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SHORT COMMUNICATION

An economic assessment of differently managed sheep flocks in eastern Turkey

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ABSTRACT

The aim of this study was to evaluate production and economic effects of feeding management and hormonal strategy on fat tailed sheep raised in eastern Anatolia. Animals were divided into six groups. Strategies were as follows: ewes were offered 1) 1.0 of the estimated metabolizable energy (1.5kg dry grass hay/ewe/day) (non flushed: NF, n=77) 2) 1.5kg dry grass hay/ewe/day and 300gr barley/ewe /day for 21 days prior to mating (flushing: F, n=100). Thereafter, nutritionally flushed ewes were subdivided: 3) supplemented with Vitamin A and E prior to mating (VIT, n=90), estrus of ewes were synchronized; 4) FGA (30mg) impregnated sponge and 600 U PMSG (Sponge and Flushing: SF, n=113) or 5) $PGF_{2\alpha}$ (125µg/mL Cloprostenol) and 600 U PMSG (PGF, n=90), or 6) feed additive estrus synchronization treatment, Melengesterol Acetate (MGA, 0.25mg per head daily, n=90). Ewes in estrus were hand mated with rams of proven fertility. Reproductive performance was measured from fertility, percentage of animals in estrus within 6 days of ram introduction and the number of lambs born. Also, lamb birth and weaning weights, and survivability rate at weaning were recorded for prolonged productivity. Production data was subjected to gross margin calculating for economic evaluation. The use of MGA outperformed the other groups in fertility and survivability. Net returns per ewe were US$ 21.58/ewe. $PGF_{2\alpha}$ hormone treatments (US$ 17.12/ewe) was the most profitable source of extra revenue compared with vaginal sponge (US$ 12.69/ewe) and supplementing vitamins (US$ 13.66/ewe). The economic viability and reproductive performance indicators demonstrate that steps should be taken to disseminate these new practices in the fat tailed sheep development program.

Key words: Economic assessment, Sheep, Nutrition, Reproductive technology.

RIASSUNTO

UNA VALUTAZIONE ECONOMICA DI DIVERSE MODALITÀ DI GESTIONE DELLE PECORE NELLA TURCHIA ORIENTALE

Scopo della ricerca è stato la valutazione della produttività e degli effetti economici del tipo di alimenta - zione e della strategia ormonale in pecore dalla coda grassa nell'Anatolia orientale. Gli animali vennero suddivisi in sei gruppi. Le strategie adottate furono le seguenti: alle pecore vennero somministrati 1) 1.0 dell'energia metabolizzabile stimata (1,5 kg di fieno/capo/giorno) (non trattate: NF, n=77); 2) 1,5 kg di fieno/capo/giorno e 300 g di orzo/capo/giorno per 21 giorni prima dell'accoppiamento (flushing: F,

n=100). Poi le pecore trattate con flushing furono suddivise in: 3) integrazione con vitamina A ed E prima dell'accoppiamento (VIT, n=90), l'estro venne sincronizzato; 4) spugna impregnata con FGA (30 mg) e 600 UI di PMSG (spugna e flushing: SF, n=113;) 5) $PGF_{2\alpha}$ (125 µg/mL Cloprostenolo) e 600 UI di PMSG (PGF, n=90); 6) trattamento di sincronizzazione dell'estro con additivo alimentare, Melengesterolo ace - tato (MGA, 0,25 mg/capo/giorno, n=90). Le pecore in estro vennero fatte accoppiare con arieti di prova - ta fertilità. L'efficienza riproduttiva fu misurata sulla base della fertilità, dela percentuale di soggetti in estro entro 6 giorni dall'introduzione degli arieti e del numero di agnelli nati. Inoltre, per valutare la pro - duttività a lungo termine, furono registrati il peso degli agnelli alla nascita e allo svezzamento e il tasso di sopravvivenza allo svezzamento. Per una valutazione economica, i dati produttivi furono sottoposti al calcolo del margine lordo. L'impiego di MGA fece rilevare prestazioni superiori agli altri gruppi in termini di fertilità e sopravvivenza. Il ricavo netto fu pari a 21,58 US$/pecora. Il trattamento ormonale con $PGF_{2\alpha}$ (17,12 US$/pecora) fu la fonte più vantaggiosa di reddito extra se paragonato con la spugna vaginale (12,69 US$/pecora) e con le vitamine (13,66 US$/pecora). Gli indicatori economici e le prestazioni ripro - duttive dimostrano l'opportunità di diffondere queste nuove pratiche nel programma di sviluppo della pecora a coda grassa.

Parole chiave: *Valutazione economica, Pecora, Nutrizione, Tecnologia riproduttiva.*

Introduction

There are approximately 25.5 million sheep in Turkey, which ranks it eighth in the world. The sheep industry in the Turkey has been declining for several years. Reasons for this decline include drastic changes in livestock, support policies, ratios between prices of inputs and outputs, rangeland degradation and attractive alternatives for investment. Turkey was once an important supplier of live sheep, lamb and mutton to the Middle East (Gursoy and Sungur, 1997). Turkey is now on its way to being a member of the European Union (EU) and the sheep industry is the single production type to compete in the EU markets (Koc *et al.*, 2001). To reduce the gap between the demand and production of lamb and mutton, it is necessary to augment the reproductive rate of these sheep. Thus the sheep industry requires regrowth by increasing production efficiency with the use of improved technologies. Some of these technologies are hormonal treatment for estrus synchronization associated with increasing prolificacy with co-treatments and nutritional manipulations such as flushing, additive vitamins and minerals (Greyling *et al.*, 1997; El-Hag *et al.*, 1998; Esen and Bozkurt, 2001). The reduction in open grazing land has led sheep owners to adopt semi-intensive management whereby feeding with grains, hay and agricultural by-products has become an integral and important part of the nutrition policy. Improving the nutrition of the sheep under semi-intensive conditions, especially during the mating season, has led to improvements in lamb production (Perevolotsky and Landau, l991; Ginguld *et al.*, 1995). It is also widely documented that vitamins and minerals play an important role in the growth of animals and their physiological functions, as well as their reproductive performance (Gabryszuk and Klewiec, 2002). Emsen and Gimenez Diaz (2004) have underlined the importance of nutritional manipulations and reported that nutritional flushing enriched with both vitamins and minerals has increased overall productivity of fat tailed ewes.

The most economically important trait in sheep production is reproduction and it can be manipulated using hormonal treatments. Although hormonal treatments have

produced desirable results in some studies in Turkey, lack of awareness about their use and the fact that they are not economically viable under most prevailing production circumstances limit their use (Emsen and Yaprak, 2006).

The objective of this study was to investigate economic return of different management systems prior to mating in sheep flocks raised in eastern Turkey.

Material and methods

Data was collected from 560 fat tailed Redkaraman, Awassi and Tuj ewes of mixed ages (1-6yr) reared at the Sheep Research and Application Center, College of Agriculture, Ataturk University, Erzurum. The effects of 3 different feeding regimes and 3 estrus synchronization programs were evaluated. Metabolic energy requirement for maintenance was calculated and 1.0 of the estimated metabolizable energy was met with 1.5 kg dried grass hay ewe/day. Ewes assigned for nutritional manipulations were offered: 1) 1.5 kg dried grass hay ewe/day (non flushed: NF; n.=77); 2) 1.5 kg dried grass hay ewe/day and 300 g barley ewe/day (flushing: F; n.=100) for 21 days; 3) flushed ewes were supplemented with 300 U vitamin E and 9400 U vitamin A which were given daily for 14d prior to mating (VIT, n.=90). Vitamin E and A were administrated by adding them to the drinking water of animals in treatment groups. To evaluate efficiency of different estrus synchronization regimes; nutritionally flushed ewes: 4) were treated with a vaginal sponge containing 30 mg fluorgestone acetate (FGA) (Chrono-gest, Intervet, Boxmeer, The Netherlands) for 14d. After the sponge removal 600 U PMSG (Chrono-gest, Intervet, Boxmeer, The Netherlands) was injected intramuscularly at sponge removal (Sponge and Flushing: SF, n.=113); or 5) received two injections (i.m.) of $PGF_{2\alpha}$ (Estrumate®, 0.5ml, DİF) in 11 day intervals and 600 U PMSG was injected at the second injection (PGF, n.=90); or 6) ewes in the MGA treatment group were offered 0.25 mg MGA in the concentrate (MGA^R 200 premix, Pharmacia & Upjohn Company, Kalamazoo, Michigan 49001, USA) daily for 9 days prior to breeding (MGA, n.=90). Estrus synchronization and vitamin supplementation were started during the flushing and ended at the end of flushing. Thereafter all animals were fed a similar diet that was used in the non flushed group. Animals in the groups were satisfactorily homogeneous in terms of genotype, age, and body condition score. All animals were dry and distance from previous lambing was at least 24 weeks. Trials were conducted in breeding season (November). Vasectomized rams were introduced to mark ewes as they came into heat at the rate of 5 rams per 100 ewes. The animals were screened for estrus beginning after estrus synchronization treatments ended and at the last day of additional feeding supplement continuing up to 6 days. Screening was performed every day at 0900h and at 2100h. Ewes exhibiting behavioral estrus were hand-mated with a ram of proven fertility (ewe:ram ratio of 12:1) at 12 h intervals from the onset to the end of behavioral estrus. Rams were removed 21 days after the date of introduction.

In this study, gross margin was calculated in order to compare the different trials of the production to find the most economical means of production. Gross margin is a value that can be used to compare the most profitable means of production. Gross margin is calculated by subtracting variable costs from gross production value. The trial group with the largest gross margin represents the most economical means of production.

Reproductive performance was measured by fertility, number of animals in estrus within 6 days of ram introduction and the number of lambs born. Also, lamb birth and weaning weights, and survivability rate at weaning were recorded for prolonged productivity. Survivability of lambs was determined by recording the death of lambs until weaning (75 days). Data were analyzed by analysis of variance and means and were compared by Duncan multiple range test.

Results and discussion

The results of this study indicated that estrus synchronization with either $PGF_{2\alpha}$ +PMSG, sponge + PMSG or MGA without PMSG can be done successfully in fat tailed sheep breeds during the breeding season (Table 1). This tight synchrony of estrus with different agents resulted with synchronized lambing in autumn by hand-mated ewes. Most of the lambing (75%) took place over a short period of time (5 days) in the synchronized groups. In the experiment, the onset of estrus occurred in treated ewes, on average, 2 days after sponge withdrawal, compared with 3 days in $PGF_{2\alpha}$ and 6 days in MGA treated ewes. This result is in agreement with Zarkawi (2001) in Awassi sheep in Syria, Jordan treated with sponges and PMSG. This indicates the effectiveness of the hormonal treatment in estrus synchronization. The range observed in the nutritionally manipulated groups is normal since the introduction of nutritional management (flushing procedures) can slightly help to synchronize group lambing.

There was a tendency to an increase in the fertility rate in nutritionally and hormonally manipulated ewes compared to NF groups. This increase was significantly ($P<0.05$) different between MGA treated and NF groups. Following the synchronization of estrus with different treatments during the breeding season, the fertility of naturally mated ewes was found satisfactorily high (89-94%). Fertility results of the study were found similar to other fat tailed breeds such as Akkaraman (Aşkın, 1982; 97%). In general, a higher prolificacy was recorded for the ewes treated with intravaginal sponges. PMSG injection increased litter size 37% in sponge-treated ewes and 14% in $PGF_{2\alpha}$ injected ewes compared with ewes

Table 1. Reproductive performance of fat tailed ewes and growing performance of their lambs.

Treatment	N.	Estrus (%)	Fertility (%)	Prolificacy (%)	Lamb birth weight (kg) mean ± SE	Lamb weaning weight (kg) mean ± SE	Lamb survivability (%)
Nonflushed	77	31.0^{a}	75.0^{a}	133^{ab}	4.2 ± 0.23^{ab}	13.96 ± 1.16^{a}	75.0
Flushed	100	39.0^{a}	86.0^{ab}	119^{ab}	4.5 ± 0.10^{ac}	18.17 ± 0.53^{ab}	83.0
Vitamin	90	54.0^{ac}	91.0^{ab}	125^{ab}	4.6 ± 0.17^{ac}	16.54 ± 1.07^{ab}	90.0
FGA+ PMSG	113	77.0^{bc}	89.0^{ab}	148^{a}	3.9 ± 0.12^{b}	15.50 ± 0.67^{ab}	79.0
PGF2α+ PMSG	90	84.0^{b}	90.0^{ab}	127^{ab}	4.6 ± 0.12^{ac}	18.98 ± 0.63^{b}	80.0
MGA	90	74.0^{bc}	95.0^{b}	111^{bc}	4.8 ± 0.20^{c}	16.83 ± 0.94^{ab}	95.0
		*	*	*	**	**	ns

*^{a,b,c}: Means within columns bearing different subscript (a, b, c) differ significantly at **: P<0.01, *: P<0.05 ns: not significant.*

treated with MGA without PMSG. This increase is of great value to sheep holders, and is similar to that obtained by Lubbadeh (1986) who reported that Awassi ewes in Jordan, treated with sponges plus PMSG, had a twinning rate of 42% compared with 12% for untreated and 10% for sponge-treated ewes without PMSG. Lambing rate increased from 120% in Yankasa ewes treated with sponges without PMSG to 150% in ewes treated with sponges plus PMSG (Oyedipe *et al.*, 1991). Therefore, PMSG is required to stimulate follicular growth leading to higher estrus response (Greyling and Van Niekerk, 1991).

Birth weights of the lambs decreased as litter size increased from singles to quadruplets, which was mostly observed in the sponge treated groups. Nonflushed dam lambs had lower body weights, weaning weights and the lowest survival rate at weaning.

However, in addition to the impracticability arising from prohibitive prices of hormonal preparations and the problems with hormonal administration at the farm level, there are other technical problems associated with the use of these technologies. For example, technologies aimed at increasing litter size in traditional small ruminant production systems should not be applied unless management, including nutrition, can be improved in concert to ensure the survival of the additional progeny.

Reproduction can also be manipulated without the application of exogenous hormones. The nutritionally flushed ewes were observed with a 10% increase in fertility rate. Flushing has been used successfully in sheep to increase ovulation rate and embryo survival (Johnson *et al.*, 1990) but has been reported to be only partially successful in enhancing the reproductive performance of ewes in poor condition (West *et al.*, 1991). The results of the present study are in contrast to those of Molle *et al.* (1995) who flushed ewes for 2 weeks prior to and 3 weeks after ram introduction and observed an increase in ovulation rate and number of lambs born per ewe. Mudd and Mackie (1973) reported that a combined intra-muscular injection of 6 mg selenium with 272 U Vitamin E given 4 weeks before mating to hill ewes at five sites in Scotland significantly ($P<0.001$) increased the proportion of ewes with multiple births from 10.1 to 29.6% which was similar to our results. Such management approaches offer practical options

Table 2. Total productivity and gross production value for 100 ewes.

		Nonflushed	Flushed	Vitamin	FGA+ PMSG	$PGF_{2\alpha}$+ PMSG	MGA
Fertility	%	75	86	91	89	90	95
Litter size		100	102	114	134	114	105
Survivability of lambs	%	75	83	90	79	80	95
Weaning (head)		75	85	103	106	91	100
Av. lamb weight	kg	13.96	18.17	16.54	15.50	18.98	16.83
Total productivity (per 100 sheep/kg)		1047	1544	1704	1643	1727	1683
Live weight price	$	2.41	2.41	2,41	2.41	2.41	2.41
Gross Production Value	"	2523	3721	4107	3960	4162	4056

Table 3. The distribution of variable expenses for 100 ewes ($).

Type of variable expenses	Nonflushed	Flushed	Vitamin	FGA+ PMSG	$PGF_{2\alpha}$+ PMSG	MGA
Barley	-	141	141	141	141	141
Hired Labor Wages	1252	1252	1252	417	417	417
Veterinary Personnel Wages	-	-	-	276	276	-
Sponge, PGF, MGA	-	-	-	586	345	69
Vitamin (E, A)	-	-	77	-	-	-
Total variable expenses	1252	1393	1470	1420	1179	627

Table 4. The quantity of gross margin for 100 ewes ($).

	Nonflushed	Flushed	Vitamin	FGA+ PMSG	$PGF_{2\alpha}$+ PMSG	MGA
(A) Gross Production Value	2523	3721	4107	3960	4162	4056
(B)Total Variable Expenses	1252	1393	1470	1420	1179	627
(A-B) Gross Margin	1271	2328	2637	2540	2983	3429
Gross margin per sheep	12.71	23.28	26.37	25.40	29.83	34.29
Extra revenue per sheep	0	10.57	13.66	12.69	17.12	21.58

for increasing annual lamb production in situations where other technologies are either not available or not appropriate.

Owing to higher fertility (89-95%) and increased litter size (105-134%) total productivity was found superior in hormone treated ewes and ewes supplemented with vitamins (Table 2). Indeed, the size of the litter at birth is an essential component of the productivity of sheep husbandry, which contributes more to the variability of weight in lambs weaned by the ewe than the individual growth of lambs. However, lamb survival greatly influences productivity (Dickerson, 1970). Aboul-Naga (1988) demonstrated a large decrease in lamb survival with increased litter size, emphasizing the need for intensive management practices when higher reproductive rates are achieved (e.g., in the Sponge + PMSG group). It is assumed that if higher litter size is accompanied by acceptable survivability rate in sponge + PMSG treated ewes, total productivity would be greatest in this group. These results suggest that sponge + PMSG and MGA without PMSG are not different for total productivity, and MGA treatment is best suited for management systems using a more traditional system in which total variable expenses are minimum.

Gross margin data for the differently managed sheep are shown in Table 4. Increasing litter size in sponge + PMSG treated group resulted 0.9 times higher than the total variable expenses for traditional management system (NF group) and gross margin was 2 times more than in the NF group. In this research it was clearly shown that the highest gross margin could be obtained with MGA treatment by taking advantage of its low total variable expenses.

Conclusions

Intravaginal sponge and $PGF_{2\alpha}$ combined with PMSG treatment not only

increased litter size in fat tailed sheep but also saved labor by shortening the lambing period. The low cost of the MGA treatment and simplicity of its application are great advantages. This will allow producers to increase their flock productivity using a low cost product compared to other estrus synchronization agents. The supplemental nutrition provided to the fat tailed sheep ewes appears necessary to maintain a high level of ewe reproductive performance, which brings a significant economic return. The shift to feeding strategies prior to mating provides an economic incentive for fat tailed sheep producers in the eastern Anatolia. The increased fertility, prolificacy and weaning weight in differently managed fat tailed ewes, indicate the relevance of using both nutritional and hormonal manipulations in an economic view.

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