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Impact of Shearing Date on Behaviors and Performances of Pregnant Rahmani Ewes

T. M. Mousa-Balabel* and M. A. Salama

Abstract**—**The effect of shearing date on behaviors and performances of 20 pregnant Rahmani ewes was evaluated in four groups (5each). Ewes were shorn at 70, 100 and 130 days of pregnancy in the first three groups respectively, while the fourth group was maintained unshorn as a control. Some behavioral and physiological data related to ewes in addition, blood cortisol level were recorded. Results revealed a significant increase in the frequencies of comfort and eating behaviors, respiratory rate, pulse rate, lamb birth weight and blood cortisol level in early and mid pregnancy shorn ewes. Also, a slight increase in pregnancy period was observed for those ewes. On the other hand, social behaviors, and core temperature were not affected by shearing. These results conclude that prenatal shearing (early and mid-pregnancy) of ewes increases the frequencies of comfort and eating behaviors, and improves the survival rates of lambs by increasing their birth weights.

Keywords**—**behavior, blood cortisol, pregnant rahmani ewes, shearing.

I. INTRODUCTION

SHEEP are normally shorn twice a year, once in autumn and then again in late winter. Winter shearing usually takes place during pregnancy, which increases energy requirements and voluntary food intake. Shearing may improve the utilization of dietary protein and enhance the mobilization of maternal fat reserves, thus justifying its necessity for the well-being of sheep. Shearing, however, is also considered a stress factor on sheep, capable of causing some behavioral changes including comfort behavior that change immediately after shearing [1].

The respiration rate represents a significant and accessible indicator for the evaluation of stress. The physiological responses to shearing include decreased respiration rate, increased heart rate and a fall in body temperature [2]. Hargreaves [6] mentioned that the elevation in cortisol level due to shearing process may indicate a challenge to the welfare of sheep. Cortisol levels therefore, are a helpful indicator of short-term stresses from handling or husbandry procedures such as shearing. Moreover, corticoid levels increase regardless of the method used, and noise, heat, and contact with the shear are believed to be responsible for this reaction [11] while Symonds [16] found no effect of shearing on cortisol level.

Comparison of the shearing date during the period of pregnancy with the performances of ewe produced some interesting trends. Shearing date has been shown to affect placental development and the birth weight of lambs [8]. Ewes shorn in early pregnancy, 70 days after union with rams, have lambs heavier at birth than those shorn in late pregnancy (pre-lamb) or summer shorn (after lambing).Trials recently undertaken in Marlborough confirmed that shearing earlier in pregnancy resulted in better lamb survival and fewer ewe deaths than when ewes were shorn in late pregnancy. Mid-pregnancy shearing has been shown to increase birth weights of single- and twinborn lambs under housed [2, 4, 19] and pastoral conditions [7]. Moreover, the lambs born from shorn ewes grew on average 20% faster than those from unshorn ewes over the first 30 days of lactation [17]. Lamb deaths represent a considerable economic loss to the sheep industry each year. One of the main causes of neonatal death is low birth weight lambs, which are much more susceptible to death during the neonatal period than heavier lambs [5], especially under adverse conditions [18]. Mortality rates decreased from 35.8% in lambs born to unshorn ewes to 18.5% in lambs born to shorn ewes. In addition, winter shearing increased the gestation period and lamb birth weight, and it may even stimulate ewe milk production and result in faster lamb growth rate. Therefore, any management practices that are able to reduce the incidence of low birth weights of lambs will likely increase lamb survival rates. The objective of this study was to determine the effect of shearing date on the behaviors and performances of pregnant Rahmani ewes.

II. MATERIALS AND METHODS

A. Animals and management

In order to study the effect of shearing date during pregnancy on their behaviors and performances, 20 adult, apparently healthy, Rahmani pregnant ewes with an average age of 4 years and an average body weight of 49±0.5 kg were selected. These animals were raised at Animal Production Research Station, Mehallet-Mousa, Kafr EL-Sheikh Governorate, Egypt. These animals were divided into four groups (5 each). Ewes in the first group were shorn at 70 days of pregnancy; at 100 days in the second group and at 130 days in the third one, while the fourth group was maintained unshorn as a control. The animals were kept in open shaded pens with a stocking density of 2 m^2/head. They were fed, during the course of experiment, green fodder, concentrates and hay in rates of 10, 0.75 and 2 kg/head/day, respectively

*Tarek Mahmoud Mousa-Balabel (corresponding author) is with Department of Hygiene and Preventive Medicine, Faculty of Veterinary Medicine, Kafr EL-Sheikh, University, Egypt. Current address: Tottori-shi, Mihagino 1chome 55-3 Ken Ju 51 Gou. Postal code. 689-0202. Tel. +81-80-6302-4217, Fax. +81-857-59-1775. (e-mail: balabel_2006@yahoo.com)

Mahmoud Abdel-Momen Salama is with Animal Production Research Institute, Ministry of Agriculture, Egypt. (e-mail: osostoto2008@gmail.com).

and watered three times daily in the morning, noon and late afternoon. Shearing process was conducted by the along method beginning from the neck toward the tail, described by Outhouse [10] using an electric shearing machine. Shearing time for each ewe was 40 to 50 minutes.

B. Measurements

Some physiological parameters; respiratory rate, pulse rate and core temperature were recorded before shearing, just after the shearing process and 3 hours after shearing.

Gestation period and lamb birth weight were recorded.

Lamb mortality rate up to one month old was recorded.

Blood cortisol level was estimated. All measurements were always taken between 10.00 and 11.00 a.m.

C. Meteorological conditions

The average environmental temperature and mean relative humidity levels on the experimental days were 28°C and 60%.

D. Behavior observation

Behavioral patterns were recorded as a frequency, directly by video camera for 3 hours, after shearing. The observed behaviors were categorized into three different groups, namely, comfort behavior (oral grooming, head shaking, complete body shaking and standing idle), feeding behavior (eating concentrates and hay and drinking water) and social behavior (calling, walking and butting).

E. Blood samples and assay

5ml of blood was drawn from the jugular vein of each ewe before shearing, just after the shearing process, 1, 2, and 3 hours after shearing, following the procedure described by Symonds [16]. Cortisol levels in blood serum were determined by using Competitive Colorimetric Immunoenzymatic technique as described by Rolleri [13]. This analysis was conducted at Sakha Animal Production Research Station of the Ministry of Agriculture, Kafr EL-Sheikh, Egypt.

F. Statistical analysis

Data relating to each parameter were subjected to statistical analysis, using one way ANOVA and T-test following Snedecor [14]. Measurements related to respiratory rate, pulse rate, core temperature and blood cortisol level, which were recorded after the shearing process, were compared within groups against those before shearing.

III. RESULTS

The effects of shearing during pregnancy on the frequency of the behaviors in ewes are presented in Table 1. A significant difference in the patterns of comfort behavior between shorn (early, mid and late periods) and unshorn ewes was observed, details of which are as follows. Frequency of oral grooming and complete body shaking were significantly ($P<0.05$) higher in shorn (for early, 19.3 and 2.7, for mid, 17.5 and 2.5 and for late, 14.3 and 2.3) than unshorn ewes (2 and 1.9) for the mentioned patterns, respectively. While, the frequency of head shaking and standing idle were lower in shorn (for early, 0.9 and 2.8, for mid 1.1 and 3.6 and for late, 1.3 and 4.1) than unshorn (1.5 and 4.9) ewes for the stated patterns, respectively.

Regarding the effects of shearing on the frequency of feeding behaviors are shown in Table 1. The frequency of eating behavior increased by shearing in early, mid and late pregnancy periods (38.7, 35.1 and 32.6 *vs.* 30 for control), where as the frequency of drinking water decreased as a result of shearing in all shorn ewes (2.7, 3.1 and 3.4 *vs.* 4.1). Meanwhile, the frequency of the patterns of social behavior for shorn ewes such as calling (1.9, 1.8 and 1.8), walking (38.1, 37.9 and 38.5) and butting (0.6, 0.5 and 0.5) did not differ significantly from unshorn ewes (1.7), (38.3) and (0.6) for the stated patterns, respectively.

The impacts of shearing during pregnancy period on some physiological parameters and lamb performance are shown in table 2. A considerable increase ($P<0,05$) in the respiratory rate (38.4, 38.5 and 39.2 breathes/minute) and pulse rate (96, 98 and 99 beats/minute) of all shorn (early, mid and late shearing) ewes was observed just after shearing, compared with pre-shearing data (28.4, 29.5 and 30.2 breathes/minute for respiration rate and 66, 68 and 70 beats/minute for pulse rate). But, all records for respiratory and pulse rates returned to normal values within 3 hours after shearing. The rectal temperatures, of the entire sheep population did not show any significant difference ($P<0.05$) for all shorn ewes, measured immediately after shearing (39.5, 39.6 and 39.5 °C) and 3 hours after shearing (39.3, 39.2 and 39.5 °C) compared with those before shearing (39.1, 39.3 and 39.4 °C). However, a slight increase in gestation period of early and mid pregnant shorn ewes (148.5 and 148 days) was observed, while, the gestation lengths remained similar (147days) for those shorn in late pregnancy and the control ewes.

Early and mid pregnancy shearing significantly ($P<0.05$) increased the lamb birth weights (3.8 and 3.7 kg, respectively). Meanwhile, late pregnancy shearing did not affect the lamb birth weights, which remained similar to those for the control (3.2 kg) ewes. In addition, lamb survivability improved due to early and mid pregnancy shearing in comparison with that applied in late pregnancy, as the mortality rate was lower in lambs for early and mid pregnancy shorn (0 and 12.5 %) ewes than for late and the control (14.3 %) ones. A significant ($P<0.05$) increase in blood cortisol level immediately after shearing for all shorn ewes in comparison with the pre-shearing levels (159.3 *vs.* 35.1 ng/ml, 168 *vs.* 37.3 ng/ml and 177 *vs.* 39.8 ng/ml for early , mid and late shearing, respectively) is shown in Table 3. The level of cortisol subsequently decreased to reach the baseline levels within 3 hours after shearing.

TABLE I
EFFECT OF SHEARING DATE ON THE FREQUENCIES OF BEHAVIORS OF PREGNANT RAHMANI EWES

Items	Comfort behavior			Feeding behavior			Social behavior		
Treatment	Oral grooming	Head shaking	Complete body shaking	Standing idle	Eating	Drinking	Calling	walking	butting
Shorn at 70 days	19.3±0.8[a]	0.9±0.7[a]	2.7±0.3[a]	2.8±0.3[a]	38.7±1.1[a]	2.7±1.2[a]	1.9±0.5[a]	38.1±0.2[a]	0.6±0.9[a]
Shorn at 100 days	17.5±0.6[c]	1.1±0.3[a]	2.5±0.2[a]	3.6±0.1[c]	35.1±0.9[c]	3.1±0.8[c]	1.8±0.3[a]	37.9±1.3[a]	0.5±0.7[a]
Shorn at 130 days	14.3±0.4[d]	1.3±0.6[a]	2.3±0.5[a]	4.1±0.5[d]	32.6±0.6[d]	3.4±0.3[d]	1.8±0.6[a]	38.5±1.6[a]	0.5±0.6[a]
Control	2±0.5[b]	1.5±0.7 [a]	1.9±0.6[b]	4.9±0.9[b]	30±1.3 [b]	4.1±0.6 [b]	1.7±0.4[a]	38.3±0.9 [a]	0.6±0.8[a]

a, b: $P < 0.05$ among the groups, within the same control data.

TABLE II
EFFECT OF SHEARING DATE ON SOME PHYSIOLOGICAL PARAMETERS AND PERFORMANCES OF PREGNANT RAHMANI EWES

Items	Physiology									Performances		
	Respiratory rate (breaths per min)			Pulse rate (beats per min)			Body temperature (°C)					
Time	Before shearing	Just after shearing	3 Hours after shearing	Before shearing	Just after shearing	3 Hours after shearing	Before shearing	Immediately after shearing	3 Hours after shearing	Gestation Period (day)	Lamb birth Weight (kg)	Mortality Rate (%)
Shorn at 70 days	**28.4±1.5[a]**	**38.4±1.3[a]**	**28.4±1.2[a]**	**66±1.1[a]**	**96±1.3[a*]**	**68±1.4[a]**	**39.1±0.3[a]**	**39.5±0.5[a]**	**39.3±0.6[a]**	**148.5±0.5[a]**	**3.8± 0.1[a]**	**0 ±0.01[a]**
Shorn at 100 days	**29.5±1.2[a]**	**38.5±1.4[a]**	**28.5±1.5[a]**	**68±0.8[c]**	**98±0.9[c*]**	**70±0.6[c]**	**39.3±0.6[a]**	**39.6±0.4[a]**	**39.2±0.3[a]**	**148±0.7[a]**	**3.7±0.3[c]**	**12.5±0.3[c]**
Shorn at 130 days	**30.2±0.9[a]**	**39.2±0.8[a]**	**29.2±1.1[a]**	**70±1.3[d]**	**99±1.2[c*]**	**71±1.1[c]**	**39.4±0.7[a]**	**39.5±0.9[a]**	**39.5±0.8[a]**	**147±0.3[b]**	**3.2±0.6[b]**	**14.3±0.6[b]**
Control	**24.5±1.1[b]**	**25±1.2[b]**	**24.6±0.9[b]**	**73±0.9[b]**	**74±0.7[b]**	**73±0.9[b]**	**39.2±1.1[a]**	**39.3±1.5[a]**	**39.3±1.2[a]**	**147±0.4[b]**	**3.2±0.2[b]**	**14.3±0.1[b]**

a, b: $P < 0.05$ among the groups, within the same control data; *: $P < 0.05$ vs. before shearing, within the same group.

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TABLE III
EFFECT OF SHEARING DATE ON BLOOD CORTISOL LEVELS IN PREGNANT RAHMANI EWES (NG/ML)

Treatment	Before shearing	Immediately after shearing	One hour After shearing	Two hours after shearing	Three hours after shearing
Shorn at 70 days	35.1± 0.8[a]	159.3± 1.3[a*]	96± 1.6[a*]	60± 1.4[a*]	34.5± 1.1[a]
Shorn at 100 days	37.3±0.5[c]	168±1.5[c*]	104±1.2[c*]	65±1.7[c*]	36.7±1.8[a]
Shorn at 130 days	39.8±0.6[d]	177±0.9[d*]	109±1.4[d*]	72±1.3[d*]	38.9±1.5[d]
Control	28.2±1.1[b]	28.5±1.3[b]	28.7±1.5[b]	28.4±0.9[b]	28.6±0.7[b]

a, b: $P < 0.05$ among the groups, within the same control data; *: $P < 0.05$ vs. before shearing, within the same group.

IV. DISCUSSION

The aim of the present study is to determine the applicability of shearing during pregnancy of ewes under large-scale commercial conditions as a management technique to increase the birth weight of lambs and their survival. Shearing is necessary to enhance the physical welfare of the animals, as domesticated sheep do not shed their wool naturally. Immediate benefits of shearing include greater comfort, particularly in hot weather, and the correction of "wool blindness" in closed-faced breeds. The increase in the patterns of comfort behaviors (oral grooming and complete body shaking) due to shearing treatment on 70, 100 and 130 days of pregnancy can be explained following the suggestions offered by Benjamin [1], who mentioned that the skin of ewes immediately after shearing, presents different set of cutaneous stimuli than that in the fully fleeced condition leading to some grooming or rubbing actions. The frequencies of head shaking and standing idle that decreased due to shearing may be attributed to the increase in the feeding behaviors. The existence of a relationship between shearing and eating behaviors is well demonstrated as all shorn pregnant ewes are more likely to eat than unshorn ewes. The increased food intake due to shearing has been reported previously [19, 2] and persisted until lambing, probably due to the removal of the fleece, which increased heat production to maintain body temperature post shearing, and caused a reduction in heat stress in late pregnancy. On the other hand, shearing of ewes during pregnancy and the decrease in drinking behavior could be due to a reduction in heat stress caused by fully fleeced animals and a small amount of heat loss that occurs through cutaneous evaporation.

Respiration rate, pulse rate and body temperature are widely used physiological indicators for studying stress and adaptation to the environment. The considerable increase in respiratory and pulse rates after shearing, which continues for a short period after shearing, subsequently within 3 hours return to normal values, similar to those before shearing and the control ewes. On the other hand, rectal temperatures recorded after shearing did not differ from those obtained before shearing and the control ewes. The slight increase in gestation length in all shorn ewes was in agreement with the findings of Revell [12], who recorded a slight increase in the gestation period in the shorn ewes. However, this increase does not account for the increase in lamb birth weights.

Lamb birth weights were increased by early and mid-pregnancy shearing by 0.6 and 0.5 kg compared with lambs born to late-pregnancy shearing and unshorn ewes, respectively. Same results were recorded by Cam [3], who reported that lambs born to mid-pregnancy shorn ewes were heavier than their counterparts born to unshorn ewes. The shearing of ewes at housing increased lamb birth weight due to increased silage intake probably associated with cold stress immediately post shearing, reduced heat stress in late pregnancy and gestation length**,** but contrary to the observations of Black [2] who reported no effect. The percentage of lamb mortalities for early and mid-pregnancy shorn ewes was lower than those from late shorn and unshorn ewes. This may be explained by the observations of Morris [9] and Kenyon [7] who recorded that mid-pregnancy shearing increases lamb survivability which is related to the increase in lamb birth weight, increase in numbers of ewes seeking shelter, reduction in wool around udder facilitating teat location and reduction in numbers of ewes becoming recumbent.

A significant increase in the blood cortisol level was observed in all shorn ewes compared with the values before shearing and that for the control ewes, which subsided gradually till its return to the baseline level. These results could be related to the emotional stimuli of restraint and contact of shears that stimulate the HPA axis leading to acute cortisol responses, which after reaching the peak level, fall again by negative feed back mechanism. The obtained results are in concert with those obtained by Hargreaves [6] but disagree with the findings of Symonds [16], who reported that the decline of cortisol to the base level occurs within 90 minutes after shearing. Additionally, the changes in plasma cortisol concentrations have been used to assess acute distress responses to a wide range of noxious or potentially noxious

husbandry practices [15]. Moreover, Hargreaves [6] mentioned that a stress response (elevation in cortisol level) to shearing may indicate a challenge to the welfare of sheep. The cortisol measurements therefore, are a useful indicator of short-term stresses from handling or husbandry procedures such as shearing.

V. CONCLUSION

Results from this study indicate that early and mid-pregnancy shearing is beneficial to sheep producer as it increases the frequencies of ewes' comfort and eating behaviors and birth weight of lambs consequently improving the survival rate of lambs. In spite, shearing is considered as a type of stress leading to increase the cortisol blood level.

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