Growth rate and carcass evaluation of purebred and crossbred lambs from five greek sheep breeds (preliminary results)

Gabrilidis G.T.

Le croisement industriel ovin en Méditerranée

Paris : CIHEAM
Options Méditerranéennes : Série Etudes; n. 1981-III

1981
pages 67-75

Growth rate and carcass evaluation of purebred and crossbred lambs from five greek sheep breeds

(Preliminary results)

George T. Gabrilidis

Animal Husbandry

Institute Giannitsa

GREECE

ABSTRACT - RESUME

The preliminary results of a crossbreeding experiment undertaken from 1975 to 1980 by the use of five local breeds as female material and five local and four imported breeds as male lines are very encouraging. When compared to the purebred lambs, the average superiority of the two-breed crossbred lambs was 8.30 % for birth weight and 12.07 % for daily weight gain while it was respectively 21.50 % and 20.80 % for the four-breed crossbreds.

The crossbred carcasses were more acceptable to the butchers and consumers than these of the purebred lambs.

VITESSE DE CROISSANCE ET EVALUATION DE LA CARCASSE DES AGNEAUX DE RACE PURE ET CROISES ISSUS DE CINQ RACES OVINES GRECQUES
(Resultats preliminaires)

Les résultats préliminaires du croisement industriel (1975-1980) entre cinq races locales (races maternelles) et cinq races locales et quatre races spécialisées importées (races paternelles) a donné des résultats encourageants. La comparaison des croisées aux agneaux de race pure permet da constater une supériorité de 8,30 % pour le poids à la naissance et de 12,07 % pour le gain journalier des agneaux croisés d'un premier croisement et de 21,58 % et 20,80 % respectivement pour les agneaux issus d'un croisement à deux étapes.

Les carcasses d'agneaux croisés sont plus appréciées (plus de morceaux nobles) par les bouchers et les consommateurs que ceux d'agneaux de race pure.

1. INTRODUCTION

The purpose of our study was to evaluate the possibility of increasing meat production from the local sheep breeds. In order to obtain a better income, sheep breeders in Greece are now attempting, on the one hand a better utilisation of the local genetic material and on the other hand an optimal use of the available nutritional resources. Besides a rise in average milk yield per ewe, which is the result of

good selection efforts of recent years, they must also consider increasing the lambs' carcass weights by selection and crossbreeding to heavy local and foreign breeds.

In recent years, information concerning the growth potential and carcass qualities of a number of Greek breeds *(KARAGOUNIKO, VLAHIKO, CHIOS* and *SERRES),* some imported breeds *(EAST FRIESIAN, HUNGARIAN MERINO, SUFFOLK* and *ILE DE FRANCE)* and their crossbreds, was reported on by GEORGIOU (1960), DIMAKOPOULOS (1960), KATSAOUNIS (1968), TSONGAS (1971), PAPADOPOULOS et al. (1972) and ZERVAS et al. (1977).

Five local breeds *(VLAHIKO:* Ve; *KARAGOUNIKO:* Kar; *THRAKI:* Th; *FLORINA:* Fl; *ROUMLOUKION:* R) were used as basic female material while five local breeds *(KARAGOUNIKO, FLORINA, ROUMLOUKION, SERRES:* Ser; *CHIOS:* Ch); and four imported breeds *(EAST FRIESIAN:* EF; *HUNGARIAN MERINO:* HM; *ILE DE FRANCE:* IdF; *BERRICHON DU CHER:* BdC) were used as basic male lines in a series of crossbreeding experiments undertaken from 1974 to 1980 at the Giannitsa Animal Husbandry Institute.

2. MATERIAL AND METHODS

The work was undertaken during three successive

Table 1

GRAIN MIXTURES FED TO THREE CLASSES OF EXPERIMENTAL ANIMALS

MELANGES DONNES AUX TROIS CLASSES D'ANIMAUX EXPERIMENTALES

Ingrédients	Suckling lambs 1	Growing lambs 2	Mature animals 3
Maize ..... *Maïs*	35,0	46,0	25,0
Wheat ..... *Blé*	12,0	—	20,0
Barley ..... *Orge*	28,0	20,0	16,0
Wheat bran ..... *Son de blé*	8,0	10,0	—
Soyabean oil meal ..... *Tourteaux de soja*	12,0	—	—
Alfalfa meal ..... *Luzerne*	2,5	10,0	—
Cottonseed meal ..... *Graines de coton*	—	10,0	12,5
Sugar beet, dried ..... *Betteraves sêches*	—	—	25,0
Salt ..... *Sel*	1,5	—	0,5
Calcium carbonate. ..... *Carbonate de calcium*	0,5	—	—
Dicalcium phosphate ..... *Bicalcium phosphate*	0,5	—	1,0
Mineral mixture ..... *Mélange de minéraux*	—	4,0	—
TOTAL	100,0	100,0	100,0

1 = *AGNEAUX EN ALLAITEMENT.*

2 = *AGNEAUX A L'ENGRAISSEMENT.*

3 = *ANIMAUX ADULTES.*

Table 2

CROSSING SCHEME OF NATIVE BREEDS AND EWES' AVERAGE LIVE WEIGHT

SCHEMA DE CROISEMENT DE RACES LOCALES ET POIDS VIF MOYEN DES BREBIS

Ewe genotype *Race matern.*	Ram genotype *Race paternelle*					N	Average live weight $\bar{X}\pm S$
	Kar	Fl	R	Ser	Ch		
Vl	+	+	+	+	+	57	47,30±0,82
Kar	—	+	+	+	+	35	55,74±1,18
Th	+	+	+	+	+	17	52,53±1,88
Fl	+	—	+	+	+	61	68,29±1,28
R	+	+	—	+	+	25	55,76±1,65

periods under standard and controlled experimental farm husbandry conditions:

—Two-breed crossing between the local breeds (table 2) for the production of slaughter lambs and crossbred breeding ewes;

—Two-breed crossing between imported breeds (table 3) for the production of slaughter lambs and crossbred breeding rams;

—Four-breed crossing between first generation crossbred ewes (table 3) and first generation crossbred rams (table 3) for the production of slaughter lambs.

The lambs' weights at birth and at 90 days of age, growth rates (0-90 days; both sexes and all types of birth confounded), carcass evaluations (dressing percentages and quality) were the criteria retained.

The comparison undertaken thus concerned three types of lamb genotypes:

1. Pure-bred local breed lambs (tables 4 and 7).
2. Two-breed crossbred lambs (tables 5 and 8).
3. Four-breed crossbred lambs (tables 6 and 9).

Indicative adult ewe weights of five «local» breeds (Vl, Kar, Th, Fl, R) and three «imported» breeds (BdC, IdF, HM) measured on the Institute's flocks, are also given in these tables as background information. From our records, we can also indicate that the ewes of the Institute's five local breeds' flocks in question (Vl, Kar, Th, Fl, R) are relatively low to average milk yielding, of limited reproduction potential and unsatisfactory lamb growth rates but hardy and well-adapted to the difficult environmental and husbandry conditions of the area. There is a tendency for the lambs to have fat carcasses if slaughtered after 100 days of age. In particular the *VLAHIKO* and *THRAKI* are small-bodied breeds while the *ROUMLOUKION* and *KARAGOUNIKO* are of average size (table 2).

In what concerns the *SERRES* and *CHIOS* breeds, ZERVAS & BOYAZOGLU (1977) indicated the *SERRES* to be a rather big-bodied animal with average milk production and the *CHIOS* to be a big-bodied, highly fertile and high milk-yielding breed.

The suckling period was on average 50 days and different rations (grain mixtures) were fed ad-libitum to the three types of animals in our experiments (suckling lambs, growing lambs, mature ewes; ta-

Table 3

CROSSING SCHEME OF FOREIGN SHEEP BREEDS AND EWES' AVERAGE LIVE WEIGHT

SCHEMA DE CROISEMENT DE RACES ETRANGERES ET POIDS VIF MOYEN DES BREBIS

Ewe genotype *Race matern.*	Ram genotype *Race patern.*			N	Average live weight $\bar{X}\pm S$ (Kg)
	BdC	IdF	EF		
BdC	—	+	+	53	74,09±1,40
Id F	+	—	+	30	68,86±1,88
HM	+	+	+	46	63,39±1,22

ble A). Alfalfa hay of good quality was freely available to all animals. Slaughtering took place after 18 hours of fasting and the cool-carcass measurements were made after 24 hours cooling at a temperature of 3-5° C.

The available lamb data were analysed by the analysis of variance method with unequal subclass numbers.

3. RESULTS AND DISCUSSION

3.1. Growth rates

3.1.1. *Pure-bred lambs*

Highly significant statistical differences were found between the live weights at birth and 90 days and the daily weight gains of the five Greek breed lambs (table 4). The best breed from a growth rate point of view is the *FLORINA* followed by the KARAGOUNIKO.

For comparison purposes it can be mentioned that according to the available bibliography (KATSAOUNIS, 1968; ZERVAS et al., 1976; GABRILIDIS, 1971) the average growth rates from birth to 90 days of the *KARAMANIKO, SERRES* and *CHIOS* breeds are 164 g, 208 g and 231 g respectively - under quite similar husbandry conditions to ours.

3.1.2. *Two-breed crossbred lambs*

The significant and highly significant differences between the different crossbred genotypes (between local breeds) for birth and 90 days live weights and average daily gains are shown in table 5. The most interesting result is the clear superiority of the *CHIOS* crosses as compared to all other genotypes. This can be at least partially due to «nicking». Comparable results on different Greek experiences were reported on in length by ZERVAS et al. in 1976.

3.1.3. *Four-breed crossbred lambs*

The available numbers per genotype are unfortunately not sufficient per class to undertake more refined interpretations (table 6). With a few exceptions though, the four-breed crossbred lambs show great homogenity with respect to their daily weight gains which are in all cases near 200 g and even more per day.

Considering the ewe genetic material used, these daily weight gains compare favourably with the ones obtained by DICKERSON et al. (1972) with *DORSETS,* American *RAMBOUILLETS* and *CORRIDALES* in the U.S.A.

3.2. Carcass information

Besides cool-carcass weight and dressing percentages (including the head, lungs, heart and liver; tables 7 8 and 9), the carcasses were cut according to the method shown in figure 1 (leg, loin, neck-shoulder, rack, and flanck-breast) and the interior and kidney fat contents evaluated for a limited number of purebred and crossbred lambs (tables 7 and 9), the slaughtering age being approximately 100 days in both cases.

Table 4

RESULTS CONCERNING THE GROWTH OF LAMBS OF BOTH SEXES FROM FIVE LOCAL BREEDS

RESULTATS CONCERNANT LA CROISSANCE DES AGNEAUX DES DEUX SEXES, DE CINQ RACES LOCALES

Genotype	N	Lambs' average live weight at birth (kg) $\bar{X}\pm S$ (1)	Lambs' average live weight at 90 days (kg) $\bar{X}\pm S$ (2)	Average growth rate (g) $\bar{X}\pm S$ (3)
VI	238	3,06±0,03 δ	17,28±0,24 δ	158±2,7 γ
Kar	145	3,88±0,04 α	20,76±0,25 αβ	187±2,7 α
Th	79	3,49±0,06 γ	18,35±0,33 γ	168±3,6 βγ
Fl	217	3,53±0,04 βγ	20,79±0,22 α	191±2,3 α
R	156	3,79±0,04 αβ	19,24±0,27 βγ	172±2,7 β
TOTAL	835	**	**	**

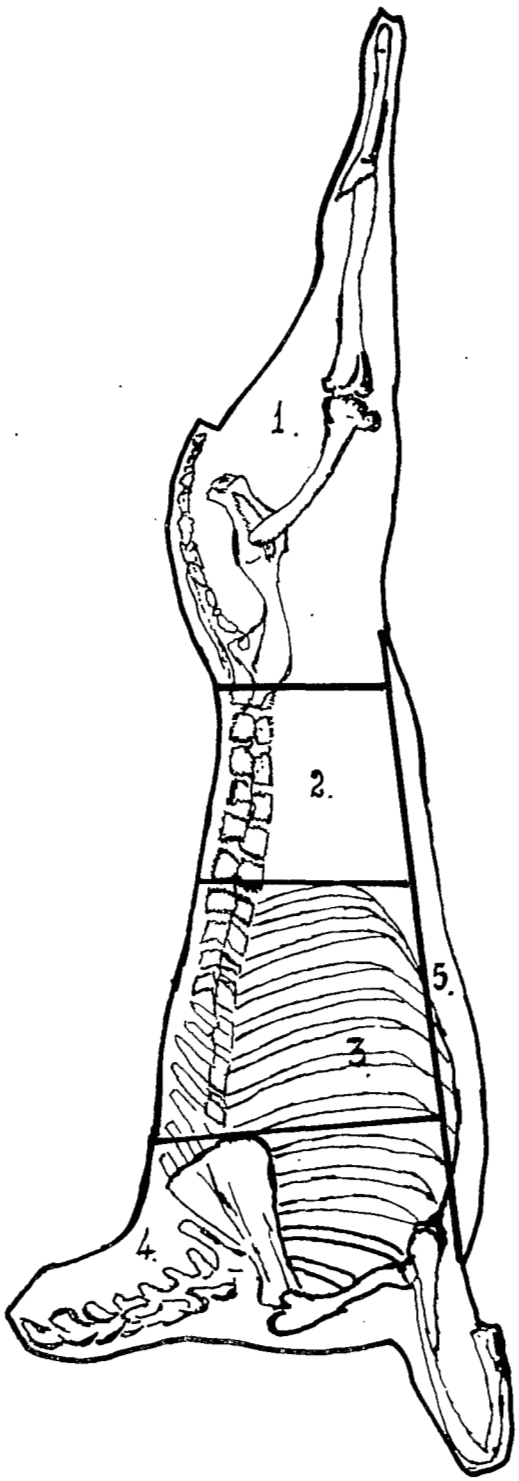
** = (P>.01).

(1) *POIDS MOYEN DES AGNEAUX A LA NAISSANCE (KG).*

(2) *POIDS MOYEN VIF A 90 JOURS (KG).*

(3) *GAIN MOYEN QUOTIDIEN (G).*

Figure 1. Half-carcass cuts.
Schéma de la coupe de la demi-carcasse.



1. Leg.
2. Loin.
3. Rack (8 last ribs).
4. Neck-shoulder (5 first ribs).
5. Flank-breast.

1. *Cuisse.*
2. *Filet.*
3. *Côtes (8 dernières).*
4. *Epaule (5 premières).*
5. *Flanc.*

Table 5

RESULTS CONCERNING THE GROWTH OF BOTH SEXES CROSSBRED LAMBS COMING FROM GREEK BREEDS

RESULTATS CONCERNANT LA CROISSANCE DES AGNEAUX DES DEUX SEXES, DE RACE GRECQUE

Ewe Genotype *Race matern.*	Traits *Critères*	P	Ram Genotype/*Race paternelle*											
			N	Kar	N	Fl	N	R	N	Ser	N	Ch		
Vl	ALWB	*	18	3,49αβ	23	2,95β	20	3,18αβ	20	3,16β	14	3,66α	95	
	ALW90D	**		18,99β		18,27β		18,76β		18,84β		22,54α		
	ADG	**		172 β		170 β		173 β		172 β		209 α		
Kar	ALWB	**	—	—	12	3,64β	12	3,69β	12	3,99αβ	10	4,34α	46	
	ALW90D	**		—		20,73β		22,92αβ		23,92α		25,96α		
	ADG	**		—		190 β		214 α		221 α		240 α		
Th	ALWB	*	10	3,58β	9	4,42α	8	3,61β	7	3,90αβ	9	4,10α	43	
	ALW90D	*		21,51αβ		20,84β		22,64αβ		22,35αβ		23,70α		
	ADG	NS		199		208		211		205		197		
Fl	ALWB	**	18	3,74α	—	—	20	3,51β	24	3,65αβ	18	4,24α	80	
	ALW90D	**		22,50β		—		21,96β		21,02β		25,95α		
	ADG	**		208 β		—		205		193 β		241 α		
R	ALWB	*	11	3,93β	9	3,92β	—	—	11	3,92β	10	4,92α	41	
	ALW90D	*		21,35αβ		22,52αβ		—		20,81β		25,61α		
	ADG	NS		193		206		—		187		227		

ALWB = Average Live Weight at Birth/*Poids moyen à la naissance.*

ALW90 = Average Liver Weight at 90 Days/*Poids moyen vif à 90 jours.*

ADG = Average Daily Gain/*Gain moyen quotidien.*

* = (P < .05).

** = (P < .01).

Although the main purpose of the two-breed crossing between local breeds was to produce «local» crossbred female genotypes with a better dairy potential, some interesting information on the male crossbred lambs'carcasses is given in table 8. The best dressing percentage being of the *SERRES* × *VLAHIKO* crosses and the worst being that of the *CHIOS* × *VLAHIKO.* The averages for all crosses are very similar to the information published by other authors under more or less similar conditions (TSONGAS, 1971; KIRIAFINIS et al., 1974; ZERVAS et al., 1976).

The full information concerning the four-breed crossbred lamb carcasses is shown in table 10. A comparison with the data in table 7 (purebreds) shows a better carcass composition for the crossbreds: the leg representing 34-35 % of the carcasses as compared to 31-32 % for the purebreds.

The carcasses of the crossbreds were also much more homogenous and acceptable to the butcher (and consumers) in comparison with the purebred carcasses.

4. CONCLUSIONS

The average superiority of the 422 two-breed crossbred lambs as compared to the 835 local purebred lambs was 8,30 % for birthweight and 12,07 % for daily weight gain while that of the 103 four-breed crossbreds was respectively 21,58 % and 20,80 %.

In Sardinia, BOYAZOGLU et al. (1979) reported a 14,16 % weight superiority at birth for 25 % *FRIESIAN* × *SARDA* lambs as compared to the purebred *SARDA,* the crossbred lambs being also more suitable for fattening than the purebreds (149 days of fattening for 32 kg live weight of the purebreds as compared to 123 days for 33 kg of the crossbreds).

In the case of our slow growing breeds, it is thus

Table 6

RESULTS CONCERNING THE GROWTH OF BOTH SEXES: FOUR-BREED CROSSBRED LAMBS

RESULTATS CONCERNANT LA CROISSANCE DES AGNEAUX DES DEUX SEXES; CROISEMENT A DEUX ETAGES

Ram Genotype *Race patern.*	Ewe Genotype/*Race maternelle*															TOTAL N	P	
	N	ALWB (kg)	ADG (g)	N	ALWB (kg)	ADG (g)	N	ALWB (kg)	ADG (g)	N	ALWB (kg)	ADG (g)	N	ALWB (kg)	ADG (g)		1	2
—	—	1	2	—	1	2	—	1	2	—	1	2	—	1	2	—	—	—
(IdF × HM)				9	(Fl × Vl) 3,94	207	5	(R × Vl) 3,58	172	7	(Ser × Vl) 4,21	206	6	(Ch × Vl) 3,60	177	27	NS	NS
(IdF × BdC)				5	(Fl × Kar) 4,76	220 αβ				7	(Ser × Kar) 4,16	243 α	13	(Ch × Kar) 4,24	198 β	25	NS	*
(EF × HM)	8	(Kar × Th) 4,44	227 αβ				5	(R × Th) 3,96	199 β				6	(Ch × Th) 4,75	270 α	19	NS	*
(BdC × IdF)	7	(Kar × Fl) 4,26	218				6	(R × Fl) 4,37	224	9	(Ser × Fl) 4,20	220	10	(Ch × Fl) 4,43	231	32	NS	NS

TOTAL 103

ALWB = Average Live Weight at Birth/*Poids moyen à la naissance.*

ADG = Average Daily Gain/*Gain moyen quotidien.*

more efficient to crossbreed the less producing dairy ewes for better lamb production under our harsh environmental conditions. No serious problems were encountered with either our two-breed cross or four-breed cross experiments but further and more complete information is needed, in particular with respect to carcass quality.

Table 7

CARCASS PROPERTIES OF SINGLE MALE PUREBRED LAMBS OF FOUR GREEK BREEDS AT THE AGE OF 100 DAYS

QUALITE DES CARCASSES DES AGNEAUX MALES DE QUATRE RACES GRECQUES A L'AGE DE 100 JOURS

Genotype	N	Cool carcass weight (kg)	Killing out percentage (%) (1)	Leg (%)	Loin (%)	Rack (%)	Neck shoulder (%)	Flank breast (%)	Interior fat (%)	Kidney fat (%) (2)
Vl	7	9,19	56,90 β	31,87	11,89 γ	10,74 β	34,51 α	9,82 α	1,16 β	14,28 α
Th	7	12,68	62,50 α	31,72	14,71 α	12,17 α	31,55 γ	8,10 αβ	1,75 αβ	16,72 α
	7	14,00	60,76 α	31,49	13,39 αβ	12,77 α	32,98 βγ	7,41 β	1,95 α	11,82 β
R	7	13,16	61,57 α	31,32	13,26 β	12,10 α	33,15 αβ	8,28 αβ	1,88 α	13,07 α
—	—	—	**	NS	**	**	*	**	**	*

(1) The head, liver, heart and lungs are included.

(2) It is estimated as: kidney fat (Kg): loin (kg) × 100.

* (P<.05).

** (P<.01).

Table 9

RESULTS OF BOTH SEXES; FOUR-BREED CROSS LAMBS AT SLAUGHTERING

RESULTATS DES DEUX SEXES; AGNEAUX DE CROISEMENT A DEUX ETAGES

Genotype		N	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
o	o											
(IdF × HM)	(Fl × Vl)	9	109	13,82	56,54	34,55	10,28α	12,00α	34,32	7,55	1,31	17,15αβ
	(R × Vl)	5	125	12,43	54,17	35,86	8,35β	11,10β	35,45	8,19	1,03	11,12γ
	(Ser × Vl)	7	113	13,91	55,93	34,12	11,03α	11,30αβ	34,79	7,39	1,36	17,76α
	(Ch × Vl)	6	131	13,50	55,78	35,35	9,78αβ	11,11β	34,81	7,66	1,27	13,75βγ
—	—	27	—	—	NS	NS	*	*	NS	NS	NS	*
(IdF × BdC)	(Fl × Kar)	5	102	14,48	58,36	32,56β	12,52α	12,57α	32,92β	7,77	1,66α	17,08α
	(Ser × Kar)	7	102	15,02	57,16	33,96αβ	10,96αβ	12,04αβ	33,55αβ	7,96	1,51αβ	15,25αβ
	(Ch × Kar)	13	121	14,38	56,43	35,16α	10,14β	11,39β	34,42α	7,76	1,11β	11,71β
—	—	25	—	—	NS	*	**	**	*	NS	*	*
(EF × HM)	(Kar × Th)	8	99	13,77	55,36αβ	33,84	11,17	11,24	34,55	8,12	1,08	11,91
	(R × Th)	5	115	13,40	54,75β	34,94	10,36	11,15	34,72	7,70	1,10	13,75
	(Ch × Th)	6	85	15,84	59,38α	33,55	11,57	11,04	33,78	8,71	1,33	12,87
—	—	19	—	—	*	NS	NS	NS	NS	NS	NS	NS
(BdC × IdF)	(Kar × Fl)	7	102	13,49	56,60	34,16	10,40	11,35	35,04	7,71	1,32	15,44
	(R × Fl)	6	104	14,66	57,27	34,59	10,51	11,35	34,46	7,49	1,58	13,97
	(Ser × Fl)	9	109	14,93	57,81	34,53	10,92	11,38	34,39	7,45	1,31	12,11
	(Ch × Fl)	10	105	14,61	57,52	34,17	11,52	11,22	34,10	7,56	1,40	14,84
—	—	32	—	—	NS	NS	NS	NS	NS	NS	NS	NS

1. Average age at slaughtering (days).
2. Cool carcass weight (kg).
3. Killing out percentage as in table 7.
4. Leg (%) on net cool carcass weight.
5. Loin (%) on net cool carcass weight.
6. Rack (%) on net cool carcass weight.
7. Neck-shoulder (%) on net cool carcass weight.
8. Flank-breast (%) on net cool carcass weight.
9. Interior fat (%) on net cool carcass weight.
10. Kidney fat (%) as in table 7.

1. *Age moyen à l'abattage.*
2. *Poids de la carcasse froide (kg).*
3. *Rendement comme dans le tableau 7.*
4. *Cuisse (%) du poids de la carcasse froide.*
5. *Filet (%) du poids de la carcasse froide.*
6. *Côtes (%) du poids de la carcasse froide.*
7. *Epaule (%) du poids de la carcasse froide.*
8. *Flanc (%) du poids de la carcasse froide.*
9. *Gras intérieur (%) du poids de la carcasse froide.*
10. *Gras périrénal comme dans le tableau 7.*

Table 8

AGE AT SLAUGHTERING, LIVE WEIGHT BEFORE SLAUGHTERING, COOL CARCASS WEIGHT AND DRESSING PERCENTAGE OF SINGLE MALE LAMBS; PRODUCTS OF TWO GREEK BREEDS

AGE D'ABATTAGE, POIDS VIF AVANT L'ABATTAGE, POIDS DES CARCASSES FROIDES ET POURCENTAGE (RENDEMENT) DES CARCASES DES AGNEAUX MALES CROISES (ENTRE DEUX RACES GRECQUES)

Genotype (M×F)	N	Average age at slaughtering	Average live weight before slaughtering	Average cool carcass weight	Killing out percentage as in T.8
Kar × Vl	7	100	18,86	11,21	59,43 α
R × Vl	7	100	17,97	10,40	57,87 αβ
Ser × Vl	7	100	20,36	12,17	59,77 α
Fl × Vl	6	126	23,78	13,02	54,75 αβ
Ch × Vl	5	126	29,30	15,75	53,75 β
Kar × Fl	5	120	27,96	15,84	56,65 αβ
R × Fl	7	126	25,13	13,54	53,87 β
Ser × Fl	5	125	26,68	14,90	55,84 αβ
—	—	—	—	—	**

** (P<.01).

Breed reference table / Tableau de reference des races.

Greek breeds / Races locales

Vlahiko = Vl
Karagouniko = Kar
Thraki = Th
Florina = Fl
Roumloukion = R
Chios = Ch
Serres = Ser

Foreign breeds/ Races étrangères

East Friesian = EF
Hungarian Merino = HM
Ile de France = IdF
Berrichon du Cher = BdC

BIBLIOGRAPHIE

BOYAZOGLU, J., CASU, S., FLAMANT, J-C., 1979. Crossbreeding the *SARDINIAN* and *EAST FRIESIAN* breeds in Sardinia. Ann. Génét. Sél. Anim. 11, 1, 23.

DICKERSON, G.E., CLIMP, H. A., TUNA, H. J., GREGORY, K. E., 1972. Genetic resources for efficient meat production in sheep growth and carcass characteristics of ram lambs of seven breeds. J. Anim. Sci., 34: 940.

DIMAKOPOULOS, J., 1960. The best adapted breeds of sheep. Report Meeting Prod. Utiliz. Sheep Goat Milk (Athens) FAO-FEZ.

GABRILIDIS, G. T., 1971. Prolificacy, efficiency and lamb livability of *CHIOS* sheep. J. Anim. Sci. 33, 1, 199 (Abstr).

GEORGIOU, A., 1960. Sheep and goat raising in Greece. Report Meeting. Prod. Utiliz. Sheep Goat Milk (Athens) FAO-FEZ.

KATSAOUNIS, N., 1968. Etude des possibilités d'accroissement de la production de viande de mouton et d'agneau. Note de la Station de Recherches Agricoles d'Ioannina (in greek).

KIRIAFINIS, B., KALAISSAKIS, P., ZERVAS, N., PAPADOPOULOS, G., HATJIMINAOGLU, J., 1974. Contribution to the study of fattening weaned crossbred *FRIESIAN* × *CHIOS* and *FRIESIAN* × *SERRES* lambs. Geoponika. 219, 175 (in greek).

PAPADOPOULOS, G., KALAISSAKIS, P., ZERVAS, N., PAPADIMITRIOU, T., 1972. Etude des races de *CHIOS*, de *FRISE ORIENTALE* et de leurs croisements dans la région de l'Attique. II. Croissance des agneaux. Rapport spécial du Ministére de l'Agriculture. Athens (in greek).

TSONGAS, E., 1971. Le croisement de la race ovine d'Epire pour la production d'agneaux de lait de 100 jours par allaitement naturel et artificiel. Note de la Station de Recherches Agricoles d'Ioannina (in greek).

ZERVAS, N., MATSOUKAS, J., BOYAZOGLU, J., 1976. La production de viande ovine et le croisement industriel en Grèce. Bull. Tech. Dep. Génét. (I.N.R.A.), n.° 25.

ZERVAS, N., BOYAZOGLU, J., 1977. L'élevage en Grèce: présent et avenir. Ethnozootechnie, n.° 18, 73 pp.

ZERVAS, N., MATSOUKAS, J., HATJIMINAOGLU, J., 1977. Research work for the intensive mutton production. Dept. of Anim. Production. School of Agriculture and Forestry. Aristotelian University of Thessaloniki. Bull., n.° 1 (in greek).