EVALUATION OF LAMB PRODUCTION IN RAHMANI SHEEP UNDER TWO REGIMES FOR SUPER-OVULATION

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SUMMARY

The aim of this study was to calculate the net return of two farms each of 500 ewes applying two protocols for superovulation (PMSG treatment and flushing) compared to a control farm. The study included two parts; the first was an experimental study to extract some technical coefficients, while the second was an empirical simulation study. In the first part, 94 Rahmani ewes were divided into three groups. Ewes in all groups were estrous synchronized by two doses (0.5 ml each) of $PGF_{2\alpha}$ (Estrumate) at 11-day interval. Ewes in the 1st (G1) and the 2nd (G2) groups were fed during the pre-mating period (3 weeks) on maintenance requirements, while those of the 3rd one (G3) were flushed by feeding 160% of G1 and G2 requirements during the same period. Ewes of G2 were treated with 750 IU PMSG immediately after the 2nd dose of Estrumate, while the 1st group was kept without treatment as control.

Ovulation rate (OR) measured as number of corpora lutea per ewe mated increased (P<0.05) from 1.54 in G1 to 3.38 and 2.10 in G2 and G3, respectively. The highest average of litter size (LS) and LS alive were observed in G2 (1.73 and 1.59, respectively), while the lowest were recorded in G1 (1.21) for both traits. Lambs weaned per ewe mated were 0.56, 0.83 and 0.89 in G1, G2 and G3, respectively.

In the second part, the annual gross margin per head was LE 11.58, 67.60 and 100.79 in G1, G2 and G3, respectively. Treatment of ewes with superovulation or flushing increased the value added by 44.4 % and 53.9 %, respectively, while the additional cost increased as compared to untreated ones respectively by 14.9 % and 5.7 % only.

It was concluded that, flushing increases the annual profitability of local Rahmani sheep as compared to PMSG treatment and untreated ewes.

Keywords: sheep, PMSG, flushing, lamb production, economic evaluation

INTRODUCTION

Lamb production affects the net return of sheep flocks. Enhancing ovulation rate by increasing feeding allowance before breeding season (flushing) (Ozbey and Tatli, 2002 and Lassoued *et al.*, 2004), or treating ewes with pregnant mare serum gonadotropin (PMSG) (Salama, 1991, Sallam, 1999 and Ozbey and Tatli, 2002) were widely applied to increase lamb production in sheep flocks. Super-ovulation regimes are sometimes accompanied by estrous synchronization to facilitate insemination of

ewes and/or to reduce labor cost of newborn lambs care (Gordon, 1997). Treatment of ewes for estrous synchronization using prostaglandin $F_{2\alpha}$ is a common practice (Sallam, 1999, Hussein *et al*., 2003 and Lethy *et al.*, 2003).

To the knowledge of the authors, no reports are available to compare the net return of sheep flocks using the hormonal treatment to enhance ovulation rate with flushed or untreated ewes, which is the aim of this study.

MATERIALS AND METHODS

The present study was carried out in years 2002-2003 at the experimental farm of Animal Production Department, Faculty of Agriculture, Cairo University, Giza, Egypt. The study included two parts, the first was to derive different technical coefficients, while the second was an empirical economic study to investigate the impact of ovarian enhancement before breeding season on the net return of the farm.

Part 1

Animals and management

Rahmani ewes (n = 94) of the age 3.0±0.1 years with an average body weight of 37.9±0.6 kg were estrous-synchronized with two intramuscular doses of Estrumate (each of 0.5 ml, 125 μ_g Cloprostenol, Coopers Co., England) at 11-day interval.

Ewes were randomly classified into three groups. Ewes of group 1 (G1), as a control, were fed their maintenance requirements (NRC, 1985) for three weeks pre-mating (pre-mating period). To enhance ovulation, ewes of group 2 (G2) were fed as G1 and were injected intramuscularly with one dose of PMSG (750 IU) just after the 2nd dose of Estrumate, while ewes of group 3 (G3) were flushed with 160% of feed requirements of G1 during the pre-mating period.

Throughout the pre-mating period, ewes of G1 and G2 were fed on a daily ration of 0.65 kg of concentrate mixture and 0.15 kg wheat straw (0.45 kg TDN and 80 g total crude protein) per ewe. Daily ration of ewes of G3 was 1.05 kg of concentrate mixture and 0.25 kg of wheat straw. During the rest of the experiment, ewes of G1, G2 and G3 were fed similarly according to their physiological status (pregnancy and suckling). Mineral blocks and water were made available all the time of the experiment.

Estrous detection and mating

Simultaneously with the 2nd dose of Estrumate, fertile rams were introduced to ewes for five days. Estrous expression (ewes showed estrus per those treated by PGF2α), and fertility measures included conception rate (ewes conceived per ewes mated), lambing rate (ewes lambed per ewes mated) and abortion of ewes (ewes aborted per ewes conceived) were recorded. Ovulation rate (number of corpora lutea per ewe mated at day seven after mating) (OR), lambs born per ewe mated (LB/EM), live-lambs born per ewe mated (LLB/EM) and lambs weaned per ewe mated (LW/EM), were also recorded as fecundity traits. In addition to prolificacy traits which included litter size (lambs born per ewe lambed) (LS), LS alive (live-lambs born per ewe lambed) and LS at weaning (lambs weaned per ewe lambed).

To evaluate the effect of estrous synchronization on fertility and fecundity traits, mating of ewes was allowed to take place within five days post the second dose of Estrumate.

Statistical analysis

The data were analyzed using the General Linear Model Procedure (GLM) of SAS (1995) to derive estimates for the measured traits (technical coefficients). Data were adjusted for body weight as regression which was included in the following model underlying each of the measured traits:

$Y_{ij} = \mu + T_i + b\ w_{ij} + e_{ij}$;

where

Y_{ij} = the measured trait;

μ = overall mean;

T_i = effect of treatment (untreated = 1, PMSG-treated = 2 and flushing = 3);

$b\ w_{ij}$ = the partial regression coefficient of each of the measured traits on ewe body weight; and

e_{ij} = a random error.

Part 2

Economic analysis

Technical coefficients obtained from the first part of this study were used to perform a simulation study of a generated flock of 500 breeding ewes to assess the effect of treatments on the economic efficiency of lamb production at weaning.

Farm budget was used as a measure for farm profitability. The measured economic efficiency indicators were gross margin per head in Egyptian pound (LE), output/input ratio, and opportunity cost. The gross margin (GM) of an enterprise or activity is defined as: total gross income-total variable costs. The opportunity cost is the return (=extra income) that would be earned by using one unit of a certain factor of production in the best alternative use to the one being considered (FAO, 2002). Therefore, choosing the system of management depends on the value of opportunity cost obtained due to applying this technique.

Variable costs included: the cost of permanent and casual hired labor (1 agricultural engineer x LE 300/month, 2 workers x LE 200/month and 1 part-time veterinarian x LE 100/month), feeding cost: (LE 0.39/ewe/day in G1, LE 0.40 in G2 and LE 0.42 in G3), hormonal treatment cost: (LE 4.5/ewe in G1 and G3 and LE 27/ewe in G2), and veterinary care: (medicine and drugs) (LE 5/ewe/year for all groups).

While, outputs included lambs weaned (LE 300/lamb), manure (1 m^3/ewe/year x LE 15) and wool (1 kg/ewe/year x LE 0.75). All prices of inputs and outputs were calculated according to a farm gate price of 2002-2003.

RESULTS AND DISCUSSION

Estrous expression and fertility traits

Estrous expression and fertility traits did not differ significantly in all studied groups (Table 1).

Table 1. Estrous expression and fertility traits of Rahmani ewes (LSM±SE) in the control (G1), PMSG treated (G2) and flushing (G3) groups.

Traits	G1	G2	G3
Estrous expression	0.74 [a] ±0.07 (31)	0.84 [a] ±0.07 (31)	0.78 [a] ±0.07 (32)
Conception rate	0.65 [a] ±0.10 (23)	0.65 [a] ±0.09 (26)	0.72 [a] ±0.10 (25)
Lambing rate	0.61 [a] ±0.10 (23)	0.62 [a] ±0.10 (24)	0.67 [a] ±0.10 (24)
Abortion	0.05 [a] ±0.05 (15)	0.00 [a]±0.00 (15)	0.07 [a] ±0.05 (17)

Means within rows with different superscripts are significantly different at 5% level. Numbers between parenthesis represent number of observations.

Fecundity and prolificacy traits

Ovulation rate as well as LS and LS alive were affected (P<0.05) by treatment, however, the other fecundity and prolificacy traits did not differ significantly (Table 2). However, an increase of 220 and 135 % in OR of ewes of G2 and G3, respectively were observed relative to G1.

Table 2. Fecundity and prolificacy traits of Rahmani ewes (LSM±SE) in the control (G1), PMSG treated (G2) and flushing (G3) groups.

Traits	G1	G2	G3
Ovulation rate	1.54 [c] ±0.16 (23)	3.38 [a] ±0.15 (26)	2.10 [b] ±0.15 (25)
Lambs born / ewe mated	0.74 [a] ±0.17 (23)	1.07 [a] ±0.16 (24)	1.06 [a] ±0.17 (24)
Live-lambs born / ewe mated	0.74 [a] ±0.16 (23)	0.99 [a] ±0.16 (24)	0.97 [a] ±0.16 (24)
Lambs weaned / ewe mated	0.56 [a] ±0.15 (23)	0.83 [a] ±0.15 (24)	0.89 [a] ±0.15 (24)
Litter size	1.21 [b] ±0.13 (14)	1.73 [a] ±0.13 (15)	1.56 [a] ±0.12 (16)
Litter size alive	1.21 [b] ±0.12 (14)	1.59 [a] ±0.12 (15)	1.46[ab]±0.12 (16)
Litter size at weaning	0.92 [a] ±0.14 (14)	1.33 [a] ±0.14 (15)	1.33 [a] ±0.13 (16)

Means within rows with different superscripts are significantly different at 5% level. Numbers between parenthesis represent number of observations.

Although there were no significant differences among treatments in the estimate of lambs weaned per ewe mated, it increased by 48 % in PMSG-treated ewes and by 59 % in flushed ewes as compared to untreated animals. Also, LS at weaning increased by 45 % in the superovulated and the flushed ewes compared to control group.

Despite of the observed increase of live-lambs born per ewe mated in G2 as compared to G3 by about 2%, lambs weaned per ewe mated increased in G3 by about 7% compared to G2. This may be due to the increase in pre-weaning mortality in G2.

LS alive was higher ($P<0.05$) in G2, while G3 showed no significant difference when compared to G1 (Table 2).

Farm budget

Using the obtained technical coefficients, the total variable costs of a simulated farm of 500 heads of breeding ewes increased by 14.9% in G2 and by 5.7% in G3 as compared to G1 (Table 3). The feed cost represented the highest component of the annual variable costs in the three studied groups, representing 83.3, 74.1 and 84.2 %, in G1, G2 and G3, respectively. Increase of the total variable costs in G2 by LE 12787 over G1 is due to the cost of PMSG doses (LE 11250) while increasing the total variable costs in G3 by LE 4892 over G1 is due to increasing feed cost.

Table 3. Farm budget for the simulated flocks in the control (G1), PMSG treated (G2) and flushing (G3) groups. (LE)

	G1		G2		G3	
	Mean	%	Mean	%	Mean	%
Gross outputs:						
Meat (lambs weaned)	84000	91.4	124800	94.1	133500	94.4
Manure	7500	8.2	7500	5.6	7500	5.3
Wool	375	0.4	375	0.3	375	0.3
Total gross outputs	**91875**	**100.0**	**132675**	**100.0**	**141375**	**100.0**
Variable costs:						
Feeding	71737	83.3	73274	74.1	76629	84.2
Hormones	2250	2.6	13500	13.7	2250	2.5
Labor	9600	11.2	9600	9.7	9600	10.6
Vet. Medicine	2500	2.9	2500	2.5	2500	2.7
Total variable costs	**86087**	**100.0**	**98874**	**100.0**	**90979**	**100.0**
Total gross margin	**5788**	-	**33801**	-	**50396**	-

The estimate of total gross outputs of the proposed farm was the highest in G3 (Table 3). The increase of the total gross outputs in G2 (by LE 40800) and in G3 (by LE 49500), over G1, is due to increasing lambs weaned / ewe mated (0.83 and 0.89, respectively) compared to the G1 (0.56). The annual number of lambs weaned was the major source of gross outputs in G1, G2 and G3, representing 91.4, 94.1 and 94.4 %, respectively.

Economic indicators

The estimate of total annual variable costs per breeding ewe was the highest in G2, while the estimate of total gross outputs was the highest in G3 (Table 4). Consequently, the annual gross margin per head was the highest in G3 (LE 100.79) followed by G2 (LE 67.60) while it was only LE 11.58 in the control group (G1). Group 3 had the highest output/input ratio (Table 4), which means that it is the most

profitable among the studied regimes. Moreover, application of flushing increased the value added by 53.9% compared to 44.4% in G2.

The present results revealed that, the opportunity cost were LE 3.19 and LE 10.12 in G2 and G3, respectively (Table 4), which means that, each LE 1 added to the annual variable costs - due to superovulation and flushing treatments - earned LE 3.19 and 10.12, respectively, in gross outputs of the two groups over the control group.

Table 4. Economic indicators per head for the simulated flocks in the control (G1), PMSG treated (G2) and flushing (G3) groups. (LE)

Traits	G1	G2	G3
Total gross outputs/head	183.75	265.35	282.75
Total variable costs/head	172.17	197.75	181.96
Gross margin/head	11.58	67.60	100.79
Output/input ratio	1.07	1.34	1.55
Opportunity cost	-	3.19	10.12

GENERAL DISCUSSION

Using two doses of 125 μg Cloprostenol (Estrumate) in synchronization of estrus of Rahmani ewes seems to be insufficient, since about only 79% of treated ewes came to heat. Increasing the dose may improve the response of ewes to estrous synchronization as reported by Sallam (1999), Hussein *et al*. (2003) and Lethy *et al.* (2003).

Increasing ovulation rate following super-ovulation treatment or flushing regimes is in accordance with the findings of Aboul-Naga and Aboul-Ela (1987), Gabr *et al*. (1989), Salama (1991), Deghedy (2000) and Lassoued *et al*. (2004), however the reported average in the present study of ovulations per treated Rahmani ewes was 1.48 in flushed ewes and 3.16 in superovulated one compared to 2.10 and 3.38, respectively.

This indicated that increasing ovulation rate before breeding season of Rahmani ewes would improve farm profitability. The low profit obtained in G2 relative to G3 is most probably due to the increase of hormonal treatment cost relative to feeding cost.

Increasing LS at weaning by 45 % in super-ovulated (G2) and flushed ewes (G3), respectively, relative to the control group, had direct impact on the annual profitability per head averaging LE 56 in G2 and LE 89 in G3 over G1.

Due to the increasing of the annual gross margin per head (LE 100.79), the value added (53.9%) and the opportunity cost (LE 10.12) of G3 over G1, it is recommended to apply the flushing protocol before breeding season to increase farm profitability.

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تقييم إنتاج الحملان فى أغنام الرحمانى تحت نظامين مختلفين للتبويض المتعدد

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أجريت هذه الدراسة بهدف تقدير أربحية مشاريع قطعان الأغنام نتيجة استخدام نظامين مختلفين لتعدد التبويض مقارنة مع قطيع نعاج غير معامل. وقد اشتملت الدراسة على جزئين، الأول منهما تجريبي لإستنباط بعض المعاملات الفنية و التى سوف يتم استخدامها لعمل دراسة محاكاه على قطيع من النعاج يبلغ قوامه 500 نعجة (الجزء الثانى). فى الجزء الأول من البحث تم تقسيم عدد 94 نعجة رحمانى الى ثلاث مجاميع متساوية تقريباً فى العمر و الوزن. تم تنظيم الشياع لنعاج الثلاث مجموعات بحقن كل منها بجرعتين من البروستجلاندين (0.5 مللتر استروميت للجرعة) بفاصل زمنى مقداره 11 يوم. تم تغذية نعاج المجموعتين الأولى و الثانية أثناء فترة ما قبل التلقيح و لمدة ثلاث أسابيع على المقررات الحافظة لها، بينما أجرى دفع غذائي لنعاج المجموعة الثالثة (160 % من المقررات الحافظة). تم حقن نعاج المجموعة الثانية بـ 750 وحدة دولية من مصل دم الفرسة الحامل مباشرة بعد الحقن بالجرعة الثانية من الاستروميت. تم قياس استجابة النعاج المعاملة لتنظيم الشبق و صفات الخصوبة و التوأمية للنعاج. وقد حسبت الميزانية المزرعية لمقارنة المجموعات الثلاث من الناحية الاقتصادية باستخدام هامش الربح السنوى و النسبة بين المخرجات و المدخلات.

ازداد معدل التبويض من 1.54 بالمجموعة الأولى (المقارنة) إلى 3.38 و 2.10 بالمجموعتين الثانية و الثالثة. وقد سجلت المجموعة الثانية أعلى معدل للحملان المولودة و الحملان المولودة حية بالنسبة للنعاج الوالدة (1.73 و 1.59 على التوالى)، بينما تم تسجيل أقل معدل لهما بالمجموعة الأولى (1.21 و 1.21 على التوالى). وقد بلغ معدل فطام الحملان نسبة إلى النعاج الملقحة حوالى 0.56، 0.83 و 0.89 بالمجموعات الثلاث على التوالى.

فى الجزء الثانى من الدراسة وجد أن هامش الربح السنوى للنعجة بلغ 11.60، 67.60 و 100.79 جنيه فى الثلاث مجموعات على التوالى. كذلك وجد أن العائد الاضافى فى المجموعتين الثانية و الثالثة قد بلغ 44.4 % و 53.9 % على التوالى مقارنة بالمجموعة المقارنة، بينما بلغت التكلفة الإضافية فى كلتا المجموعتين 14.8 % و 5.7 % على التوالى.

و لذلك فإن الدفع الغذائى للنعاج قبل موسم التناسل يؤدى الى زيادة الأربحية السنوية لأغنام الرحمانى مقارنة بالمعاملة الهرمونية لزيادة التبويض و كذلك مع النعاج الغير معامل.