PMSG, CEVA SANTE ANIMAL).  
48-

300 UI i.m.

((Draminski Ltd).  
350

(360-440

).

49-

50-

6

0,5 ml  
70%,

48-

100.

100.

100.

(n)

(%)

At 48 h after sponge removal the ewes were tested for presence of a heat with an estrous detector (Draminski Ltd). All ewes that had electrical resistance 350 units were considered to be in estrus (according to users' manual and our field observations).

Ewes with boundary values for estrus (360-440 units) were also reported. Between the 49th and 50th hours after removal of the sponges, the ewes in the estrus were inseminated once, naturally, according to a pre-prepared breeding plan. One ram did a maximum of three services per day.

A few days before the services, the semen of the rams was tested (obtained by artificial vagina) and only rams, which ejaculates had the following parameters: volume 0.5 ml and sperm motility 70%, were used for natural insemination. During the experiment, 6 rams were used.

The following parameters were studied:

- Effect of estrus synchronization (EES) – ewes in estrus on 48 h after sponge removal – ewes in a heat/all ewes x 100.

- Fertility – lambd ewes/inseminated ewes x 100.

- Fecundity – the number of born lambs (included all born lambs – live, dead and aborted)/lambd ewes x 100.

Fertility and fecundity were calculated after lambing. All results were presented in number (n) and percentage (%).

## RESULTS AND DISCUSSION

The synchronization effect was 68.75% (11 out of 16 sheep) for Group 1 (5 days treatment) and the same for Group 2 (6 days treatment) and Group 3

68,75% (11 16 )

1 (5

2 (6

3 (7



) – 73,33% (11 out of 15 sheep) (Table 1). In both groups the average values of vaginal electrical resistance of ewes in estrus was similar – 260.0 (Group 1), 265.45 (Group 2) and 270.91 (Group 3) units.

1.

**Table 1. Number of ewes, that came or not in estrus and mean vaginal electrical resistance of the ewes from the experimental groups**

Group	350	(360-440)
	Number of ewes with Vaginal electrical resistance 350 UNITS (Ewes in estrus)	Vaginal electrical resistance of ewes in estrus UNITS (mean)
1/Group 1	11	260.0
2/Group 2	11	265.45
3/Group 3	11	270.91

The obtained results for estrus synchronization have lower values than the results reported by other authors (Ungerfeld and Rubianes 1999; Viñoles et al., 2001; Ak z et al., 2006; Ustuner et al., 2007; Karaca et al., 2009; Maslev et al., 2010; Martemucci and D'Alessandro, 2011; Metodiev and Raicheva, 2011; Metodiev and Raicheva, 2014; Metodiev et al., 2018).  
 80-100% 144  
 Maritnez-Ros et al., 2018, 7-  
 PGF 2  
 63,6%.  
 (Metodiev and Raicheva, 2011) (4-6 )  
 6  
 PGF 2 ,  
 51,27h

The obtained results for estrus synchronization have lower values than the results reported by other authors (Ungerfeld and Rubianes 1999; Viñoles et al., 2001; Ak z et al., 2006; Ustuner et al., 2007; Karaca et al., 2009; Maslev et al., 2010; Martemucci and D'Alessandro, 2011; Metodiev and Raicheva, 2011; Metodiev and Raicheva, 2014; Metodiev et al., 2018). The authors report that the effect of synchronization was between 80.0 and 100% until 144 hours after sponge removal. Our results were similar to those of Maritnez-Ros et al., 2018, who on 7-day treatment protocol with treatment with PGF 2 synthetic analogue at the time of placing the sponge obtained a synchronized effect of 63.6%. In our previous study (Metodiev and Raicheva, 2011) with multiparous ile de France ewes (4-6 year old), we induced synchronized oestrus with 6 day progestagen treatment by injecting a synthetic analogue of PGF 2 , we found that the onset of estrus occurred averagely on 51.27 hours after sponge removal. In our previous experiments with animals from the same herd (Metodiev and Raicheva, 2011; Ralchev et al.,

(Metodiev and Raicheva, 2011; Raichev et al. 2012),

Ustuner et al., 2007

Maritnez-Ros et al., 2018.

(3 4 2)

(1),

– 36,0-43,4 h (Martemucci and D'Alessandro, 2011), 38,1-42,4 h (Ungerfeld and Rubianes, 1999), 43,4 – 48,0 h (Maritnez-Ros et al., 2018), 42,9-45,6 h (Ak z et al., 2006), 70,8 h (Ustuner et al., 2007), 84,8 h (Viñoles et al., 2001).

:

( )

48- 12

3 – 63,63%, 1 2 – 54,54% (2).

(Metodiev and Raicheva, 2011) – 63,64%

PGF 2

2012), we observed that the onset of oestrus occurred earlier and more synchronously after removal of the sponges in the long progestagen treatments compared to the short ones. Similar were the results of Ustuner et al., 2007 and Maritnez-Ros et al., 2018.

In all three groups (3 ewes from Group 1 and Group 3 and 4 ewes from Group 2) there were sheep with boundary values for onset of estrus (Table 1), which were likely to manifest estrus later.

In 36.0-43.4h (Martemucci and D'Alessandro, 2011), 38.1-42.4h (Ungerfeld and Rubianes, 1999), 43.4-48.0 h (Maritnez-Ros et al, 2018), 42.9-45.6 h (Ak z et al., 2006), 70,8h (Ustuner et al., 2007), 84,8 h (Viñoles et al., 2001).

Taking into account the results obtained in this experiment and the results of the studies of other authors, we could summarize the onset of oestrus occurring at different times and depends on various factors, mainly season (estral or anestrus), ovary status, individual reaction of each ewe to treatment, breed, body condition and others.

On the basis of the ongoing experiment and taking into account our earlier experiments with short progestogen treatments, we think that for more accurate results, single registration of estrus is not enough, and at least two registrations are needed – about 48 hours after sponge, and the other 12 hours later.

The fertility was highest in Group 3 – 63.63%, while for Group 1 and Group 2 it was lower and the same – 54.54%. The obtained results were similar to those obtained in our previous experiment (Metodiev and Raicheva, 2011) – 63.64% for a 6-day progestogen treatment with injection of PGF 2 synthetic analogue at the time of placement of the sponge. The

Ungerfeld and Rubianes (1999) – 75.0%, Viñoles et al. (2001) – 87.0%, Ak z et al. (2006) – 76.9-86.6%, Karaca et al. (2009) – 71.6%, Martemucci and D'Alessandro (2011) – 80%,

results obtained are lower than those obtained from other authors – Ungerfeld and Rubianes (1999) – 75.0%, Viñoles et al. (2001) – 87.0%, Ak z et al., (2006) – 76.9-86.6%, Karaca et al. (2009) – 71.6%, Martemucci and D'Alessandro (2011) – 80%, with all insemination being natural and ewes were multiparous.

15-20%

The lower fertility rates of about 15-20% that we obtained versus other authors, we supposed that were due to the stress caused by shearing and transporting, and there may have been an early death of the embryos.

(Prandzev et al., 1987).

It is well known that climatic and seasonal changes, temperature changes (especially high), overheating, long-term transport, increased exploitation, poor hygiene conditions and other stress factors may cause early embryonic deaths and abortions during the second half of pregnancy (Prandzev et al., 1987).

**2. e**  
**Table 2. Fertility and fecundity of the ewes from the experimental groups**

/Group	/Fertility		/Fecundity	
	/Number of ewes, n	%	/Number of lambs, n	%
1/Group 1	6	54.54	12	200.0
2/Group 2	6	54.54	12	200.0
3/Group 3	7	63.63	12	171.43

1 2 – 200%,  
171,43% ( 2).  
(Metodiev and Raicheva, 2011) – 140-142%.  
(300 UI 250 UI ). Bonev et al. (2002)

The fecundity for Group 1 and Group 2 was the same – 200%, while Group 3 was lower – 171.43%. The results obtained for all three groups were higher than those obtained in our previous study (Metodiev and Raicheva, 2011) – 140-142%. These results, on the one hand, were probably due to the higher dose of PMSG (300 UI in the current experiment vs. 250 UI in the previous experiment).

300 UI 12-

Bonev et al. (2002) recommend that the optimal dose of PMSG for sheep of the Ile de France breed should be 300 UI in the classic 12-day treatments, as the authors achieved a fecundity of 128%.

128%.  
(Menchaca and Rubianes, 2004).

( =3,0-3,5),  
(Todorov et al., 1994)

, On the other hand, it was established,  
- that at short term progestogen treatments,  
- after removal the progestogen device,  
- healthy follicles of the second follicular  
- wave, which have been suppressed by  
- the dominant follicles of the first follicular  
- wave, have been found to be ovulating  
(Menchaca and Rubianes, 2004). In  
- addition, the sheep were in good body  
- condition (BCS=3.0-3.5), and it is known  
- that sheep in good body condition  
(Todorov et al., 1994) are easier to  
- fertilize and to give multiple births in a  
- higher percentage than the weak sheep.

## CONCLUSIONS

68,75% 1 (5-  
) 2 (6-  
) 3 (7-  
) – 73,33%.  
2 ( 54,54%  
200%).  
3  
- 63,63%,  
- 171,43%.

The effect of synchronization was  
- 68.75% for Group 1 (5-day treatments)  
- and the same for Group 2 (6-day  
- treatments) and Group 3 (7 days  
- treatments) – 73.33%. Fertility and  
- fecundity for Group 1 and Group 2 was  
- the same (54.54% and 200%,  
- respectively). In Group 3, fertility was  
- highest – 63.63%, but fecundity was the  
- lowest 171.43%. Based on the results  
- obtained, we recommend the three  
- schemes as a suitable alternative to long  
- progestagen treatments for estrus  
- synchronization.

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## Educational and Age Structure of Persons Employed in Dairy Sheep Breeding Farms

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### SUMMARY

The aim of the paper was to study the educational and age structure of persons employed in dairy sheep breeding farms, situated in Sofia and Pernik districts. Information had been collected from 6 dairy sheep breeding farms in Bulgaria, in which 22 persons were employed in farm activities. It was found that the greatest share had the persons under an employment contracts (manager and shepherds) – 41%, followed by the owners – 32% and the unpaid family workers – 27%. The share of men was 77.3% and that of women – 22.7%. Almost half of the persons had lower secondary or less education; a little over 1/3 had upper secondary education; persons with higher education were 18.2%. Only 18.2% of the employed persons had attended vocational training courses. In the group of owners prevailed men (85.7%). The largest share occupied the owners aged 35 to 44 (42.8%). 57.1% of them had upper secondary

42.9%

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7

1

50%

15 24 .

50%

84%

(Doitchinova, 2002).

2003 .

285.9 . (www.nsi.bg),

184.5 . (65%) 101.3

(35%);

13.7 . ,

111 . ( 78.4 .

- 161.2 .

2017 .

- education and 42.9% were university graduates. Almost half of the owners had attended vocational training courses. Only in one of the farms a manager under an employment contract was assigned.
- Shepherds were relatively evenly distributed in the age groups from 15 to 64 years, there was no person aged 65 or above. Men in this category were 7 times more than women. 7 times more were the shepherds with lower secondary or less education compared to the shepherds with upper secondary education. Only 1 shepherd had attended a vocational training course in livestock breeding. In the category of unpaid family workers 50% of the persons were aged 15 to 24. They were children of farms' owners. The remaining 50% were parents of owners.

**Key words:** dairy sheep breeding farms, employed persons, education, age, Bulgaria

## INTRODUCTION

The structure and characteristics of the labour force in agriculture, and in particular in the dairy sheep breeding sector in Bulgaria are of utmost importance for the efficiency and competitiveness of the agrarian sector. Dairy sheep breeding is a promising branch for our country, given the interest in sheep production on local and international markets, as well as the fact that about 84% of the territory of the country falls into the countryside of villages (Doitchinova, 2002).

In 2003, the number of persons employed in agriculture, forestry and fisheries was 285.9 thousand (www.nsi.bg), of which 184.5 thousand were men (65%) and 101.3 thousand were women (35%); persons with higher education were 13.7 thousand, with upper secondary education – 111 thousand (including 78.4 thousand with secondary vocational) and with lower secondary or less education – 161.2 thousand. In 2017, the number of employed persons in agriculture, forestry



221 . (www.nsi.bg), 154.4 .  
 (69.86%) 66.6 .  
 (30.14%);  
 16.5 ., 112.4 . (  
 66.7 . -  
 ) - - 92  
 .  
 2003-2017  
 . -  
 22.7%,  
 (Mishev  
 et al., 2010).  
 : 20.4%  
 2003 ., 2017 .  
 1,3% , -  
 , -  
 15%, -  
 43%.  
 ,  
 2017 .  
 5% 2003 .  
 ,  
 (Gospodinova, 2011).  
 (Hurst, 2005),  
 -  
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 ,

and fisheries was 221 thousand (www.nsi.bg), of which 154.4 thousand were men (69.86%) and 66.6 thousand were women (30.14 %); persons with higher education were 16.5 thousand, with upper secondary education – 112.4 thousand (including 66.7 thousand with secondary vocational) and with lower secondary or less education – 92 thousand. Thus, in the period 2003-2017, the number of employed persons in a quantitative dimension in the sector decreased by 22.7%, which corresponded to the studies of some authors (Mishev et al., 2010).

There were also some qualitative changes: with 20.4% the number of persons with higher education had increased in 2017 compared to 2003, a minimal increase of 1.3% was also observed in the number of people with upper secondary education, people with secondary vocational education had decreased by almost 15% and those with lower secondary or less education had decreased by almost 43%. There is a process of overall reduction in the number of employed persons in the sector, but at the same time, the proportion of persons with higher education is increasing at the expense of those with lower secondary or less. At the same time, the share of women in 2017 marks a decrease of almost 5% compared to 2003.

The number of people employed in agriculture decreases mainly due to the unattractiveness of the sector, moving to other spheres of the economy (Gospodinova, 2011). It is found (Hurst, 2005), that agricultural workers as a whole are among persons with the least access to healthcare and the least protection from the point of view of the workers' compensations.

In developed countries, education has an impact on the agrarian sector by helping educated farmers to start work, including full-time employment outside of the agriculture (Huffman, 2001). A study

(Huffman, 2001).  
(Becker, 1993),  
-  
, (Quisumbing, 1996)  
,  
(Loukanova, 2007)  
.  
(Ivanova, 2014),  
92.78%  
(Gerganov and Nenova,  
2012)  
, 55  
,  
-  
(Kenfo et al., 2018),  
, 40  
.  
, 2016 . 6  
, 22  
,  
( )  
),  
)

(Becker, 1993) states that the more educated and skilled the persons, the more money they earn.

Another author (Quisumbing, 1996), points out that, as a whole the productive efficiency of farms managed by men is not differ from that of farms managed by women.

According to a study (Loukanova, 2007) the pursuit in the agrarian sector should aim at increasing labour productivity at relatively low levels of employment.

The forms of employment in the Bulgarian agriculture were analyzed in a study (Ivanova, 2014), where it was established that self-employed and family workers occupied 92.78% of the employed in agriculture. Other authors (Gerganov and Nenova, 2012), claimed that more than a half of women employed in agriculture are over 55 years of age.

Studies on the educational, age and gender structure of farmers – sheep breeders were conducted in Ethiopia (Kenfo et al., 2018) and it was found out that the prevailing part of the farmers were men, less than forty years of age.

The aim of the paper was to study the educational and age structure of persons employed in dairy sheep breeding farms, situated in Sofia and Pernik districts.

## MATERIAL AND METHODS

Information had been collected in 2016 from 6 dairy sheep breeding farms in the country engaging a total of 22 persons. Age, gender, education and attended vocational training courses of the employed persons (owners (employers and self-employed), employees and unpaid family workers) were studied in the analyzed agricultural holdings.

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 1-2 , .

- One of the farms is owned and managed by two people. In the category of employees are included hired managers and staff employed in livestock activities (general workers – shepherds). Shepherds carry out the following activities: grazing the animals, milking, cleaning the barns and yards in front of them, feeding and watering the animals, performing other non-specialized activities related to sheep rearing. In the group of unpaid family workers are included children and parents of the sheep farms' owners, whose labour is unpaid, usually within 1-2 hours a day. Their work has an auxiliary character, they are not the main source of labour.

, , : 7  
 , 1 , 8  
 6  
 1

- In the sheep farms, subject to this study, the employed persons are allocated as follows: 7 are owners, 1 is a hired manager, 8 are shepherds and 6 are unpaid family workers.

- Table 1 presents some of the characteristics of employed persons in sheep farms.

## RESULTS AND DISCUSSION

### 1.

**Table 1. Characteristics of employed persons in dairy sheep breeding farms**

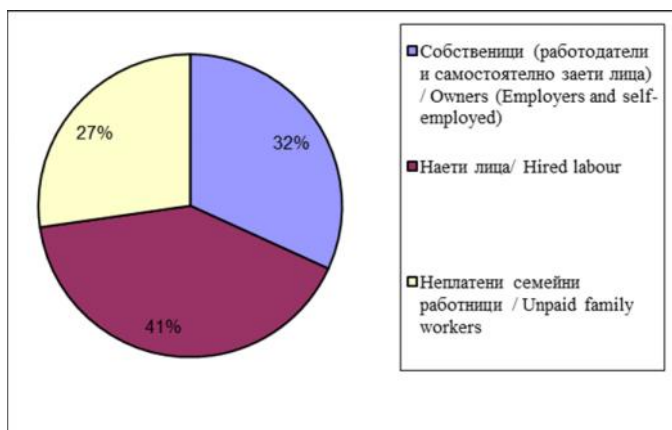
Category of employed persons	Number of employed persons in the relevant category	/ Age						/ Gender	
		15–24 (%)	25–34 (%)	35–44 (%)	45–54 (%)	55–64 (%)	65 and above (%)	Men (%)	Women (%)
Owners (Employers and self-employed)	7		28.6	42.8	14.3	14.3		85.7	14.3
/ Hired manager	1					100.0		100.0	
/ Shepherds	8	25.0	12.5	25	12.5	25.0		87.5	12.5
Unpaid family workers	6	50.00			16.7	16.7	16.6	50.0	50.0
/ Total	22	22.7	13.7	22.7	13.7	22.7	4.5	77.3	22.7

/ Source: Own calculations

/ continue:

Category of employed persons	/ Education				Share of persons attended vocational training courses (%)
	Lower secondary or less (%)	Upper secondary (without a qualification) (%)	Secondary vocational (%)	Higher (%)	
Owners (Employers and self-employed)		42.9	14.2	42.9	42.9
Hired manager				100.0	0.0
/ Shepherds	87.5	12.5			12.5
/ Unpaid family workers	50.0	50.0			0.0
/ Total	45.5	31.8	4.5	18.2	18.2

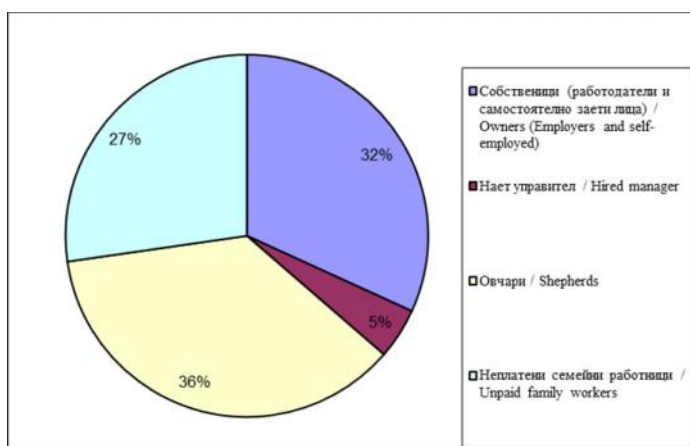
/ Source: Own calculations



. 1.

**Fig. 1. Category of employed persons in dairy sheep breeding farms**

/ Source: Own calculations



. 2.

**Fig. 2. Structure of employed persons in dairy sheep breeding farms**

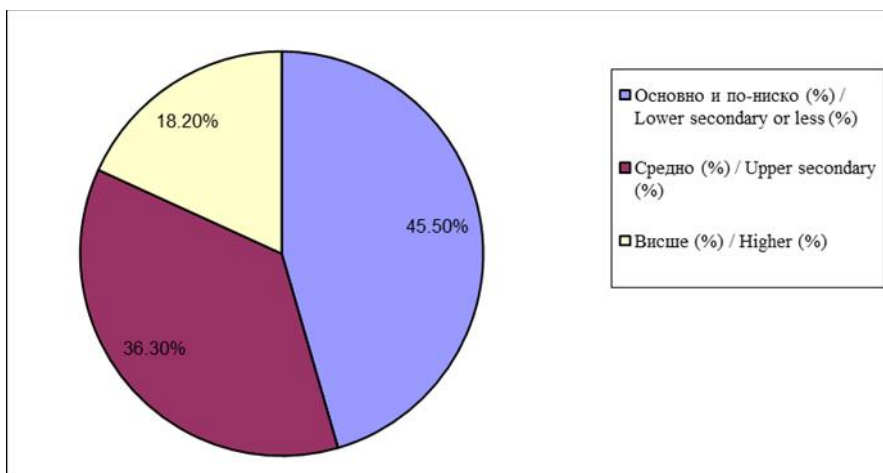
/ Source: Own calculations

( 1 2) ,  
 -  
 ) – 41%,  
 – 32%  
 – 27%.  
 -  
 15 64 .  
 ( 1), 95.5%  
 65  
 4.5% .  
 77.3% .  
 22.7% .  
 (45.5%); 1/3  
 (36.3%) -  
 31.8%,  
 - 4.5%; -  
 18.2% ( 3).  
 18.2% .  
 .

• **Total for the employed persons**

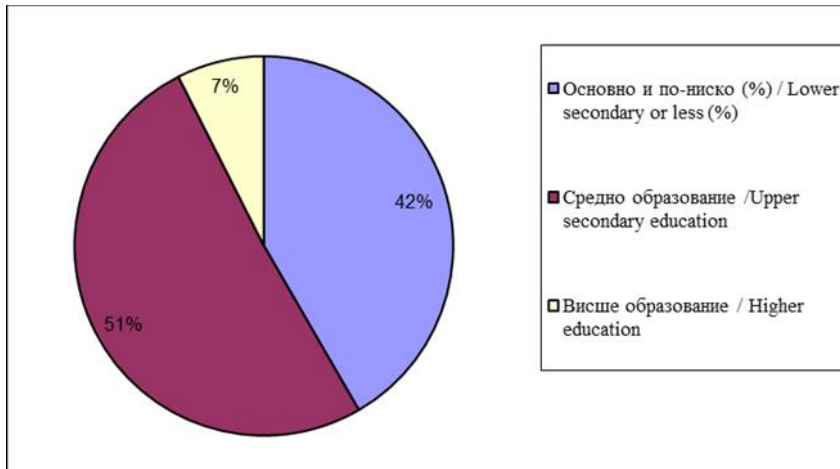
As a result of the study (Figures 1 and 2) it was found that from the employed persons in dairy sheep breeding farms the largest share occupied the employed on an employment contract (manager and shepherds) – 41%, followed by the group of owners – 32% and unpaid family workers – 27%.

The employed persons are relatively evenly distributed by age categories from 15 to 64 years of age (Table 1), where 95.5% of the persons fall. In the age group from 65 or above, only 4.5% of the persons are included. 77.3% of the employed persons are men and the rest of 22.7% are women. Almost half of the employed have lower secondary or less education (45.5%); a little over 1/3 (36.3%) have upper secondary education, whereas those with secondary education without an acquired qualification are 31.8% and those with secondary vocational education are 4.5%; the share of university graduates is 18.2% (Figure 3). Only 18.2% of the employed had attended vocational training courses.



**Fig. 3. Educational structure of employed persons in dairy sheep breeding farms**

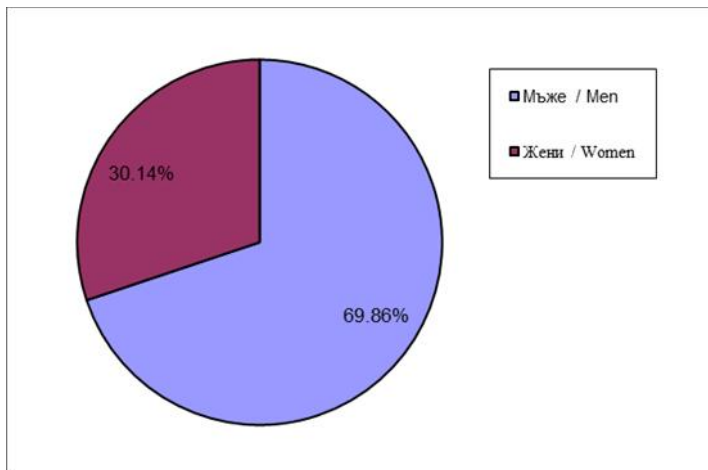
/ Source: Own calculations



4. " 2017 .

**Fig. 4. Educational structure of employed persons in Agriculture, hunting, forestry and fishery for 2017**

: (www.nsi.bg) / Source: NSI (www.nsi.bg)



5. " 2017 .

**Fig. 5. Gender structure of employed persons in Agriculture, hunting, forestry and fishery for 2017**

: (www.nsi.bg) / Source: NSI (www.nsi.bg)

(www.nsi.bg)

2017 . ( 4)

When comparing the results with the data from national statistics (www.nsi.bg) for the number of employed persons in the sector "Agriculture, hunting, forestry and fishery" with the corresponding education for 2017 (Figure 4) it was found that the percentage of the

- employed persons with lower secondary or less education is similar to the results obtained from us, the persons with upper secondary education according to statistical data are 51%, while in the studied dairy sheep farms the indicator is 36.3%. The percentages of persons with higher education differed substantially – according to the data from the national statistics for the sector "Agriculture, hunting, forestry and fisheries", 7% of the persons are with higher education, while we have established 18.2% for the studied dairy sheep farms.

According to national statistics, 30.14% of the employed persons in the sector "Agriculture, hunting, forestry and fishery" for 2017 are women and 69.86% are men (Figure 5), which is relatively close to our results from the studied dairy sheep breeding farms.

**• Owners (Employers and self-employed)**

Men predominate in the group of owners (85.7%). The largest share is held by owners aged from 35 to 44 (42.8%), followed by those aged 25-34 (28.6%). Owners between 45 and 54 and between 55 and 64 occupy equal shares (14.3%). None of the owners is aged 65 or above. 57.1% have upper secondary education, of which 1 person has secondary vocational education in agrarian economy. 42.9% of the owners have higher education. Of those with higher education 1 is a veterinarian and 1 is an ecologist. Almost half of the owners have attended vocational training courses (42.9%). The courses attended concern animal welfare and farmer's profession (150 hours and 30 hours).

**• Hired manager**

Only in one of the farms a manager under an employment contract was assigned, who was a man with higher education and fall into the 55-64 age group.

- employed persons with lower secondary or less education is similar to the results obtained from us, the persons with upper secondary education according to statistical data are 51%, while in the studied dairy sheep farms the indicator is 36.3%. The percentages of persons with higher education differed substantially – according to the data from the national statistics for the sector "Agriculture, hunting, forestry and fisheries", 7% of the persons are with higher education, while we have established 18.2% for the studied dairy sheep farms.

- According to national statistics, 30.14% of the employed persons in the sector "Agriculture, hunting, forestry and fishery" for 2017 are women and 69.86% are men (Figure 5), which is relatively close to our results from the studied dairy sheep breeding farms.

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- Owners between 45 and 54 and between 55 and 64 occupy equal shares (14.3%). None of the owners is aged 65 or above. 57.1% have upper secondary education, of which 1 person has secondary vocational education in agrarian economy.

- 42.9% of the owners have higher education. Of those with higher education 1 is a veterinarian and 1 is an ecologist. Almost half of the owners have attended vocational training courses (42.9%).

- The courses attended concern animal welfare and farmer's profession (150 hours and 30 hours).

**• Hired manager**

- Only in one of the farms a manager under an employment contract was assigned, who was a man with higher education and fall into the 55-64 age group.

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 50%  
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 1-2  
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 45 65  
 ( )  
 ( ) – 41%,  
 32%  
 27%.  
 15 64  
 95.5%  
 77.3% 22.7%  
 1/3  
 18.2%

• **Shepherds**

Shepherds were relatively evenly distributed in the age groups from 15 to 64 years, there was no person aged 65 or above. Men in this category were 7 times more than women. 7 times more were the shepherds with lower secondary or less education compared to the shepherds with upper secondary education. Only 1 shepherd had attended a vocational training course in livestock breeding (150 hours course).

• **Unpaid family workers**

In this category, 50% of the individuals were aged 15 to 24. They were actually children of owners, who helped their parents in farm activities when they were not in school, usually 1-2 hours a day. Because children had not finished school, they fall into the group of people with lower secondary or less education. The remaining 50% of the unpaid family workers were parents of owners, who have upper secondary education and fall into the age groups from 45 to 65 or above. They were also employed in farm activities within a few hours a day or in campaign periods (lambing campaigns, harvesting).

**CONCLUSIONS**

As a result of the study, it was found that from the employed persons the largest share occupied those on an employment contract (manager and shepherds) – 41%, followed by owners – 32% and unpaid family workers – 27%. The employed persons are relatively evenly distributed by age categories from 15 to 64 years of age, where 95.5% of the persons fall. The share of men was 77.3% and that of women – 22.7%. Almost half of the persons had lower secondary or less education; a little over 1/3 had upper secondary education; persons with higher education were 18.2%. Only 18.2% of the employed persons had attended vocational training courses.



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