

Interreg - IPA CBC



Greece - Republic of North Macedonia

PAPESHE

Deliverable 3.2.1 Production characteristics of Pelagonia sheep in the cross-border area farms

Project acronym: **PAPESHE**

Project full name: **Protection of Autochthonous populations of PELagonia SHEep breed in the cross-border area**

Start date of project: **30 July 2018**

Duration of project: **32 months**

Project website: <http://papeshe.vet.auth.gr/>

Giannitsa, 2021



Key information

Authors of this Report	Basiliki kotsampasi, <i>¹Research Institute of Animal Science (RIAS) / ELGO-DIMITRA</i> <i>Correspondence: vkotsampasi.arig@nagref.gr</i>
Date	15/03/2020

Abstract

This report is the Deliverable 3.2.1 drafted by Research Institute of Animal Science (RIAS) of Hellenic Agricultural Organization-Dimitra. Its objective was to evaluate productive characteristics of Pelagonia sheep. Taking into account that RIAS keeps and manage the major flock of Pelagonia sheep, researchers of the Institute worked on the implementation of experiments to assess the production characteristics of Pelagonia ewes in the experimental/intensive system and also in the more extensive system in farms found in areas of Florina and Kozani prefectures, concerning milk yield. Moreover, the aim was to evaluate growth performance of Pelagonia growing lambs and the potential of rearing lambs up to heavier body weights for the disposal of heavier lamb carcasses. For this reason a cohort of Pelagonia ewes from RIAS flock were separated from the rest flock and reared under common practice of an intensive feeding system. Individual milk yield was recorded once at month from weaning up to dry period. Furthermore, a research in the specific area of Western Macedonia was firstly implemented in order to indentify flocks of Pelagonia sheep or flocks of sheep that their phenotypic characteristics are close to Pelagonia sheep. In the various areas of Florina and Kozani prefectures visited, Pelagonia sheep flocks were found in various villages of Florina prefecture and one flock in Siatista of Kozani prefecture. One of these flocks was selected for milk yield measurements and from the others all data and the appropriate information were recorded, concerning the rearing system used and the productive characteristics of the flocks. The second aim of this deliverable was to evaluate growing characteristics Pelagonia lambs up to high body weight for production of heavy carcass. For this reason 40 Pelagonia lambs were selected from weaning and were individual reared under *ad-libitum* feeding system based on concentrates, until slaughtered at different live body weights at 25kg, 35 and 45kg, in order to evaluate their performance concerning growth rate, feed intake and feed conversion. All the mentioned parameters were observed in Chios breed sheep, as reference dairy breed, and compared. Results of the two studies revealed that Pelagonia sheep breed presents satisfactory milk yield that in the low input systems has the potential to improve. The higher milk yield of Pelagonia ewes found in RIAS flock was the result of the systemic data record of the individual productive and reproductive traits of male and female animals, the genealogical data record and the evaluation of offspring progenies, so that to implement the appropriate selection program for the genetic improvement of the flock. In extensive or semi-extensive breeding systems the genetic potential of the breed, in terms of yields, is lower than that of the farm of the RIAS flock, however, but it is possible to be improved so as to increase the yields of the extensive Pelagonia flocks and consequently improve the income of the farms. Concerning growth characteristics of Pelagonia lambs at different live body weights up to 45kg, it is confirmed the characterization of this breed as a dual purpose breed, since it was revealed that Pelagonia lambs even of heavy body weight can use more efficiently their feed for meat production, relative to dairy breeds, thus they have lower nutritional requirements to reach a desirable BW with lower cost for production.

Table of Contents

1. Introduction.....	5
2. Aim of the deliverable.....	6
3. Productive characteristics of Pelagonia ewes of farms	7
3.1 Material and Methods	7
3.1.1 RIAS flock milk yield measurement	7
3.1.2 Data collection from farms located in Western Macedonia	8
3.2 Results.....	11
3.2.1 Productive data (milk yield) of the selected ewes of RIAS flock.....	11
3.2.2 Extensive systems data collection.....	17
3.3 Discussion	21
4. Productive characteristics of Pelagonia growing lambs.....	22
4.1. Materials and Methods	22
4.1.1 Experimental procedure.....	22
4.1.2 Lambs rations	25
4.2. Results.....	26
4.2.1 Productive characteristics of lambs up to 25 kg of body weight.....	26
4.2.2 Productive characteristics of lambs up to 35 kg of body weight.....	28
4.2.3 Productive characteristics of lambs up to 45 kg of body weight.....	30
4.2.4 Comparison between productive characteristics of Florina lambs from the age of 25kg up to 45 kg of body weight	31
4.3 Discussion	32
5. Conclusions.....	33
References	34

1. Introduction

In Greece, sheep and goat production represent an important economic, environmental and sociological section. On the average, the income of milk systems tends to be higher than meat systems thanks to a good market price. Sheep and goat production, being frequently the only possible enterprises in less favoured areas, are often fundamental to maintaining social activities and to keep the vegetation out of danger from fire. Greek sheep breeds are mainly farmed for their milk production, which is always combined with lamb meat production, while wool production is third in importance. Lambs are weaned and slaughtered at about 4–8 weeks of age, and so carcass weights are low (i.e., 6–10 kg) and the marketing period is relatively short. However, production of heavier carcasses with acceptable composition may introduce greater flexibility into farming systems, resulting in applicability to a wider market (Zygoyiannis et al., 1990, 1999).

Based on its productive characteristics, Pelagonia sheep breed can be characterized as a "dual purpose" breed, i.e. it presents satisfactory milk yield and high growth rates of growing lambs. Pelagonia breed, which used to be raised in the mountainous less favored areas of Pelagonia region (Greece-Western Macedonia), is now legally listed as endangered. The breed presents resistance to disease and low lamb mortality rates (Ploumi et al., 1997). The mature body weight (BW) of Pelagonia sheep was reported to be 82.5 kg for rams and 60 kg for ewes (Triantafillidis et al., 1998), and the average milk yield was the previous years about 113.5 ± 4.0 kg per lactation in the experimental flock of Pelagonia sheep at the Research Institute of Animal Science (RIAS) of ELGO-DIMITRA (ex NAGREF). While milk production is much lower than the world's best known Greek breed (i.e., Chios), it is similar to many other Mediterranean breeds (Boyazoglu, 1991).

Pelagonia is a sheep breed of low nutritional requirements that can be exploited in the best way the natural resources of mountainous and semi-mountainous areas and it can easily travel long distances to find feed. According to the data collected from the flock kept in the Agricultural Station of Kozani, during the period 1981-1991, the average milk yield increased from 83.16 ± 3.34 kg to 112.8 ± 2.27 kg. In the flock of the Research Institute of Animal Science of Giannitsa (RIAS/ELGO-DIMITRA), in a period of 19 years (1976-1994), the average milk yield increased from 60.9 ± 35.3 kg to 73.2 ± 26 kg. The low increase in milk production was due to the fact that during this period the interest of researchers focused on the crosses of the breed and not on its genetic improvement. In 1994, with the implementation of a Genetic Improvement program, on

the one hand, and with the implementation of a program to eradicate Maedi-Visna infection, on the other hand, there was an increase in the milk yield of adult ewes (> 2nd lactation period), from 73.2 ± 26 kg to 89.9 ± 40.8 kg of milk. Data collected at the productive year 2000-2001 raised the average milk production of the flock to 137.4 ± 32.4 kg. During this period the highest individual yield observed in the flock was 242 kg in 180 days.

Based on the above past data concerning milk production of Pelagonia sheep breed, it is obvious that there has been a significant improvement in animal performance, which highlights the potential of this breed to increase its milk production capacity.

2. Aim of the deliverable

The aim of the deliverable involves the assessment of the production characteristics of Pelagonia ewes in the experimental/intensive system and also in the more extensive system in farms found in areas of Florina and Kozani prefectures, concerning milk yield and feeding requirements. Moreover, the aim was to evaluate growth performance of Pelagonia growing lambs and the potential of rearing lambs up to heavier body weights for the disposal of heavier lamb carcasses.

3. Productive characteristics of Pelagonia ewes of farms in the cross-border area

3.1 Material and Methods

Two different approaches were followed in order to evaluate the production characteristics of Pelagonia ewes concerning mainly milk yield and to clarify the ability of this breed to respond genetically with higher milk yield rearing under an intensive system.

3.1.1 RIAS flock milk yield measurement

The first approach concerned the evaluation of productive performance of Pelagonia ewes in the intensive system (indoor feeding throughout the year) followed in the Research Institute of Animal Science (RIAS) of Hellenic Agricultural Organization – DEMETER. More particular in RIAS Pelagonia sheep flock is rearing under the intensive system, according to which ewes are kept indoor and they don't graze at no time of the year. Their feeding is based on concentrate mixture, alfalfa hay and wheat straw. Most of feeds i.e corn grain, wheat and barley grains, alfalfa hay and wheat straw are cultivated and produced in the area that owns to the Institute. Protein feeds (soyabean meal and sunflower meal), vitamins and inorganic premixes are bought.

Lambs are natural suckling until the age of 42-45 days of age. After lambs weaning, ewes are milked with an automated milking parlor, until dry period.

In order to evaluate individual milk production, a number of eighty Pelagonia ewes (n=80) were randomly selected from the cohort of animals and raised separately from the rest of the flock. From weaning until the dry period ewes were milked twice a day with the automated milking parlor (Figure 1). Once a month individual milk yield was recorded. Ewes were group fed and feed intake was daily recorded. Feed was provided twice a day, at the morning and at the evening.

In order to evaluate the productive performance of Pelagonia ewes under the particular intensive system, as well as the evolution of milk performance due to the genetic improvement program of the breed that is followed in the last years, milk yield data from the whole flock were collected from 2016 to 2020.

The same protocol was followed in 100 ewes of Chios breed, the highest milk yielding breed of native origin, as a reference milking purpose breed.



Figure 1. Individual milk measurement procedure of Pelagonia ewes. (personal files)

3.1.2 Data collection from farms located in Western Macedonia

The second approach was to evaluate and study the productive characteristics of Pelagonia ewes that are rearing under the extensive or semi-intensive systems in the cross border area of Pelagonia region, in Greece. In this case, a research in the specific area of Western Macedonia was firstly implemented in order to indentify flocks of Pelagonia sheep or flocks of sheep that their phenotypic characteristics are close to Pelagonia sheep. In the various areas of Florina prefecture, close to the cross-border are and Kozani visited, Pelagonia sheep flocks were found in Keli, Variko, Vevi and Papagiannis villages of Florina prefecture and one flock in Siatista of Kozani prefecture. One of these flocks was selected for milk yield measurements and from the others all data and appropriate information were recorded, concerning the rearing system used and the productive characteristics of the flocks (Figure 2a&b).



Figure 2a. Data collection from Pelagonia farms in Western Macedonia.
(personal files)



Figure 2b. Measurement of Pelagonia ewes milk yield in selected farm. (personal files)

3.2 Results

3.2.1 Productive data (milk yield) of the selected ewes of RIAS flock

The following figure (figure 3) represents the lactation curve of ewes of Pelagonia breed kept in group, after weaning until the dry period (n=80).

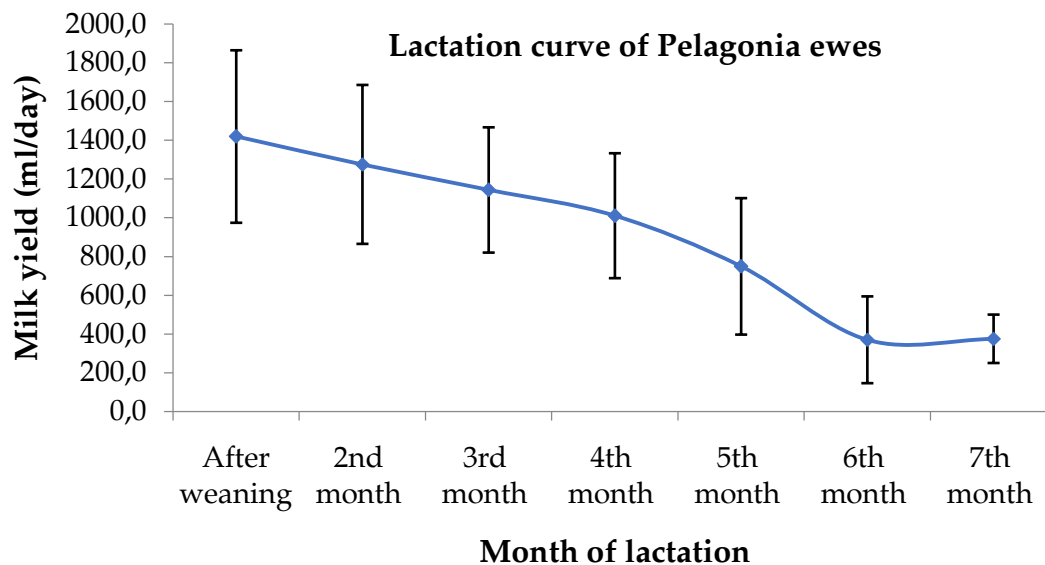


Figure 3. Lactation curve of selected RIAS Pelagonia ewes kept in group (n=80)

As it is shown in figure 3, the mean individual daily milk production of Pelagonia ewes at weaning (start of milking) was 1419.74 ± 445.28 ml/day that was progressively reduced until dry period to 375.41 ± 124.95 ml/day (7th month of lactation). The highest individual milk yield that was recorded was 2560 ml at weaning, whereas the lowest was 100 ml the last month of lactation.

The next figure (figure 4) represents the lactation curve of ewes of Chios breed kept in group, after weaning until the dry period (n=100).

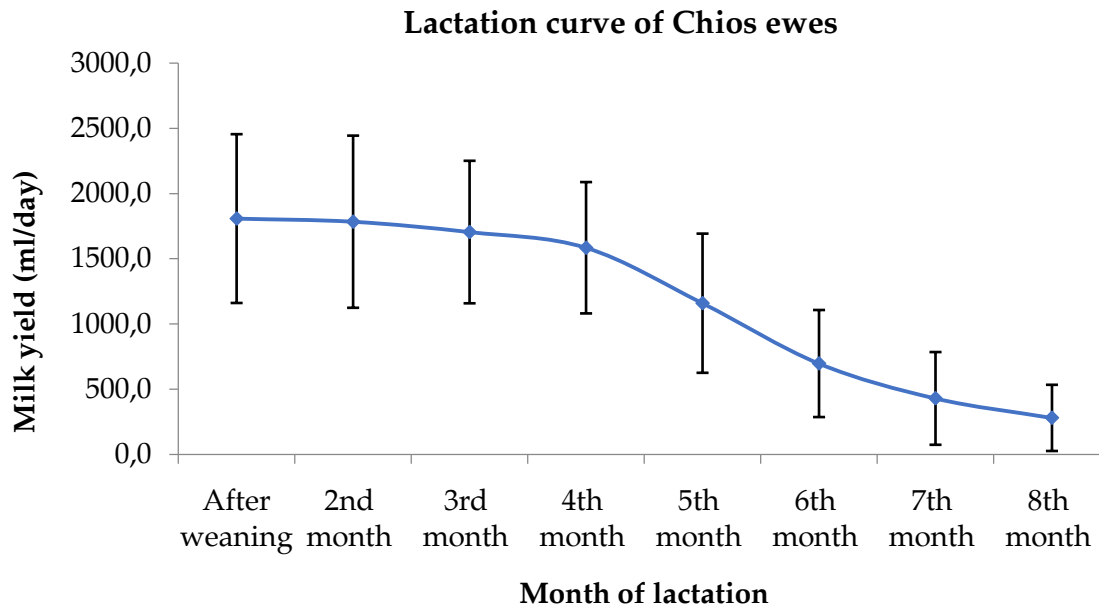


Figure 4. Lactation curve of selected RIAS Chios ewes kept in group (n=100)

The mean individual daily milk production of Chios ewes (Figure 4) at weaning (start of milking) was 1808.88 ± 646.78 ml/day that was progressively reduced until dry period to 281.36 ± 253.66 ml/day (8th month of lactation). The highest individual milk yield that was recorded was 2900 ml at weaning, whereas the lowest was 150 ml the last month of lactation. In contrast to Pelagonia ewes, mean daily milk yield was kept high the first 3 months of lactation and was progressively reduced thereafter, until dry period (8th month of lactation).

In the following table (Table 1), it is represented the mean real milk yield, the mean milk yield at 180 days, the mean marketable milk yield, as well as the mean days of lactation of Pelagonia and Chios ewes reared separately from the flock, throughout the lactation period. In table 2, it is represented the lactation yield of Pelagonia and Chios breed according to lactation period.

Table 1. Mean real and marketable milk yield, mean milk production at 180 days and mean days of lactation of selected Pelagonia and Chios ewes, throughout the lactation period.

Breed	Milk yield (ml)	
Pelagonia (n=80)	Real milk yield ¹	204.09±51.75
	Milk yield at 180 days	172.60±41.08
	Marketable milk yield ²	148.39±41.68
	Days of lactation	213.06±20.39
Chios (n=100)	Real milk yield ¹	325.84±76.29
	Milk yield at 180 days	259.69±50.10
	Marketable milk yield ²	243.67±62.56
	Days of lactation	225.72±26.13

¹Mean milk yield including suckling period

²Mean milk yield not included suckling period

Productive data (milk yield) from the whole RIAS flock

In order to evaluate the productive performance of Pelagonia ewes under the particular intensive system, as well as the evolution of milk performance due to the genetic improvement program of the breed that is followed in the last years, milk yield data from the whole flock were collected from 2017 to 2020 (table 2). As reference, Chios breed data were also collected the same years (table 3).

Table 2 represents productive performance of Pelagonia ewes from 2017 to 2020, as well as the evolution of the productive performance due to the genetic improvement program that is followed.

Table 2. Evolution of mean real and marketable milk yield, mean milk production at 180 days and mean days of lactation of Pelagonia ewes from productive year 2017 to 2020 (whole flock).

Productive Year	Milk Yield (ml)	
2017-2018	Real milk yield ¹	206.63±58.83
	Milk yield at 180 days	155.18±45.70
	Marketable milk yield ²	147.01±47.63
	Days of lactation	208.84±27.11
	Max individual milk yield ¹	325.74
2018-2019	Real milk yield ¹	200.70±74.90
	Milk yield at 180 days	156.29±55.76
	Marketable milk yield ²	144.64±61.26
	Days of lactation	194.41±26.85
	Max individual milk yield	424.40
2019-2020	Real milk yield ¹	235.35±58.70
	Milk yield at 180 days	163.97±46.99
	Marketable milk yield ²	172.29±48.99
	Days of lactation	205.55±16.19
	Max individual milk yield	438.46

¹Mean milk yield including suckling period

²Mean milk yield not included suckling period

As shown in table 2, milk yield of RIAS Pelagonia ewes was increased from year to year. This fact was mainly due to the implementation of controlled mating and the fact that low-yielding ewes were removed from the flock and those of high yields were kept for further breeding.

In particular in this flock:

- individual record of the qualitative and quantitative traits of ewes,
- genealogical data record,
- evaluation of progenies of offspring and
- controlled mating

are implemented for the purpose of the genetic improvement of the flock. Moreover, in recent years, an animal control program has been implemented to create a nucleus of the breed resistant to Maedi-Visna disease, from which stakeholders will be able to obtain high-yielding, disease-resistant Pelagonia sheep.

Table 3 represents the evolution of Chios breed, a dairy sheep breed. As in the case of Pelagonia breed, genetic selection according to milk yield and controlled mating resulted in improvement of milk yield of this breed, too.

Table 3. Mean real and marketable milk yield, mean milk production at 180 days and mean days of lactation of Chios ewes at productive years 2017 to 2020.

Productive Year	Milk Yield (ml)	
2017-2018	Real milk yield ¹	260.62±87.85
	Milk yield at 180 days	219.10±77.89
	Marketable milk yield ²	181.07±63.76
	Days of lactation	174.25±13.62
	Max individual milk yield	549.58
2018-2019	Real milk yield ¹	314.51±91.62
	Milk yield at 180 days	250.90±69.56
	Marketable milk yield ²	237.87±59.96
	Days of lactation	208.48±21.47
	Max individual milk yield	565.50
2019-2020	Real milk yield ¹	304.35±80.35
	Milk yield at 180 days	284.61±73.56
	Marketable milk yield ²	252.35±66.77
	Days of lactation	196.71±13.53
	Max individual milk yield	466.71

¹Mean milk yield including suckling period

²Mean milk yield no included suckling period

In the following table (table 4) milk yield of both Pelagonia and Chios ewes is represented, relative to lactation period.

Table 4. Mean real yield relative to lactation period of Pelagonia and Chios ewes of

Breed	Milk yield (ml) ¹	
Pelagonia	1 st lactation period	177.84±56.73
	2 nd lactation period	221.83±50.24
	3 rd lactation period	202.07±62.23
	4 th lactation period	215.23±47.47
	5 th lactation period	214.02±49.95
	6 th lactation period	218.53±63.19
Chios	1 st lactation period	259.54±78.98
	2 nd lactation period	289.35±84.78
	3 rd lactation period	259.55±92.09
	4 th lactation period	260.14±90.34
	5 th lactation period	232.52±89.91
	6 th lactation period	204.92±55.24
	7 th lactation period	230.61±97.86
	8 th lactation period	336.69±3.74

¹Mean milk yield including suckling period

3.2.2 Extensive systems data collection

Pelagonia farm selected for ewes milk yield measured

After weaning of the lambs at 50 days old, a group of ewes were randomly selected (n=20) from the whole flock (200 dairy ewes) and individual milk yield was recorded with the use of a chemistry bar cylinder of 500 ml. Three measurements were taken at the start the middle and the end of milking period. Ewes were hand milked. Milk yield was measured after weaning, the 3rd, 5th and 6th month of lactation.

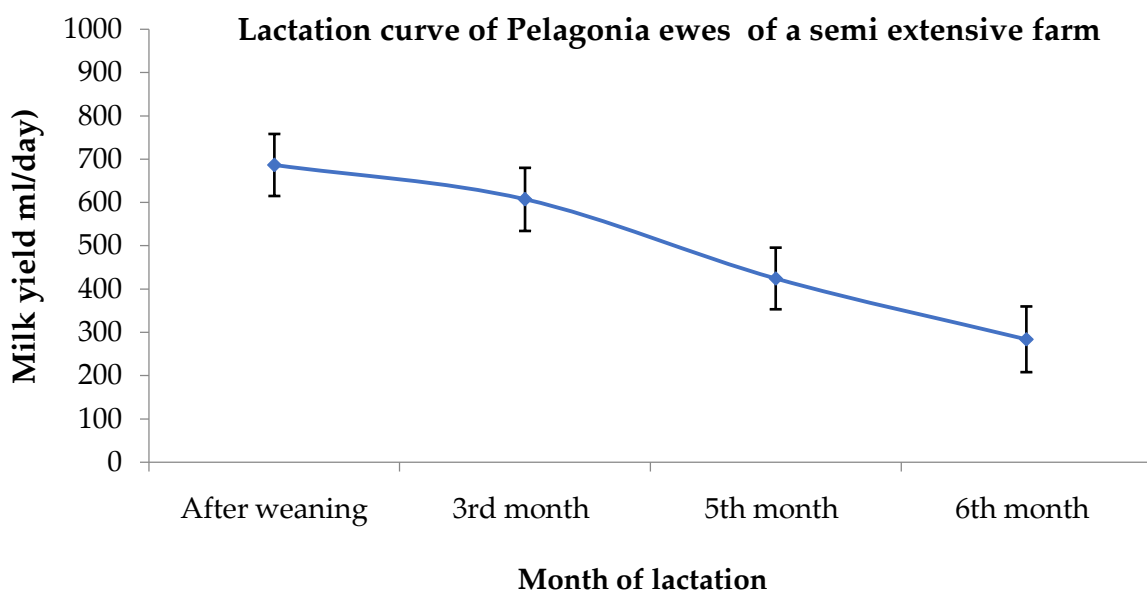


Figure 5. Lactation curve of Pelagonia ewes of selected farm under semi extensive rearing system

As shown in figure 5 individual milk yield was progressively decreased from weaning to sixth month after weaning. The mean individual daily milk production of Pelagonia ewes at weaning (start of milking) was 752.63±71.64 ml/day that was progressively reduced until dry period to 284.21±60.58 ml/day. The highest individual milk yield that was recorded was 950 ml at weaning, whereas the lowest was 200 ml the last month of lactation.

The following tables (Tables 5a, 5b and 5c) summarize, the data concerning management practices, according to the survey carried out from the sheep farms of Pelagonia breed found in Florina and Kozani prefectures.

Table 5a. Data and description of the main management practices of Pelagonia flocks found in the area of Florina and Kozani prefectures.

	Farm 1	Farm 2	Farm 3
System	Semi-extensive	Semi-extensive	Semi-extensive
Number of ewes	200	187	150
Number of rams	13	13	15
Milk yield	110kg	130kg	135kg
Way of milking	By hand	By hand	Milking parlour
Mating	Random	Random	Random
Period of mating	Meat of August	August	August
Period of parturition	January to March	December to March	December to March
Twinning	1.4	1.2	1.2
Age of lambs at weaning, for slaughter	50 days old	50-55 days old	50 days old
Body weight at weaning for slaughter	14kg	17kg	14-15kg
Body weight at weaning of female for replacement	24kg	22-23kg	
Grazing	yes	yes	yes
Kind of pastures	Natural pastures and cultivated oat, zea, pea	Natural pastures and cultivated oat, vetch	Natural pastures, and cultivated mixes cereals and legumes
Grazing period	All the year except period of parturition		March to December
Self production of feeds	Yes (alfalfa)	yes (alfalfa barley grain, wheat grain, corn grain)	Yes (rye, barley grain, wheat grain, corn grain, sunflower)
Supplementary bought feeds	Yes (soyameal, barley grain, corn grain, mineral and vitamin premixes)	Yes (soyameal, mineral and vitamin premixes)	Yes (soyameal, mineral and vitamin premixes)
Infrastructures	Basic	Basic	Basic

Table 5b. Data and description of the main management practices of Pelagonia flocks found in the area of Florina and Kozani prefectures.

	Farm 4	Farm 5	Farm 6
System	Semi-extensive	Semi-extensive	Semi-extensive
Number of ewes	200	109	110
Number of rams	15	7	10
Milk yield	130kg	130kg	135kg
Way of milking	By hand	By hand	Milking parlour
Mating	Random	Random	Random
Period of mating	Late July	August	August
Period of parturition	December to January	December to March	December to March
Twinning	1.5	1.2	1.2
Age of lambs at weaning, for slaughter	60 days old	50-55 days	50 days old
Body weight at weaning for slaughter	15kg	17kg	14-15kg
Body weight at weaning of female for replacement		22-23kg	
Grazing	yes	yes	yes
Kind of pastures	Natural pastures	Oat, vetch, alfalfa, natural pastures	Natural pastures, and cultivated mixes of cereals and legumes
Grazing period	All the year except period of parturition		March to December
Self production of feeds	Yes (rye, oat, barley grain,, corn grain)		Yes (rye, barley grain, wheat grain, corn grain, sunflower)
Supplementary bought feeds		Yes (soyameal, barley grain, wheat grain, corn grain, mineral and vitamin premixes)	Yes (soyameal, mineral and vitamin premixes)
Infrastructures	Basic	Basic	More infrastructures

Table 5c. Data and description of the main management practices of Pelagonia flocks found in the area of Florina and Kozani prefectures.

	Farm 7	Farm 8
System	Semi-extensive	Semi-extensive
Number of ewes	59	75
Number of rams	5	6
Mean milk yield	140 kg	135kg
Way of milking	Milking parlour	By hand
Mating	Random	Random
Period of mating	August	August
Period of parturition	December to January	December to March
Twinning	1.2	1.2
Age of lambs at weaning, for slaughter	45 days old	50-55 days old
Body weight at weaning for slaughter	14kg	15kg
Body weight at weaning of female for replacement		22-25kg
Grazing	yes	yes
Kind of pastures	Natural pastures	Natural pastures and cultivated oat, vetch
Grazing period		
Self production of feeds	yes (alfalfa barley grain, wheat grain, corn grain)	yes (alfalfa barley grain, wheat grain, corn grain)
Supplementary bought feeds	Yes (soyameal, mineral and vitamin premixes)	Yes (soyameal, mineral and vitamin premixes)
Infrastructures	More infrastructures	Basic

The rearing system followed in all Pelagonia farms is the semi-extensive. Four from the eight farms have more than 150 lactating ewes, two farms have 100 to 150 ewes and two farms less than 100 ewes. According to the data collected, the mean individual marketable milk yield of all Pelagonia sheep farms ranges from 110kg to 145kg, relative lower to RIAS flock that ranged the last three years from 147.01 ± 47.63 kg to 172.29 ± 48.99 kg. From the eight farms visited only in the three ewes are milked in a parlor and in the rest by hand. Lambs destined for slaughter are weaned around 45 to 55 days of age, at 14-17kg of body weight. The production system is based on grazing,

either of the land around the farm, either rangelands or cultivated lands, either of the community pastures. Furthermore, according to the available fodder of the pastures and the productive stage of the animals and the season, supplementary feeds are given to cover nutritional requirements of animals. Most farmers are cultivated some of the required feeds i.e. corn, barley, wheat grains, oat, rye and alfalfa and most of them buy protein feeds like soyameal and vitamin and mineral premixes.

3.3 Discussion

The present results, obtained from the intensive rearing system followed in RIAS farm and the semi-extensive farms found in Florina and Kozani prefectures, revealed that Pelagonia sheep breed presents satisfactory milk yield that in the low input systems has the potential to improve. The higher milk yield of Pelagonia ewes in RIAS flock was the result of the systemic data record, the last years, of the individual productive and reproductive traits of male and female animals, the genealogical data record and the control of progenies of offspring, so that to implement controlled matings for flock genetic improvement.

In extensive or semi-extensive breeding systems, due to lack of suitable infrastructure, lack of controlled animal performance, non-record of genealogical data, as well as lack of designed mating, the genetic potential of the breed, in terms of yields, is lower than that of the farms of the RIAS flock and ranges around 130kg of milk per ewe per lactation period. However, with the availability of medium and high-yield animals and with a rational and programmed system of breeding, it is possible to improve the genetic potential of these farms and increase their yields, even under an extensive rearing system so as to improve their farm income.

4. Productive characteristics of Pelagonia growing lambs

4.1. Materials and Methods

4.1.1 Experimental procedure

For the purpose of the project, weaned male lambs of Pelagonia breed were used in an experiment conducted at the Research Institute of Animal Science (RIAS) of Hellenic Agricultural Organization-DEMETER, in Giannitsa, Greece. All animals used in the experiment were cared for according to applicable recommendations of the European Union (2010).

For the evaluation of the performance of Pelagonia lambs, 45 Pelagonia male lambs (Fig. 1a & 1b) were selected from the flock, according to their birth date and twinning. Lambs were weighted at birth and at weaning (42 days of age), after individual weighing, grouped accommodated into four pens. Pens were identical, with the same orientation and surface area (2m²/lamb). The pens were equipped with troughs for feeding grain concentrates, hay and water. During the experiment, all lambs were offered two types (i.e., 'starter' and 'finisher') of a concentrate mixture *ad libitum* (Table 1), and alfalfa hay, according to applicable nutrient requirements of sheep (NRC, 1985). The starter concentrate was offered to lambs from day 42 of age, up to the age that reach 30% of their mature body weight (BW), approximately at 24.75 kg and the finisher concentrate from 30% of the mature BW up to slaughter at different weights (25kg, 35kg and 45 kg) (Table 1). Mature BW has been determined to be 82.5 for males according to the findings of [Triantafillidis et al. \(1998\)](#). The first group of lambs was slaughtered at weaning, approximately at 45 days of age (n=10 lambs), the second at 25 kg of BW (n=10 lambs), the third one at 35 kg of BW (n=10 lambs) and the last one at 45 kg of BW (n=15 lambs).

Feed was provided in each group once a day and feed residues were recorded before the next morning feeding. Each lamb was weighed at the start and end of the experiment, and at 15 day intervals, and BW gain was calculated. When lambs approached their target BW for slaughter (25kg, 35kg and 45 kg), they were weighed daily. Feed intake was measured daily, and dry matter (DM) intake and feed conversion ratio (FCR) were calculated.



Figure 6. Florinas' male lambs during fattening period. (personal files)



Figure 7. Florinas' male lambs body weight measurement. (personal files)

4.1.2 Lambs rations

From weaning and up to the age that lambs reached 30% of their mature body weight (approximately 24.75 kg), they were offered starter concentrate mixture and alfalfa hay *ad libitum*, while from 30% of their mature BW age until slaughter (35 kg and 45 kg), were consumed *ad libitum* the finisher concentrate and alfalfa hay, as shown in Table 6.

Table 6. Concentrate composition of growing lambs' rations.

Ingredients composition (kg/t, as mixed)	Starter concentrate	Finisher concentrate
Corn grain, ground	453	188
Wheat grain, ground	120	280
Barley grain, ground	110	270
Soybean meal (483 g CP/kg DM)	137	120
Sunflower	80	90
Skimmed powder milk	50	-
Limestone	12	10
Monocalcium phosphate	8	14
Salt	5	3
Vitamin-trace mineral premix	25	25

4.2. Results

4.2.1 Productive characteristics of lambs up to 25 kg of body weight

Growing lambs' body weight (BW) curve, from the start of the experiment (birth) up to the age they reached 25 kg of BW, is presented in Figure 8.

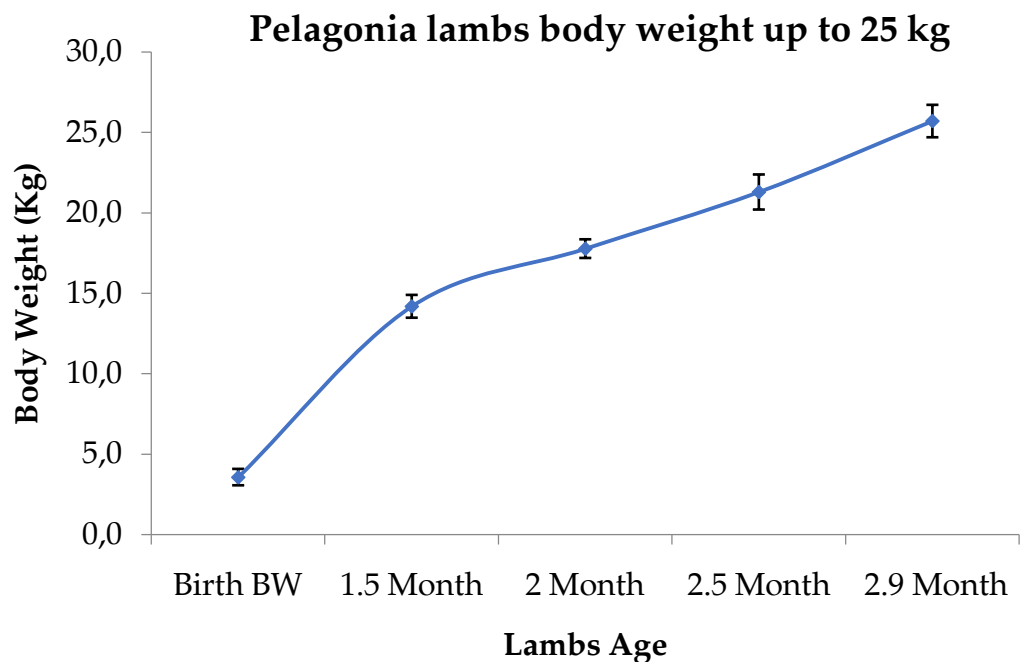


Figure 8. Pelagonia male lambs body weight curve from birth up to 25 kg of BW

As shown in Table 2, mean birth BW and BW at weaning of Pelagonia male lambs was 3.57 ± 0.162 kg and 14.19 ± 0.224 kg, respectively. Lambs represented a mean growth rate of 256 ± 6.000 g/day and they reached the body weight of approximately 25 kg (mean 25.7 ± 1.01 kg) at the age of 86.9 ± 1.865 days (2.90 months). Mean total dry matter intake (DMI) was 910 g/day (620g concentrate and 280 g alfalfa hay) and the mean feed conversion ratio (FCR) was found at 3.58 ± 0.081 . Feed cost for increase of 1kg of body weight was estimated at 0.95€.

Table 7. Mean body weight (BW), BW gain, feed intake, and feed conversion ratio (FCR) of growing Pelagonia and Chios male lambs up to 25 kg of body weight.

	Florina ^a	Chios	P-value
BW (kg)			
Birth body weight (kg)	3.57±0.162	4.30±0.119	0.002
Body weight at weaning (kg)	14.19±0.224	13.54±0.119	0.020
Slaughter body weight (kg)	25.70±1.01 ^b	25.20±0.899	
Growth rate (g/day)	256±6.000	230±4.710	0.004
Age when they reached the BW of 25 kg (days)	86.9±1.865	91.00±0.788	0.058
Mean Dry Matter intake (g/day)	910.0	1000.0	
Concentrate (g/day)	620.0	680	
Alfalfa (g/day)	280.0	320	
FCR (kg DM intake/kg BW gain)	3.58±0.081	4.36±0.073	<0.001
Mean Feed Cost (€/kg BW gain)	0.95	1.16	

^a Mean ± SE (standard error)

^b Mean ± SD (standard deviation)

As far as it concerns Chios lambs, although body weight at birth was higher relative to Pelagonia lambs (4.30±0.119 vs 3.57±0.162kg, P=0.002), they presented lower BW at weaning (P=0.020), lower growth rate (230±4.710g/day, P=0.004) and thus they reached the age of 25 kg later than Pelagonia lambs (91.00±0.788 vs 86.9±1.865 days, P=0.058). Moreover, their feed conversion ratio, the efficiency with which the lambs convert 1 kg of feed into 1 kg of meat, was also worst than Pelagonia lambs (4.36±0.073 vs 0.081, P<0.001). Moreover, estimated feed cost for increase of 1kg of body weight was estimated higher in Chios breed (1.16€) relative to Florina breed (0.95€).

4.2.2 Productive characteristics of lambs up to 35 kg of body weight

Growing lambs' body weight (BW) curve, from the start of the experiment (birth) up to the age when they reached 35 kg, is presented in Figure 9.

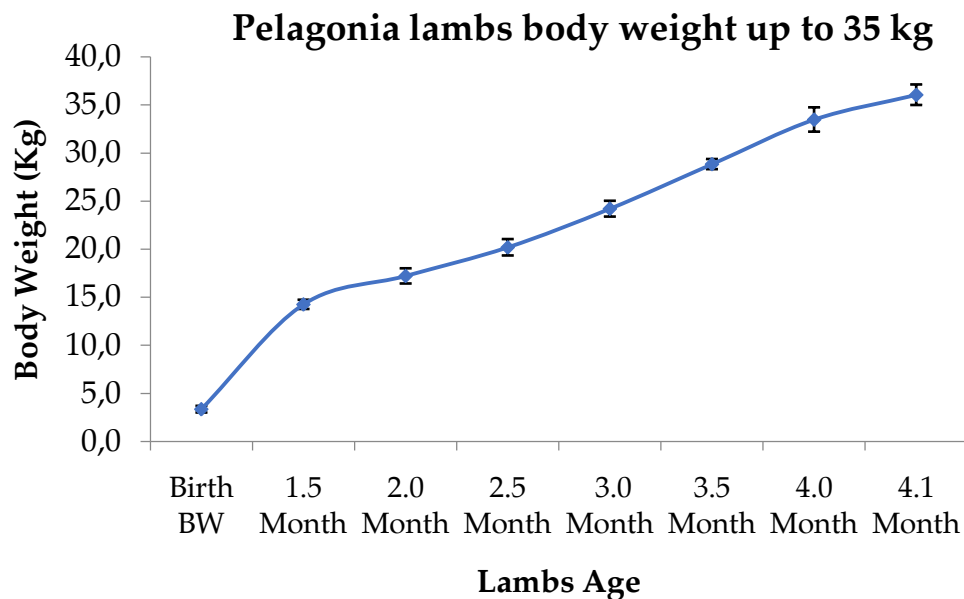


Figure 9. Pelagonia male lambs body weight curve from birth up to 35 kg of BW

As shown in Table 8, mean birth BW and BW at weaning of Pelagonia male lambs was 3.35 ± 0.125 kg and 15.95 ± 0.689 , respectively. They represented a mean growth rate of 268 ± 7.000 g/day and they reached the body weight of approximately 35 kg (mean 36.05 ± 1.07 kg) at the age of 122.3 ± 1.532 days (4.08 months). Mean total dry matter intake (DMI) was 1.070 g/day (750g concentrate and 320 g alfalfa hay) and the mean feed conversion ratio (FCR) was 4.01 ± 0.087 . Feed cost for increase of 1kg of body weight was estimated at 0.95€.

Table 8. Mean body weight (BW), BW gain, feed intake, and feed conversion ratio (FCR) of growing Pelagonia and Chios male lambs up to 35 kg of body weight.

Parameters studied	Florina ^a	Chios	P-value
BW (kg)			
Birth body weight (kg)	3.35±0.125	3.81±0.227	0.099
Body weight at weaning (kg)	14.95±0.689	13.47±0.227	0.004
Slaughter body weight (kg)	36.05±1.068 ^b	36.03±0.729	
Growth rate (g/day)	268±7.000	242±5.365	<0.001
Age when they reached the BW of 35 kg (days)	122.3±1.532	132.88±1.187	<0.001
Mean Dry Matter intake (g/day)	1070	1170	
Concentrate (g/day)	750.0	820.0	
Alfalfa (g/day)	320.0	360.0	
FCR (kg DM intake/kg BW gain)	4.01±0.087	4.83±0.055	<0.001
Mean Feed Cost (€/kg BW gain)	0.95	1.18	

^a Mean ± SE (standard error)

^b Mean ± SD (standard deviation)

Chios lambs reared up to 35 kg presented lower BW at weaning ($P=0.004$) and lower growth rate ($P<0.001$), relative to Pelagonia ones and they reached that body weight later than Pelagonia lambs ($P<0.001$). Moreover, their feed conversion ratio, was also worst than Pelagonia lambs ($P<0.001$) and feed cost for increase of 1kg of body weight was estimated higher (1.18€) relative to Florina breed (0.95€).

4.2.3 Productive characteristics of lambs up to 45 kg of body weight

Growing lambs' body weight (BW) evolution, from the start of the experiment (birth) up to the age of 45 kg of body weight, is presented in Figure 10.

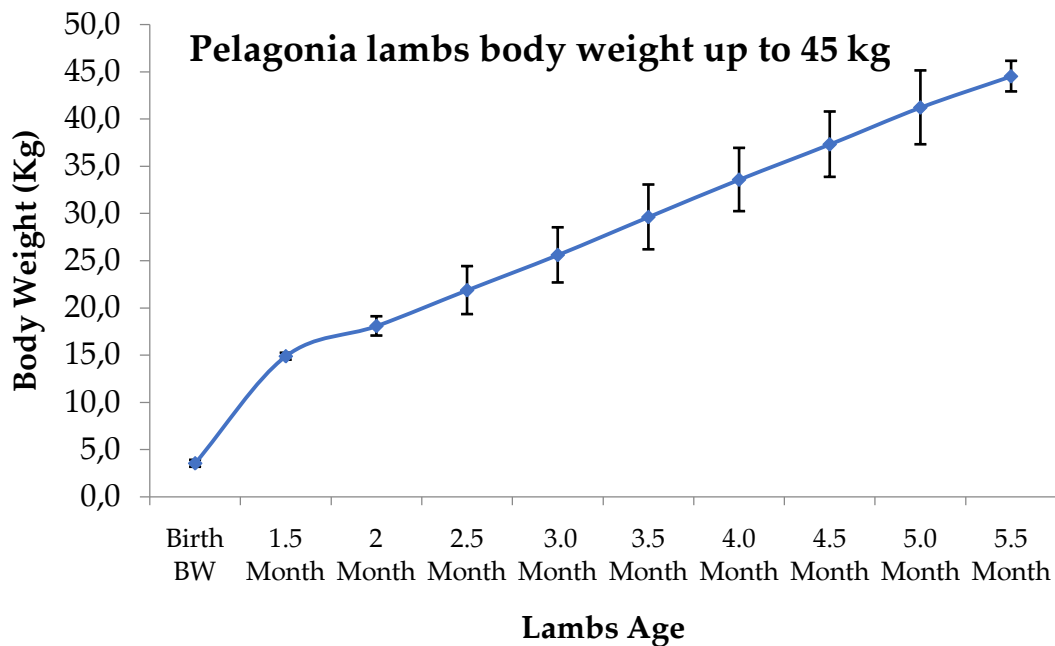


Figure 10. Pelagonia male lambs body weight curve from birth up to 45 kg of BW

As shown in Table 9, mean birth BW of Pelagonia male lambs was 3.53 ± 0.094 kg. Lambs represented a mean growth rate of 250.0 ± 4.98 g/day and they reached the body weight of approximately 45 kg (mean 44.53 ± 1.621 kg) at the age of 164.5 ± 2.566 days (5.48 months). Mean total dry matter intake (DMI) was 1.110 g/day (780g concentrate and 330 g alfalfa hay) and the mean feed conversion ratio (FCR) was 4.46 ± 0.089 . Feed cost for increase of 1kg of body weight was estimated at 1.08€.

Chios lambs that were reared until the body weight of 45 kg presented lower growth rate ($P=0.007$) and BW at weaning ($P<0.001$). Lambs reached that body weight later than Pelagonia lambs ($P=0.037$). The feed conversion ratio was worst than Pelagonia lambs (5.28 ± 0.080 vs 4.65 ± 0.089 , $P<0.001$) and the estimated feed cost for increase of 1kg of body weight was higher (1.44€) relative to Florina breed (1.08€).

Table 9. Mean body weight (BW), BW gain, feed intake, and feed conversion ratio (FCR) of growing Pelagonia and Chios male lambs up to 45 kg of body weight.

	Florina ^a	Chios	P-value
BW (kg)			
Birth body weight (kg)	3.53±0.094	4.35±0.104	<0.001
Body weight at weaning (kg)	14.87±0.094	14.11±0.131	<0.001
Slaughter body weight (kg)	44.53±1.621	44.15±1.270	
Growth rate (g/day)	250.0±4.98	232.0±3.68	0.007
Age when they reached the BW of 45 kg (days)	164.5±2.566	171.67±2.013	0.037
Mean Dry Matter intake (g/day)	1110	1223	
Concentrate (g/day)	780.0	861.0	
Alfalfa (g/day)	330.0	402.0	
FCR (kg DM intake/kg BW gain)	4.46±0.089	5.28±0.080	<0.001
Mean Feed Cost (€/kg BW gain)	1.07	1.44	

^a Mean ± SE (standard error)

^b Mean ± SD (standard deviation)

4.2.4 Comparison between productive characteristics of Florina lambs from the age of 25kg up to 45 kg of body weight

Table 10 presents the comparison on growth rate and feed conversion ratio (FCR) between different rearing ages of Pelagonia lambs up to 25kg, 35kg and 45kg of body weight.

Table 10. Comparison between growth rate and feed conversion ratio (FCR) of growing Pelagonia male lambs at different body weights up to 45 kg.

Body weight (kg)	25kg	35kg	45kg	P-value
Growth rate (g/day)	256±6.010	268±7.010	250.0±4.980	0.134
FCR (kg DM intake/kg BW gain)	3.58±0.081 ^a	4.01±0.087 ^b	4.46±0.089 ^c	<0.001

*Different superscripts denotes significant differences between mean values.

The comparison reveals that as the rearing age of Florinas lambs increases from 25kg to 45 kg, the mean growth rate decreases not significantly but the feed required to gain 1kg of weight (FCR) increases.

4.3 Discussion

Taking together all the above data concerning growth characteristics of Pelagonia lambs at different live body weights up to 45kg, it is confirmed the characterization of this breed as a dual purpose breed, since it was revealed that Pelagonia lambs even of heavy body weight can use more efficiently their feed for meat production, relative to dairy breeds, thus they have lower nutritional requirements to reach a desirable BW with lower cost for production. According to the results, Pelagonia lambs fed *ad libitum* alfalfa hay and concentrate have high growth rates similar to Triantafillidis et al. (1987). The same was the case for feed conversion ratio. Growth rate and feed conversion ratio up to targeted body weight of 35 kg were similar to that of Bampidis et al (2007), but up to 45kg of targeted body weight growth rate was lower and feed conversion ratio was higher. Relative to Chios lambs, Pelagonia lambs have higher growth rates, reach the targeted live body weight of 25kg, 35kg and 45kg earlier than Chios lambs and present better feed conversion ratio, which means that they have lower nutritional requirements for growth, utilize more efficient feed for meat production and therefore this breed could be used in a more economical breeding system for meat production, of lower inputs, as indicated by the lower estimated feed cost for the increase of body weight at 1kg.

Concerning high targeted body weights for production of heavy carcasses (i.e. 35kg and 45kg) growth rate was high but slightly decreased in 45kg and feed conversion ratio was slightly increased relative to that at 35kg of body weight.

5. Conclusions

Taking into consideration all the results of the present deliverable, it is concluded that Pelagonia sheep breed is a dual purpose indigenous breed, that combines satisfactory ewes milk yield and high growth rates of the growing lambs of low nutritional requirement. The higher milk yield in the intensive rearing system of RIAS relative to semi-extensive confirms the potential of the breed to improve its productive characteristics, if a rational and programmed breeding system is adopted by Pelagonia farmers, concerning systemic data recording, and selection programs for its genetic improvement. Simultaneously, the high performance of fattening lambs, even in high body weights for the production of heavy carcasses, might be proved to be more economically beneficial for the breeders and moreover, the increased meat produced locally might help cover the local needs of meat market.

Taken together all the above, it becomes obvious that Pelagonia sheep breed is particularly valuable for the area of its origin, where it could play an important role in milk and meat production. Its preservation could significantly contribute to increasing the income of sheep farming in the area, but also be a driving force to create multiplier beneficial effects for other sectors in the area. At the same time, the conservation and protection of Pelagonia sheep breed can significantly contribute to the conservation of biodiversity, contributing to the promotion of sustainable rural development and launching new views and situations concerning the environment of the wider region of Western Macedonia. However, all these could be achieved only if the proper and effective management of the animals, as well as the breeding system are adopted.

References

Boyazoglu, J.G. (1991). Milk breeds in sheep. In: Maijala, K. (Ed.), World Animal Science: Genetic Resources of Pig, Sheep and Goat, pp. 243–255.

Christodoulou, V., Bampidis, V.A., Sossidou, E., Ambrosiadis J. (2007). Evaluation of Florina (Pelagonia) sheep breed for growth and carcass traits. Small Ruminant Research, 70, (2–3), 239–247,

Ploumi, K., Christodoulou, V., Vainas, E., Giouzelyannis, A., Katanos, I. (1997). Performance analysis of the Florina (Pelagonia) sheep for lamb production and growth. ˇ Zivo ˇ ci ˇ sn ´ a V ´ yroba 42, 391–397.

Triantafillidis, D., Karalazos, A., Agoritsas, P. Katanos, I. (1987). The effects of percentage of dietary fibers on *ad libitum* feeding and animal performance of growing lambs. EZE, 6.

Triantafillidis, D., Ploumi, K., Christodoulou, V. (1998). The Florina (Pelagonia) sheep breed. In: Ploumi, K. (Ed.), Veterinary Research Institute (National Agricultural Research Foundation—N.AG.RE.F.) Handbook: Greek sheep breeds in N.AG.RE.F. (in Greek), Thessaloniki, Greece, pp. 39–46.

Zygoiannis, D., Katsaounis, N., Stamataris, C., Arsenos, G., Tsaras, L., Doney, J. (1999). The use of nutritional management after weaning for the production of heavier lamb carcasses from Greek dairy breeds. Livest. Prod. Sci. 57, 279–289.

Zygoiannis, D., Stamataris, C., Kouimtzi, S., Doney, J. (1990). Carcass composition in lambs of Greek dairy breeds of sheep. Anim. Prod. 50, 261–269.

PAPESHE is implemented in the framework of competitive bilateral INTERREG IPA Cross Border Cooperation Programme "Greece - Republic of North Macedonia 2014-2020". The project is co-funded by the European Union and by National Funds of the participating countries.

More information about the project

Papeshe.vet.auth.gr

<https://www.facebook.com/Papesheproject>