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EFFECTS OF WEANING AGE AND SUCKLING REGIME ON THE PROFITABILITY OF DUAL PURPOSE SHEEP AND GOATS

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SUMMARY

Two weaning ages in sheep (35 and 42 days) and two weaning ages in goats (49 and 56 days), the younger weaning age combined with continuous and the older with restricted suckling, were used to investigate milk yield and fat content of milk and liveweight gain and feed intake of lambs and kids from 29 to 56 days in sheep and from 42 to 70 days in goats. Milking times per kg of sheep or goat milk were also measured. Sheep and goats were offered a diet composed of 66% concentrates and 34% roughage and lambs and kids were offered a pelleted creep feed *ad libitum* and alfalfa hay. Ewes weaned at 42 days *post-partum* with restricted suckling prior to weaning produced slightly more milk and their lambs had similar liveweight gain with ewes continuously sucked and weaned at 35 days of age but at the expense of higher liveweight loss. Goats continuously sucked and weaned at 49 days *post-partum* had similar milk yields and liveweight gain of kids with goats weaned at 56 days and partially sucked prior to weaning. Milking time was inversely related to the quantity of milk removed from the udder. Less time was needed to milk a unit of goat milk than a unit of sheep milk. It was concluded that in sheep, continuous suckling and weaning at 35 days of age or restricted suckling and weaning at 42 days can be applied depending on the price relationships between milk, meat and the availability of labour and facilities to separate the lambs from the ewes. It was also concluded that continuous suckling and weaning of goats at 49 days had more advantages than restricted suckling and weaning at 56 days of age.

ΠΕΡΙΛΗΨΗ

Χρησιμοποιήθηκαν δύο ηλικίες απογαλακτισμού στα πρόβατα (35 και 42 μέρες) και στις αίγες (49 και 56 μέρες) που συνδυάστηκαν η μεν μικρή ηλικία με συνεχή η δε μεγάλη με μερικό θηλασμό των αμνοεριφίων για να μελετηθεί η επίδραση των δύο συστημάτων στην παραγωγή και την λιποπεριεκτικότητα του γάλακτος, και την πρόσληψη στερεάς τροφής και ανάπτυξη των αμνοεριφίων. Η δοκιμή έγινε για τα πρόβατα στην περίοδο 29 μέχρι 56 μέρες μετά τον τοκετό και στις αίγες στην περίοδο 42 μέχρι 70 μέρες. Μετρήθηκε επίσης ο χρόνος που χρειαζόταν για να αρμεχθεί ένα χιλιόγραμμο γάλακτος αίγας ή προβάτου. Στα πρόβατα και τις αίγες δόθηκε σιτηρέσιο που αποτελείτο από 66% συμπυκνωμένη τροφή και 34% χονδροειδή τροφή. Στα αμνοερίφια δόθηκε κυβοποιημένη τροφή και τριφυλλοσανός. Οι προβατίνες που απογαλακτίσθηκαν 42 μέρες μετά τον τοκετό με εφαρμογή μερικού θηλασμού των αρνιών έδωσαν ελαφρά ψηλότερη παραγωγή γάλακτος από εκείνες που απογαλακτίσθηκαν στις 35 μέρες με συνεχή θηλασμό. Η ανάπτυξη των αρνιών και στα δυο συστήματα απογαλακτισμού ήταν η ίδια, όμως οι προβατίνες, που απογαλακτίσθηκαν στις 42 μέρες έχασαν βάρος. Οι αίγες και στα δύο συστήματα απογαλακτισμού έδωσαν την ίδια παραγωγή γάλακτος και τα ερίφια είχαν την ίδια ανάπτυξη. Ο χρόνος αρμέγματος ήταν αντιστρόφως ανάλογος με την ποσότητα του γάλακτος που αφαιρέθηκε από τον μαστό. Ιση ποσότητα αιγινού γάλακτος αρμεγόταν σε λιγώτερο χρόνο από το γάλα προβάτου. Συμπερασματικά η μελέτη αυτή έδειξε ότι και τα δυο συστήματα απογαλακτισμού μπορούν να εφαρμοστούν στα πρόβατα ανάλογα με τις τιμές του γάλακτος και του κρέατος, την διαθέσιμη εργασία και την ύπαρξη των αναγκαίων χώρων για το χώρισμα των αρνιών. Τα αποτελέσματα με τις αίγες έδειξαν ότι ο απογαλακτισμός των αιγών στις 49 μέρες με συνεχή θηλασμό των εριφίων έχει περισσότερα πλεονεκτήματα από τον απογαλακτισμό στις 56 μέρες με μερικό θηλασμό των εριφίων.

INTRODUCTION

The Damascus goats and the Chios sheep, the two main breeds in Cyprus kept under semi-intensive conditions of management, are characterised by high milk production and prolificacy and they are used as dual purpose animals for the production of both meat and milk. Therefore, it is important to increase commercial milk yield and simultaneously to achieve satisfactory growth of lambs and kids. Increase in marketable milk can be achieved through restricted suckling or weaning at a younger age (Louca, 1972; Louca *et al.*, 1975; Hadjipanayiotou and Louca, 1976).

Early weaning (42 and 52 days of age for lambs and kids, respectively) combined with restricted suckling 14 days prior to weaning (Economides, 1986; Hadjipanayiotou and Economides, 1986; Economides *et al.*, 1990a) was used to sustain uninterrupted growth of early weaned ruminants by increasing solid feed intake. The income from the sale of milk and meat was higher with early weaned lambs (42 days) combined with 8 h suckling compared to either 24 or 12 h suckling daily (Economides and Antoniou, 1989). The present work was carried out to compare weaning of lambs and kids at 42 and 56 days, respectively, with two weeks restricted suckling (12 h daily) prior to weaning, and 24 h suckling and abrupt weaning of lambs and kids at 35 and 49 days, respectively.

MATERIALS AND METHODS

Sheep

Ninety Chios sheep and their offspring (145 lambs) were kept from 3 to 28 days *post-partum* in one group and lambs sucked continuously. Surplus milk (commercial milk) was removed once daily by hand and fat, protein and total solids were determined. On day 29 ewes and their lambs were divided into the following two treatment groups.

Treatment 1. Lambs sucked continuously their dams and were abruptly weaned at 35 days ($CS_{35}W_{35}$). Ewes were milked by hand once daily from 29 to 35 and twice daily from 36 to 42 days and bulk milk yield was recorded daily.

Treatment 2. Lambs sucked their dams for 12 h only and were weaned at 42 days ($PS_{28}W_{42}$). Ewes were milked once daily from 29 to 42 days and bulk milk yield was recorded daily (phase one).

Chemical composition of commercial milk (fat, protein, total solids) was determined and milking time per kg of commercial milk from 29 to 42 days for the two treatments were measured (phase one). From day 43 to 56 (phase two) ewes in both treatments were milked by hand twice daily. Individual milk yield of ewes and fat, protein and total solids of milk were measured once weekly. Daily feed intake of ewes was 2,2 kg of concentrates, 0.2 kg of alfalfa hay and 0.6 kg of cereal hay. Lambs had free access to a pelleted diet containing 16% crude protein and 0.1 kg of alfalfa hay/head/day. Live weight of ewes and lambs was recorded at 28, 35, 42 and 56 days *post-partum* and feed consumption of lambs was recorded from 28 to 56 days.

Goats

Seventy two goats and their offspring (108 kids) were kept from 3 to 42 days *post-partum,* in one group and kids sucked continuously. Surplus milk (commercial milk) was removed by hand once daily and fat, protein and total solids were determined. On day 43 post partum goats and their offspring were divided into the following two treatment groups.

Treatment 1. Kids sucked continuously their dams and were abruptly weaned at 49 days ($CS_{49}W_{49}$). Goats were milked once daily from 43 to 49 and twice daily from 50 to 56 days and bulk milk yield was recorded daily.

Treatment 2. Kids sucked their dams for 12 h only and were weaned at 56 days ($PS_{42}W_{56}$). Goats were milked once daily from 43 to 56 days and bulk milk yield was recorded daily (phase one).

Chemical composition (fat, protein total solids) and milking time/kg of commercial milk from day 43 to 56 were determined (phase one). From day 57 to 70 (phase two)

goats were milked by hand twice daily. Individual milk yield of goats and fat, protein and total solids of milk were measured once weekly. Daily feed intake of goats was 2.5 kg of concentrates (16% crude protein) 0.2 kg of alfalfa hay and 0.4 kg of barley hay per head daily. Kids had free access to a pelleted creep feed (16% crude protein) and 0.1 kg of alfalfa hay/head daily from day 43 to 70 of age. Live weight of goats and kids was recorded at 42, 49, 56 and 70 days *post-partum* and feed consumption of kids was measured from 43 to 70 days.

Fat, protein and total solids were analysed according to MAFF (1973), and fat corrected milk yield in sheep and goats was calculated with the equations suggested by Mavrogenis and Papachristoforou (1988).

Table 1. Milk yield of ewes and milk composition from 29 to 56 days

	$CS_{35}W_{35}$	$PS_{28}W_{42}$	SD
29-35 days			
Milk yield (kg/ewe) (6% FCM)	2.30	11.10	-
Milk composition (%)			
Fat	6.00	4.70	0.23
Protein	4.73	4.97	0.06
Total solids	16.40	15.01	0.22
36-42 days			
Milk yield (kg/ewe) (6% FCM)	17.60	10.50	-
Milk composition (%)			
Fat	5.80	4.97	0.07
Protein	5.25	5.09	0.08
Total solids	16.27	15.49	0.20
43-56 days			
Milk yield (kg/ewe) (6% FCM)	31.80	36.40	7.76
Milk composition (%)			
Fat	5.87	6.22	0.87
Protein	5.58	5.50	0.47
Total solids	16.95	17.21	1.05

$CS_{35}W_{35}$ = 35 day weaning and continuous suckling; $PS_{28}W_{42}$ = 42 day weaning and partial suckling from day 28.

RESULTS

The chemical composition of surplus milk of ewes between 3 and 28 days and of goats between 3 and 42 days was 6.3±0.22 and 4.90±0.61 for fat, 5.24±0.19 and 3.72±0.15 for protein and 16.64±0.42 and 14.00±0.62 for total solids, respectively.

The milk yield of ewes (fat corrected at 6%) from 29 to 42 days was about 1.70 kg higher in treatment $PS_{28}W_{42}$; its fat content, however, was lower ($P<0.01$) (Table 1). Total solids from 29 to 35 days was also lower in treatment $PS_{28}W_{42}$. From 43 to 56 days ewes on $PS_{28}W_{42}$ produced 4.60 kg more milk with higher fat content than treatment $CS_{35}W_{35}$ (Table 1). Liveweight changes were significantly different ($P<0.01$) between treatments. Ewes on treatment $PS_{28}W_{42}$ lost weight, whereas those on $CS_{35}W_{35}$ gained weight (Table 2). Initial and final live weight and weight gain of lambs from 28 to 56 days was similar in the two treatments (Table 2). Female lambs had lower initial and final weight and daily gain than male lambs. Lambs weaned at 35 days consumed more solid feed until 56 days (Table 2), but daily feed consumption after weaning was 0.79 and 0.61 kg for lambs in treatments $PS_{28}W_{42}$ and $CS_{35}W_{35}$, respectively.

The milk yield of goats (fat corrected at 4%) from 43 to 56 days was 5.33 kg higher

Table 2. Liveweight changes of ewes and liveweight gain of lambs

	$CS_{35}W_{35}$		$PS_{28}W_{42}$		SD
Liveweight (kg/ewe)					
day 28	61.65		62.00		8.11
day 56	61.84		60.62		7.50
Liveweight change (kg/ewe)	+0.19		-1.38		3.04
Liveweight (kg/lamb)	Males	Females	Males	Females	
day 28	13.64	12.25	13.09	12.35	1.54
day 56	21.68	19.20	20.97	19.16	2.44
Liveweight gain (kg/lamb)	8.04	6.95	7.88	6.81	1.40
Feed intake (kg/lamb)					
Concentrates	13.05		11.87		-
Hay	2.26		1.95		-

in treatment $CS_{49}W_{49}$ and its fat content tended to be higher (Table 3). From 57 to 70 days, milk yield and milk composition of goats in the two treatments was similar. Liveweight changes of goats from 43 to 70 days were also similar (Table 4). Initial and final weight and liveweight gain of kids from 43 to 70 days were also similar and only male kids were heavier and grew significantly faster than females. Kids weaned at 49 days consumed until 70 days 2.30 kg/ head more solid feed, but daily feed consumption after weaning was 0.60 and 0.63 kg/kid in treatment $CS_{49}W_{49}$ and $PS_{42}W_{56}$, respectively.

Table 3. Milk yield of goats and milk composition from 43 to 70 days.

	$CS_{49}W_{49}$	$PS_{42}W_{56}$	SD
42-49 days			
Milk yield (kg/goat) (4% FCM)	2.74	9.21	-
Milk composition (%)			
Fat	5.07	4.87	0.62
Protein	3.79	3.72	0.12
Total Solids	14.12	13.99	0.56
50-56			
Milk yield (kg/goat) (4% FCM)	21.10	9.30	-
Milk composition (%)			
Fat	5.33	4.63	0.44
Protein	3.76	3.83	0.11
Total solids	14.00	12.85	0.39
57-70			
Milk yield (kg/goat) (4% FCM)	42.30	44.80	10.48
Milk composition (%)			
Fat	4.57	4.60	0.69
Protein	4.05	4.04	0.45
Total solids	13.66	13.71	0.86

The time required to milk the marketable milk (min/kg milk) was inversely related to the quantity available in the udder and it was lower in goats than in sheep (Table 5). Milking time/ewe was higher with the partial suckling regimes in both sheep and goats. Cost of milking (considering actual labour cost at 3.7 c/min) per kg milk was similar in sheep, but was lower in the continuous suckling regime of goats (Table 5).

DISCUSSION

The biological efficiency in the two treatments of sheep from 29 to 56 *post-partum* was similar. Nutrient intake and particularly energy input in the total system (lactating sheep-growing lambs) was similar; the restricted suckling regime produced slightly more milk, but at the expense of higher liveweight loss of ewes. In the case of goats biological efficiency from 43 to 70 days *post-partum* was also similar with energy input similar to energy output.

The difference in commercial milk yield and consequently the income from the sale of milk between the two treatments in sheep was marginal and smaller than the difference between either the continuous suckling and weaning of lambs at 42 days or restricted suckling and weaning at 42 days of age (Economides and Antoniou, 1989). This indicates that restricted suckling in sheep, for increasing commercial milk yield, becomes less profitable as the weaning age decreases. In line with Economides and Antoniou (1989) and Lawlor *et al.*, (1974) differences in milk yield and milk composition were insignificant from weaning until 56 and 70 days *post-partum* for sheep and goats, respectively, which is attributed to the absence

Table 4. Liveweight changes of goats and liveweight gain of kids

	$CS_{49}W_{49}$		$PS_{42}W_{56}$		SD
Liveweight (kg/goat)					
42 day	64.14		63.96		1.72
70 day	64.89		63.69		1.71
Liveweight change (kg/goat)	+0.75		-0.26		0.54
Liveweight (kg/kid)	Males	Females	Males	Females	
42 day	14.59	12.41	14.86	13.17	1.74
70 day	20.24	17.11	20.59	17.68	2.51
Liveweight gain (kg/kid)	5.66	4.70	5.73	4.50	1.43
Feed intake (kg/kid)					
Concentrates	10.80		8.76		
Hay	2.33		2.10		

Table 5. Time required to milk commercial milk and cost of milking during phase one

	Sheep				Goats			
	$CS_{35}W_{35}$		$PS_{28}W_{42}$		$CS_{49}W_{49}$		$PS_{42}W_{56}$	
	29-35	36-42	29-35	36-42	43-49	50-56	43-49	50-56
Milking time (min./kg milk)	2.65	1.46	1.45	1.59	1.87	0.67	1.40	1.14
Average (min/kg milk)	1.59		1.52		0.78		1.24	
Commercial milk yield (kg/ewe)	20.40		24.40		21.02		18.69	
Milking time (min./ewe)	32.43		37.08		16.39		23.17	
Cost of milking								
Per ewe (£)*	1.20		1.37		0.61		0.86	
Per kg milk (cents)	5.88		5.62		2.89		4.59	

1 £ = 2 U.S $; 1 £ = 100 cents.

Table 6. Production of sheep (6% fat) and goat (4% fat) milk (phase one) and meat

	Sheep		Goats	
	$CS_{35}W_{35}$	$PS_{28}W_{42}$	$CS_{49}W_{49}$	$PS_{42}W_{56}$
Phase One				
Fat CorrectedMilk (kg)	19.90	21.60	23.84	18.51
Income from milk (£) (Revenue minus cost of milking	6.79	7.43	3.60	2.48
Income from meat (£) (Revenue minus cost of feeding	10.96	10.81	7.96	8.00
Income from milk and meat (£)	17.75	18.24	11.56	10.48

of the suckling stimulus after weaning. In agreement with Economides and Antoniou (1989), Hadjipanayiotou and Louca (1976) and Louca *et al.* (1975) growth rate of lambs and kids was poorer until weaning with the restricted suckling treatment and although solid feed intake of partially sucked lambs was higher, it was not adequate to make good the deficit of energy from milk. Similarly, restriction of milk intake in kids resulted even in poorer performance than lambs, because kids consume solid feed at a later age than lambs (Economides, 1986). Growth rate of partially sucked lambs and kids after weaning was similar or better than that of lambs and kids continuously sucked until weaning. These results agree with those obtained with lambs (Economides and Antoniou, 1989) and kids (Economides *et al.*, 1990a) and it is associated with the feeding of high concentrate balanced diets allowing high energy intake (Economides *et al.*, 1990b). In line with Economides and Antoniou (1989) fat percentage of commercial milk from the restricted suckling regime was significantly lower than that from milk of continuously sucked ewes. Fat percentage of milk from restricted-sucked goats was only slightly reduced. However, the lower fat percentage is counterbalanced by the higher fat content of surplus milk produced from ewes in the first 4 weeks *post-partum* or from weaned ewes that lambed earlier than the restricted-sucked ewes.

More time was required to remove surplus milk during phase one with continuously-suckled ewes and goats when milk yield was low. This is in agreement with Economides and Antoniou (1989) who found with Chios sheep a negative relationship between the quantity of commercial milk yield and milking time. It was also apparent that less time was needed to milk one unit of goat milk than one unit of sheep milk. Cost of

milking per kg milk was similar in the two treatments of sheep but it was lower with goats in the continuous suckling treatment and weaning at 49 days. The income from the sale of milk until 42 days for sheep and 56 days for goats and the income from live-weight gain for both phases was marginally higher in partially sucked ewes and continuously sucked goats (Table 6).

Since the price ratio of goat meat to goat milk is 18:1, more attention must be given to higher growth rate and higher weaning weight of kids than increased production of commercial milk. Therefore it can be concluded that continuous suckling and weaning of goats at 49 days *post-partum* is superior than restricted suckling prior to weaning. In sheep, the price ratio of meat to milk is only 8:1 and higher commercial milk yield is more desirable. Therefore, it can be concluded that both continuous suckling and weaning at 35 days or weaning at 42 days with restricted suckling have their advantages depending on the price of milk and meat, the availability of labour and the availability of facilities for separating the lambs during the restricted suckling period.

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