

# Evaluation of Hormonal Treatment with Sponges and PMSG on Reproductive Performance and Profitability of Awassi Sheep Reared under Semi-Intensive Management Systems

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تقييم المعاملة بالاسفنجات وهرمون مصلى دم الفرس الحامل على الكفاءة التناسلية والربحية لأغنام العواسي  
المرباة تحت نظام الإدارة شبه المكثفة  
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خلاصة: تعتبر الاسفنجات المهبلية المشبعة بهرمون البرجسترون وحقن هرمون مصلى دم الفرس الحامل (PMSG) من الأساليب الجديدة لتربية الأغنام التي تم عرضها على المربين بهدف تزامن فترة الشياح و الولادة وزيادة التبويض ورفع نسبة الولادات والتوائم. أختيرت قطعان من الأغنام المرباة تحت النظام شبه المكثف. قسم كل قطيع إلى مجموعتين، مجموعة الشاهد ومجموعة المعاملة بالاسفنجات والهرمون وتم تكرار التجربة لسبع مواسم لتقييم الكفاءة التناسلية والأرباحية لهذه التقنية. أظهرت المجموعة المعاملة بالاسفنجات فروقات معنوية ( $P < 0.001$ ) عن مجموعة الشاهد في معدل الخصوبة والولادات والتوائم. حيث كان معدل الخصوبة لمجموعة المعاملة 84.8% مقارنة مع 62.7% لمجموعة الشاهد. وازداد معدل الولادات من 64.9% في مجموعة الشاهد إلى 111% في مجموعة المعاملة. وازداد معدل التوائم من 3.13% في مجموعة الشاهد إلى 29.9% في مجموعة المعاملة. استخدم أسلوب الميزانية الجزئية لتقييم الأرباحية لهذه التقنية وبلغ معدل صافي العائد الإضافي 8,91 دينار اردني/نعجة نتيجة المعاملة. أظهرت المقاييس الاقتصادية والتناسلية أن الجهود المبذولة لنشر هذه التقنية بين المربين واعدة.

**ABSTRACT:** Intravaginal progesterone impregnated sponges and PMSG hormonal injection is a new herding practice for sheep introduced to farmers in order to synchronize estrous and superovulation to increase lambing rate, twinning rate, and to synchronize lambing. Sheep flocks, raised under a semi-intensive system, were selected and divided into two groups; control and treated (sponge and PMSG). The study was repeated for seven breeding seasons to evaluate the reproductive performance and profitability of this practice. Treated groups showed a significant increase ( $P < 0.001$ ) in fertility, lambing, twinning, and prolificacy rates compared to controls. The average fertility for treated groups was 84.8% and whereas for controls, it was 62.7%. Lambing rate increased from 64.9% to 111.0% and twinning rate increased from 3.13% to 29.9% as a result of treatment. Partial budget analysis was used to determine the profitability of this practice. The incremental net return due to hormone treatment was 8.91 JD/ewe.

**Keywords:** hormonal treatment, reproductive performance, profitability, sheep, management system.

Small ruminants are the main source of red meat production in Jordan. In 1997 approximately 15,965 tons of red meat were produced. Of this, about 60% was derived from sheep and 20% came from goats. In addition, 165,000 tons of milk was produced covering 54% of local demand. About 35% of this amount was

from small ruminants (MOA, 1997), thereby indicating the importance of these animals to the national food economy. However, a study conducted by Nör and Ströbel (1966) concluded that the Jordanian small ruminant sector was non-competitive in the global market sense. The sector is unable to cover the

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economic cost of production, especially when opportunity costs of the capital invested and the institutional costs of a subsidy system are included.

Jordanian Awassi sheep exhibit poor fertility, low twinning percentage (<10%) and prolonged lambing seasons, ranging from 2 to 3 months (Abi Saab and Hamaden, 1984). Intensively raised ewes wean one lamb/year whereas in semi-intensive and grazing systems ewes wean only 0.6–0.8 lamb/year (Degen *et al.*, 1987; Harb, 1994a). Long mating seasons result in non-uniform lambs and leads to increased management costs and inefficient use of labor. Estrous can be synchronized by using teaser rams or hormone treatment (Scott, 1982). Attempts to convince farmers to use teaser rams, however, have not been successful (ICARDA, 1990). Regional information indicates that sheep fertility is usually low under extensive production and dryland systems. Moreover, animals are subjected to poor nutrition, harsh environmental conditions, high embryonic mortality, low conception rate and poor flock management (FAO, 1994). Over the last 8 years, a series of strategies for improving the fertility of extensively reared sheep has been introduced. A large number of farmers have been exposed to improved on-farm trials, demonstrations, field days and extension presentations (ICARDA, 1990–1995, ICARDA 1996–1998).

Studies conducted by Christenson (1976) indicated that ewes treated with intravaginal progesterone impregnated sponges and Pregnant Mare Serum Gonadotrophin (PMSG) injections increased twinning rate up to 63% compared to 5% in controls. Moreover, Harb (1994) reported a higher percentage in twinning (23%) in Awassi ewes treated with sponges and PMSG hormone injection compared to only 14% for control groups. It was anticipated that these techniques might increase birth rates during the normal mating season (July–September) and thus increase the income of Jordanian sheep owners. The only limitation to this practice however, appears to be the additional cost of treatments and lack of market accessibility to sponges at times when needed.

The main objective of the present study was to assess whether these newly introduced treatment technologies could provide benefit to Jordanian sheep flocks. In addition, a preliminary economic assessment of the outputs generated by these hormone treatments was undertaken.

### Materials and Methods

Approximately  $76 \pm 19$  adult Awassi ewes were selected from flocks of the northern, middle and southern part of Jordan. All selected ewes were raised semi-intensively. Ewes from each location were selected

TABLE 1

*Sponge and PMSG treatments of various Jordanian sheep flocks during the 1991–1998 breeding seasons.*

Seasons	Treatments	No.		Ewes		No.		Weaning Weight (kg)
		Flocks	Ewes	Giving Birth	Giving Twins	Born Lamb	Weaned lamb	
91/92	Control	3	71	44	2	46	42	16.17
92/93	Control	4	381	276	14	290	274	16.48
93/94	Control	3	105	74	4	78	74	17.40
94/95	Control	3	115	75	0	75	71	16.50
95/96	Control	3	113	67	1	68	67	16.03
96/97	Control	3	141	96	3	99	94	16.73
97/98	Control	3	150	51	1	52	49	16.73
91/92	PMSG	3	60	49	19	69	59	15.63
92/93	PMSG	4	143	131	32	157	140	17.05
93/94	PMSG	3	105	94	27	125	113	18.02
94/95	PMSG	3	118	96	19	115	108	16.27
95/96	PMSG	3	111	89	32	128	121	17.80
96/97	PMSG	3	139	122	47	169	156	16.63
97/98	PMSG	3	150	117	32	149	139	16.63

randomly, ear tagged and divided into two groups. One group received intravaginal sponges impregnated with progesterone for 14 days.

Two days after sponge removal ewes were injected intramuscularly with 500 IU PMSG. Rams were introduced to all ewes 24 hours later and kept in the flock for three estrous cycles. Control groups were left untreated. Sheep were fed *ad libitum* as practiced by farmers. The implementation of this project was undertaken with close cooperation between researchers, extensionists and farmers. Farmers were given the main role, followed by extensionists. Intravaginal sponges and PMSG injections were applied according to the procedures described by Lubbadeh (1986a, 1986b) and Scott (1982). Data collected included: number of ewes exposed to rams, ewes giving birth to singles and twins, number of lambs born, lambing weight, number of weaned lambs and weaning weight (Table 1).

Partial budgeting was used for the evaluation of the economic viability of the technique. Partial budgets are useful in the evaluation of changes including: adoption of a new technology, expansion of an enterprise, alternative enterprises production practices, hiring of a custom operation, rather than purchasing equipment, etc. (Norton, 1988). Partial budgeting is based on the principle that a small change in a farm business will have one or more of the following effects: (1) additional returns to be received, (2) elimination or reduction in some costs, (3) additional costs to be incurred, and (4) elimination or reduction in some returns (Kay, 1981). Positive economic effects include the total of the first two factors, whereas negative economic effects are represented by the sum of the last two parameters. The net incremental return therefore, will be the sum of positive economic effects minus the sum of negative economic effects. A positive net incremental return indicates the potential to increase net returns if a



change is made. Conversely, a negative net incremental return is an estimate of the reduction in net returns if a practice is adopted. The unit used during analyses was one head of sheep but could be applicable to the entire herd. However, the value of partial budgeting analysis is only useful when input data is accurate. A positive net change suggests economic viability and thus supports adoption of an alternate practice and *vice versa*.

Information on costs and returns were collected to construct partial budgets for the practices demonstrated on farmers' herds. Costs cover supplementary operations and inputs required by a given practice in comparison to the control; whereas return was the additional amount of meat produced per treated ewe when compared with controls.

Data on reproductive performance averages over seven breeding seasons (1991-1998; Table 1) was analyzed using SPSS<sup>®</sup> 7.5. The dependent variables were: 1) fertility rate, defined as the number of ewes lambing compared against the number of ewes exposed to rams, 2) twinning rate, defined as the number of ewes bearing twins out of the number of ewes lambing, 3) lambing rate, defined as the number of lambs born, 4) mortality rate, defined as the number of lambs dying prior to weaning and, 5) prolificacy rate which was the number of lambs born by lambing ewes. The independent variables were treatment, location and treatment and location interactions. Least significant differences (LSD) were used to compare between means. Significance was declared at  $P < 0.05$  unless otherwise noted.

### Results and Discussion

A significant improvement ( $P < 0.0001$ ) was detected in fertility, prolificacy, lambing, and twinning rates as a following use of intravaginal progesterone-impregnated sponges and PMSG injections for all ewes at different locations compared with the control groups (Table 2.). The average fertility rates for all hormone treated groups, over the seven seasons, was 84.8% and only 62.7% for the control groups which resulting in a 12.1% increase in fertility due to this technology.

The latter finding agreed with the report of Degen *et al.*, (1987) who observed a fertility rate of 88% in Awassi ewes treated with hormones. FAO (1994) reported a slightly higher fertility rate, which ranged from 91.5 to 98%. This difference likely occurred due to the use of higher concentrations of PMSG. In total, the latter findings and those presented herein agree with those of Al-Khuzaei (1985) who found a 93.7% fertility for Orabi breed treated with sponges and PMSG

Lambing rates increased from 64.9% for controls to 111% in treated groups, with an average increase of 46.1%. The average lambing rate for Awassi ewes in

TABLE 2

*Effect of using intravaginal sponges and PMSG injection on the reproductive performance of Awassi ewes in Jordan.*

Parameters	Treatments				Significance (P value)
	Control		Sponges+PMSG		
	Mean	SEM	Mean	SEM	
Fertility rate	62.70	3.9	84.8	1.7	<0.0001
Lambing rate	64.90	4.2	111.0	3.7	<0.0001
Twinning rate	3.13	0.8	29.9	2.8	<0.0001
Prolificacy	104.80	1.9	130.6	3.1	<0.0001
Mortality rate	5.20	1.1	8.6	1.2	<0.05

SEM = Standard Error of Mean.

Jordan is 80% (Nör and Ströbel, 1996). Moreover, the twinning rate of the treated ewes was 29.9% compared to 3.13% for the control groups. Lubbadah, (1986a) reported an 8% twinning rate for control and 11% for ewes with sponges and 23% when sponges + PMSG injections (750 IU) were used. Moreover, Lubbadah (1986b) found that twinning rates increased to 42% for Awassi ewes when treated with sponges and PMSG (600 IU) compared with 12% for a control group. The application of sponges and PMSG injections with Awassi sheep has been studied using varying hormone doses (Lubbadah, 1986a, 1986b; Harb, 1994) with positive effects upon twinning, ranging between 21-31%.

The prolificacy rate for the seven seasons was 130.7% for the treated groups compared with 104.8% for controls resulting in a 25.8% increase in prolificacy due to the hormone treatment. The present on-farm trials exhibited a significant increase ( $P < 0.05$ ) in mortality rates for the hormone treated groups (Sponges + PMSG) compared to controls (8.6 vs. 5.2% respectively). The increased mortality rate might have resulted due to the higher lambing and twinning rates (111.0 and 29.9%, respectively). No significant differences ( $P > 0.05$ ) were detected between the weaning weights of lambs from treated groups when compared to controls (16.59 vs. 16.96 kg, respectively).

TABLE 3

*Effect of locations on the reproductive performance parameters of Awassi ewes treated with intra-vaginal sponges and PMSG injection.*

Parameters	Treatments						P-value
	North		Middle		South		
	Mean	SEM	Mean	SEM	Mean	SEM	
Fertility rate	82.9	2.8	83.0	3.8	88.1	2.1	0.30
Lambing rate	106.6	6.3	110.2	6.2	116.0	6.7	0.50
Twinning rate	25.7	3.5	35.8	4.9	29.9	5.7	0.30
Prolificacy	127.9	3.8	133.0	5.6	131.5	6.6	0.80
Mortality rate	7.1 <sup>a</sup>	1.7	6.0 <sup>a</sup>	1.2	12.1 <sup>b</sup>	2.2	0.05

<sup>a</sup>SEM = Standard Error of Mean.

<sup>a,b</sup>Means within a row with different superscript are significantly different ( $P < 0.05$ ).



TABLE 4

*Effect of location on the reproductive performance of Awassi ewes raised under semi-intensive systems in Jordan (control).*

Parameters	Locations						P-value
	North		Middle		South		
	Mean	SEM	Mean	SEM	Mean	SEM	
Fertility rate	53.0	5.8	67.6	7.3	69.6	5.5	0.12
Lambing rate	53.9	6.0	70.2 <sup>a</sup>	8.4	74.5 <sup>b</sup>	6.3	0.10
Twinning rate	1.6	0.8	3.3	1.9	6.9	2.6	0.15
Prolificacy	101.6	0.8	109.2	6.5	106.8	2.6	0.30
Mortality rate	3.5	1.5	4.6	1.8	7.2	1.8	0.10

SEM = Standard Error of Mean.

<sup>a,b</sup>Means within a row with different superscript are significantly different ( $P < 0.05$ ).

The effect of different geographical locations (north, middle and south) upon the reproductive performance of hormone treated Awassi ewes is summarized in Table 3. Other than for mortality rates, no significant effect ( $P > 0.05$ ) was observed, for reproductive indicators examined, as a result of using sponges and PMSG injections. The mortality rate was significantly higher ( $P < 0.05$ ) in southern areas when compared to northern and mid-Jordan (12.1, 7.1 and 6.0, respectively). The same trend was found in control groups which was 7.2% for the south, 3.5% for the north and 4.6% for mid-Jordan (Table 4). The lambing rate of ewes in southern control groups was higher ( $P < 0.01$ ) than the north and middle part of the country (74.5, 53.9 and 70.2%, respectively).

In all trials conducted on sheep flocks under semi-intensive management systems during the period 1991-1998, animals treated with sponges and PMSG outperformed controls in economical performance. The additional cost of this practice consisted of the price of sponges impregnated with progesterone, PMSG, the extra feed cost of additional lambs and additional labor costs. The seven season average incremental cost (additional costs and reduced income) was  $5.02 \pm 0.11$  JD/ewe. The total return in treatment and control groups is a product of lamb price. The additional return was the difference between the total return with treatment and total return without treatment; there was no reduced income as a result of this technology. The average incremental return was  $13.94 \pm 4.04$  JD/ewe. As a result the incremental net returns per ewe due to this practice was  $8.91 \pm 4.00$  JD/ewe (Table 5). Therefore, the use of sponge and PMSG hormone treatment on sheep during the regular mating season increased farm income. Many sheep owners are applying these practices on their flocks because they realize their economic benefits. The synchronization rate was 95% and resulted in lambing in a specific period, thereby easing management practices.

TABLE 5

*Partial budget analysis of sponge and PMSG treatments.*

Season	Total Returns		Additional Returns	Additional Cost		Net Returns
	JD/ewe			JD/ewe		
	PMSG	Control	JD/ewe	PMSG	Control	JD/ewe
1991/1992	30.87 (5.12)	19.92 (4.31)	10.94	4.97 (0.09)	NA	5.97
1992/1993	33.42 (3.00)	23.96 (0.83)	9.46	4.98 (0.20)	NA	4.48
1993/1994	39.37 (6.62)	24.69 (5.69)	14.67	5.14 (0.30)	NA	9.53
1994/1995	29.78 (2.09)	20.36 (0.60)	9.42	4.87 (0.02)	NA	4.55
1995/1996	36.81 (6.76)	18.25 (12.26)	18.56	5.06 (0.36)	NA	13.50
1996/1997	37.44 (7.40)	21.80 (7.62)	15.63	5.18 (0.30)	NA	10.45
1997/1998	31.57 (6.50)	12.73 (5.91)	18.84	4.93 (0.34)	NA	13.91
Average	34.18 (3.70)	20.25 (4.01)	13.94 (4.04)	5.02 (0.11)	NA	8.91 (4.00)

Numbers in parentheses are standard deviations.

## Conclusion

The reproductive and economical performance of sponge and PMSG technology introduced to farmers in Jordan were analyzed. The hormone treated groups outperformed control groups in fertility rate, lambing rate, and twinning rate. The economic performance of new technology showed an increase of 8.91 JD/ewe in farmer's net income as a result to adopting this practice. In conclusion, this new hormone treatment technology is suitable for synchronizing the mating period, increasing lambing, twinning rates and net income in ewes.

## References

- Abi Saab, S. and S. Hamaden. 1984. Some reproductive aspects of the Awassi ewe in Lebanon. In: *Proceedings of the 10<sup>th</sup> International Conference on Animal Reproduction and Artificial Insemination, III*, 359. U.S.A.
- Al-Khuzaei, A.D. 1985. Effect of ewe age and nutrition on fertility, prolificacy and dams and lambs performance of Arabia ewes. M.Sc. Thesis. University of Basrah, Basrah, Iraq.
- Christenson, R.K. 1976. Effect of short-term progesterone treatment in induction of estrus and lambing in anestrus ewes. *Journal of Animal Science* 43:745-749.
- Degen, A.A., R.W. Benjamin, and E. Eyal. 1987. A note in increasing lamb production of fat tailed Awassi and German mutton Merino sheep grazing in semi-arid area. *Animal Production* 44:169-172.
- FAO. 1994. *Sheep production under extensive systems in the Near East, Jordan Pastoral System: A case study*. Near East Regional Office, Food and Agriculture Organization of the United Nations.
- Harb, M. 1994. The effect of the use of intravaginal progesterone impregnated pessaries and PMSG on the reproduction

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- performance of Awassi sheep. *Dirasat-Pure and Applied Science* 21b:149-161.
- ICARDA. 1990-1995. Increased productivity of barley, pasture and sheep-Mashreq project. *Annual Reports (1989/90-1993/94)*. West Asia Regional Research Program, Amman, Jordan.
- ICARDA. 1996-1998. The development of integrated crop/livestock production in low rainfall areas of West Asia and North Africa-Mashreq-Maghreb project. *Annual Reports (1994/95-1996/97)*. West Asia Regional Research Program, Amman, Jordan.
- Kay, R.D. 1981. *Farm Management: Planning, Control and Implementation*. McGraw-Hill Publishing Co., New York, U.S.A. p 69-75.
- Lubbadeh, W.F. 1986a. The use of progesterone and PMSG in the control of estrus and twinning in Awassi sheep". *Dirasat* 13:85-91.
- Lubbadeh, W.F. 1986b. Estrus synchronization and increasing twinning rate in Awassi sheep. *Dirasat* 13: 55-66.
- MOA. 1997. *Annual Report of Livestock Directorates*. Ministry of Agriculture. Amman, Jordan.
- Nör, B. and H. Ströbel. 1966. Application of a regional sector model for the evaluation of livestock sector production system in Jordan. *Seminar on Livestock Policy Analysis in Jordan*. 24-26 March 1966, Amman, Jordan.
- Norton, R.D. 1988. *Policy Analysis for Food and Agricultural Development: Basic Data Series and their Uses*. Report prepared for the Office of International Cooperation and Development, United States Department of Agriculture.
- Scott, G.E. 1982. *The Sheepman's Production Handbook*. Sheep Industry Development Program Inc., Abegg Printing, Co., Inc., Denver, Colorado. pp 2-10.

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