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BEHAVIOUR AND PHYSIOLOGICAL RESPONSES OF ABOU-DELIK SHEEP TO SHEARING STRESS IN HALAIB-SHALATEEN-ABOURAMAD TRIANGLE

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SUMMARY

Shearing has been reported to impinge on the productivity, health and welfare of sheep. The present study examined the effect of shearing and its time on behavioral, physiological and performance responses of Abou-Delik sheep; a native breed in Shalateen - Halaib - AbouRamad triangle region. Forty five male of this breed (12-15 months of age) were assigned to three equal groups (15 each). Group one (G1), was left unshorn to serve as a control, while the other two groups were hand shorn either in the early morning (G2) or in the afternoon (G3). The assessed variables were some behavioral activities (ingesting and ruminating frequency, locomotion and rest time) and physiological responses (hematocrit %, glucose level and cortisol concentration) in addition to body weight gain within 2 weeks as a productive aspect.

Results showed that, there was a significant effect of shearing on ingestive and ruminating frequencies, as it reduced these behaviours and consequently decreased ($P<0.05$) the body weight gain of sheep. However, there was no significant effect of time of day on body weight gain in this study. Meanwhile, shearing reduced the resting time and increased the locomotor's activities among the shorn sheep while time of the day was of insignificant effect on these responses.

Regarding physiological responses, there was a significant elevation in plasma cortisol, hematocrit % and glucose level due to shearing procedure. The elevation was higher in G3; that shorn in the afternoon time; than the other two groups.

It could be concluded that, shearing sheep is an important management practice to take in account for sheep husbandry. Moreover, shearing must be made less stressful by minimizing physical manipulation and social disruption to sheep.

Keywords: sheep, shearing, behaviour, physiology, body weight gain

INTRODUCTION

Community concern about methods of farm animal production has mainly concentrated on the intensive animal industries. But recently attention has shifted to grazing industries, in particular the welfare aspects of sheep production. However, more information is needed before judgments or decisions concerning the welfare of sheep can be made (Townend, 1985 and Whilloughby, 1988). Recently, welfare issues have gained greater prominences as awareness and attitudes of the community to the treatment of farm animal changes (Selye, 1976 and Hargreaves and Huston, 1990 Hargreaves and Huston, 1990 c and d).

A number of studies reported that many routine sheep handling procedures are stressful in that they result in elevated levels of corisol, glucose, hematocrit and heart rate (Pierzchala *et al.*, 1988). The most stressful of these procedures is shearing (Hargreaves and Huston, 1990 a). Shearing is a management practice performed for economic purposes and to protect the animal from skin parasites and diseases.

In Egypt, shearing usually takes place once a year, in April- May. Shearing has been reported to impinge on the productivity (Ensminger, 1979, El-Hadi, 1988 and Morris and McCutcheon, 1997), health (Baker, *et al.*, 1982, Sumner *et al.*, 1992 and Newman *et al.*, 1996), and welfare of sheep (Hill, 1983; Hargreaves, 1988; Hargreaves and Huston, 1990b and Gross and Siegel, 1993). The wool or hair is removed by noisy, sharp scissors which are capable of cutting both wool and skin and consequently the sheep become under stressful conditions. Also, wool removal is of a fundamental importance to wool harvesting, yet it is the prime contributor to the stress response to shearing (Hargreaves and Huston, 1990 b).

Gross and Siegel (1993) reported that responses to stress can include anatomical, physiological and/or behavioural changes. Plasma cortisol and/or corticosterone are frequently used as criteria for measuring response of stressors. Cortisol is a useful indicator of short term stresses such as transport and handling. It is a time dependent measure that takes 10 to 20 minutes to reach peak values (Grandin, 1997). Cortisol secretion is regulated by hypothalamin-pituitary-adrinal axis and there are various factors reported to affect its secretion among which, circadian rhythm, stress factors and negative feed back mechanism.

The present study aimed to investigate the response of Abou-Delik sheep to shearing and its time of day, which are thought to indicate different aspects of response to stressors, in terms of behavioural (ingesting, rumination, locomotion activities and resting behaviours), physiological (plasma cortisol, Ht% and glucose level) responses and body weight gain as productive aspect.

MATERIALS AND MEHODS

Forty five male of Abou-Delik sheep (12-15 months of age) raised at Hedraba Research Station, which belongs to the Desert Research Center at the Southern eastern Zone of Egypt, were maintained under grazing (free range) conditions until one week prior to shearing. Animals grazed natural vegetations dominant in the area (*Panicum*) for 8 hours daily and after return from the pasture, they were supplemented with concentrate feed mixture (43% yellow corn, 22% cotton seed meal, 20% wheat bran, 12% rice bran 1.5% limestone, 1% sodium chloride and 0.5% minerals mixture) at the rate of 500 g/head/day covering their maintenance requirement of energy (Kearl, 1982).

Animals were assigned to one of three equal groups (15 each). Group one (G1) was kept unshorn and served as a control while the other two groups were hand shorn either in the early morning (G2, 07.00 hr) or in the afternoon (G3, 14.00 hr). Each group was kept in covered pen in front of the shearing yard and had access to water *ad libitum*. Shearing was carried out in May for all station flock inside a covered yard with a wooden floor. The entire fleece was removed using very sharp, well greased scissors (hand shearing).

Parameters measured

1. Behavioural measurements

Daily observation was made between 07.00 and 10.00 hr and between 14.00 and 16.00 hr for one week after shearing. The following behavioural patterns were observed and recorded during the observation time for each group of sheep.

A. Ingesting behaviour including feeding frequency (taking food while standing or laying)
B. Ruminations: chewing and regurgitating food while standing or laying and its frequency of occurrence (Amold, 1976)
C. Locomotor behaviour: the time spent resting or sleeping during observation time (Friend, 1991)

2. Stress indicators determination

Cortisol level, hematocrit% and glucose level were recommended as physiological responses (indicators) to the stressful conditions (Hagreaves and Hutson, 1990 b and d). Blood samples were collected via vein puncture using vacutainer tubes. Six blood samples were taken from each animal of the three groups as follows; 15 minutes prior to shearing, just after shearing, 15, 30, 60 and 90 minutes post shearing according to Hargreaves and Hutson (1990 a and b) to elucidate the immediate response to shearing stress.

Samples were centrifuged at 3000 r.p.m. for 15 minutes to obtain clear plasma that stored at -20 °C till further analysis. Hematocrit percentage was determined in fresh blood samples using Wintrob tubes. Glucose was determined using commercial kits, supplied by Biodiagnostic Company, Cairo, Egypt. (Enzymatic color test on basis of Trinder-reaction (Trinder, 1969).

Cortisol was determined using radioimmunoassay (RIA) according to the method of Jephcott *et al.*, 1986 in duplicate with two dilutions using commercial antisera (st C100, Steranti Resead, St. Albans, UK (Meyer *et al.*, 1988). This analysis has been carried out in the laboratory of the Nuclear Research Center, Atomic Energy authority, Anshas, Egypt.

3. body weight gain

The initial body weight of all groups was recorded immediately before shearing and the final body weights were also recorded after 2 weeks of shearing to calculate the body weight gain of each treated group as a productive aspect according to Al-Jaryan (1996) and Scobie, *et al.* (1998).

Data was statistically analyzed by two-way analysis of variance utilizing general linear model (GLM) of SAS (1998) and differences between means were tested using Duncan (1955).

RESULTS AND DISCUSSION

The welfare of an animal is its state as regards its attempts to cope with its environment. There is more than one measure that shows there is a problem or the animal is severely affected by the treatment. The most obvious indicators are changes in behaviour which show that some aspects of the situation are aversive (Hill, 1983). Physiological changes are associated with the behavioural responses which were in agreement with those reported by Hargreaves and Hutson (1990 a & b) on Merino sheep and Fayed (2001) on Barki sheep .

1. Behavioural responses to shearing

A- Ingesting behaviour

Fear is a hypothetical state of the brain or neuroendocrine system that under certain conditions exerts certain forms of behaviour. Results revealed that the shorn sheep showed lower frequency of eating in comparison with the unshorn control group. The eating frequency was significantly ($P<0.05$) reduced immediately and for one week after shearing among sheep shorn in the afternoon. The recorded frequencies were 18.32±3.9, 11.31 ± 2.3 and 8.18 ± 1.8, for animals in control, G2 and G3 groups, respectively (Table 1). Time of day had a significant effect on eating frequency.

Regarding rumination, shorn sheep showed a decline ($P<0.05$) in frequency of rumination (8.3 and 5.71) than their unshorn counterparts (12.22). There was no significant effect due to time of day on rumination frequency.

B- Locomotor's activities and resting behaviour

There was a significant ($P< 0.05$) effect of shearing on the locomotor activities and resting behaviour while there was no significant effect of the time of day of shearing (Table 1). The shorn sheep spent more time walking, running (34.12 and 33.11 vs. 24.7min.) and less time resting (23.24 and 22.18 min.) than control one (32.1 min.). The less time spent resting might be due to the pain caused by shearing or might be due to the fear reaction as a result of shearing noise or accidental injury of skin. This result coincided with that observed by Dyrmundsson (1991) and Friend (1991). The observed results in the present study agreed with that recorded by Webster and Lynch (1966); Al-Joryan (1991) and Fayed (2001). Rushon and Cogdon (1986) and Hargeaves (1988) stated that, electroimmiobilization due to shearing might exacerbate the behavioural response.

Table 1. Behavioural responses (Mean ± SE) of shorn and unshorn Abou-Delik sheep

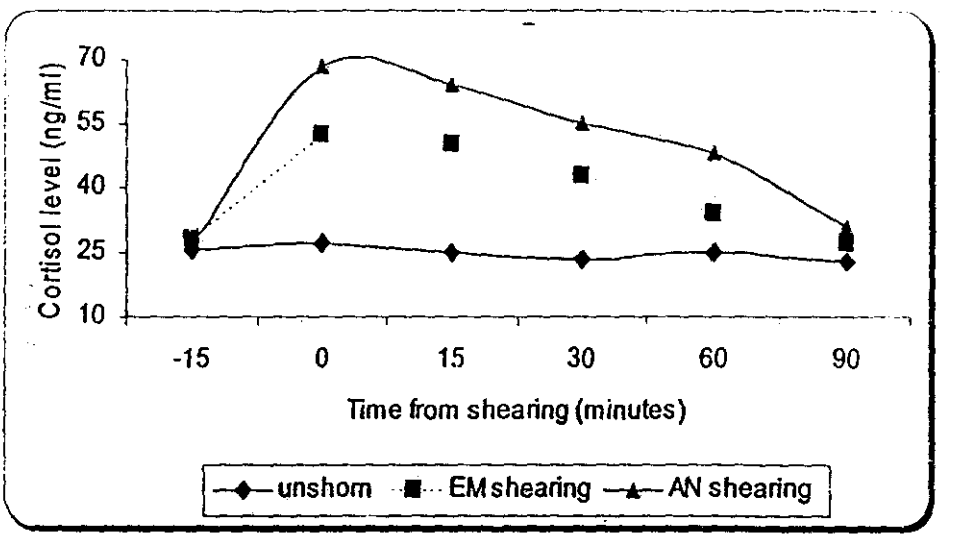
Parameters	Experimental groups		
	Unshorn	Hand shorn (early morning)	Hand shorn (afternoon)
Ingesting eating frequency	18.33 ± 3.9^{a}	11.31 ± 2.3^{b}	8.18 ± 1.8^{c}
Rumination frequency	12.22 ± 2.1^{a}	8.31 ± 1.9^{b}	5.71 ± 1.1^{bc}
Resting behaviour (min)	32.1 ± 2.3^{a}	23.24 ± 1.9^{b}	22.18 ± 1.7^{b}
Locomotor activity (min)	24.7 ± 2.1^{a}	34.12 ± 3.2^{b}	33.11 ± 2.8^{b}

Means with different superscript in the same row are differed significantly at $P<0.05$

2- Physiological response to shearing

Hematocrit percentage and plasma cortisol concentration were chosen as parameters of stress, reflecting catecholamine and pituitary adrenal response (Cross *et al.*, 1988). These parameters are thought to indicate different aspects of non specific response to stressors (Dantzer and Mormede, 1983) or different stages of the general adaptation syndrome (Hill, 1983).

The plasma concentration of cortisol has been widely used to reflect the effect of different stresses (Jensen-Waem and Nyberg, 1993). There was a significant ($P<0.05$) elevation in plasma cortisol level following shearing in shorn sheep as compared to unshorn ones (figure 1). The recorded levels of cortisol, just after shearing, were 27.0±0.2, 52.1±3.6 and 68.2±6.8 ng/ml for control, G2 and G3, respectively. Also, there was a significant ($P< 0.05$) effect of the time of day as the highest rise in cortisol was recorded in shorn in the afternoon time. Generally, the highest rise was at 0-time (immediately after shearing), then declined gradually in treated groups with time till upending at 90 min when it was to the basal level.



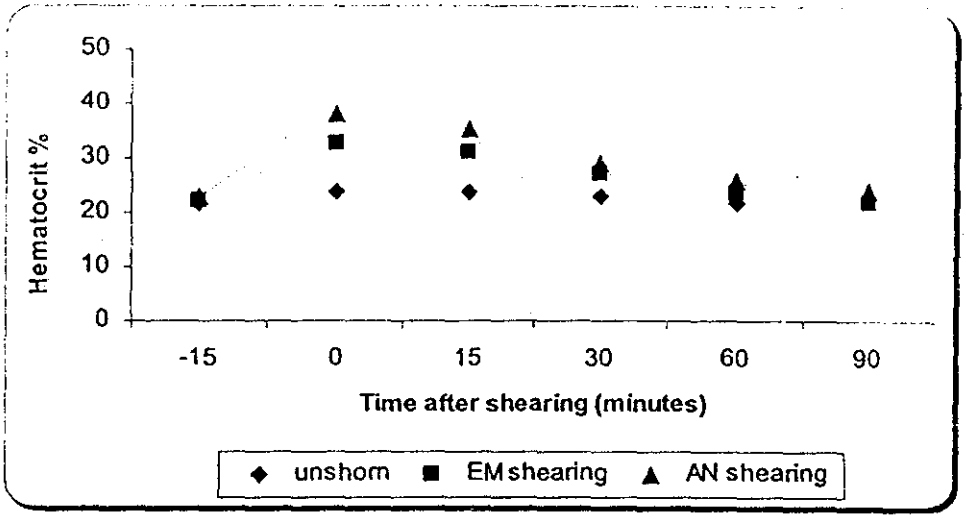
EM; early morning shearing AN; after noon shearing.

Figure 1. Plasma cortisol level (ng/ml) of different sheep groups as affected by shearing

Like other steroid hormones, which are not stored in the body, cortisol is synthesized and secreted on demand. It is believed that during stress cortisol acts antagonistically to insulin, preventing entry of glucose into muscles and adipose tissue and sparing it for tissues of high demand (e.g. liver and brain). It was, believed based on assumption from Grandin (1997), that the pre-handling cortisol levels recovered within an hour. On the other hand, there were no fluctuations of the cortisol level in the unshorn control sheep during the experimental period. These findings agree with those reported by Fulkerson and Jamieson (1982); Hargreaves and Hutson, (1990 b) and Fayed (2001).

Hematocrit percentage (Ht%) rose ($P< 0.05$) after shearing to be 32.7% and 38.1% for the two shorn groups compared to unshorn control one (24.0 ±1.7) just after shearing, then declined for all treated groups to the pre-treatment level within 90 minutes after shearing (Figure 2) as it became 22.1 ± 1.7 and 24.1 ± 1.6 for G2 and G3, respectively. The effect of the time of day was significant only just after shearing as the higher elevation in Ht% was among sheep that shorn in the afternoon. The

recorded values agreed with those reported by Hargreaves and Hutson (1990 b) and Holmes *et al.*. (1992).



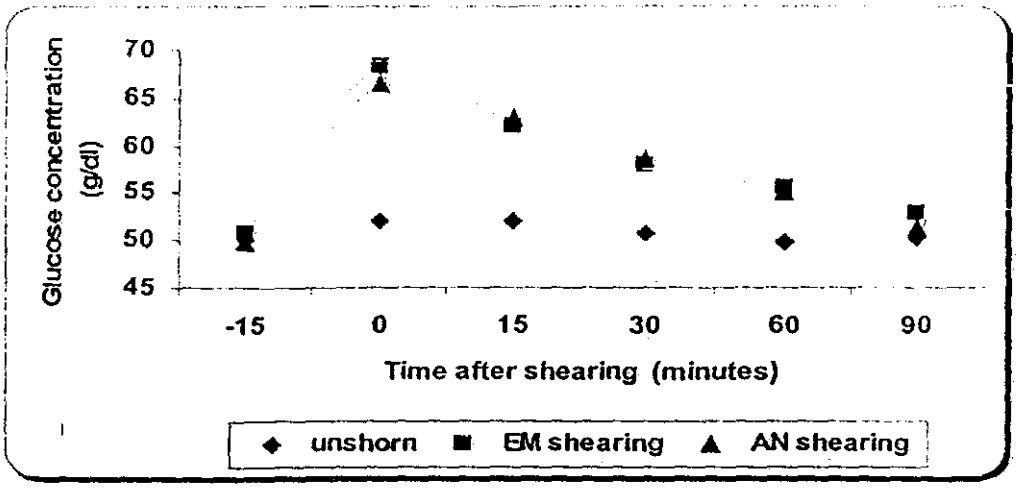
EM; early morning shearing AN; after noon shearing.

Figure 2. Hematocrit (Ht, %) of different sheep groups as affected by shearing

The elevation of cortisol and Ht% after shearing, in the present study, might be a result of either the potency of the acute short term stress of shearing or wool removal due to noise of shearing itself which elicits the stress response. Gupta *et al.*. (2007) reported that the Increases in PCV due to stress might be associated with splenic contraction, caused by the effect of catacholamines on adrenergic receptors located in the splenic capsule.

Glucose level

Results revealed a significant ($P< 0.05$) rise in glucose level immediately after shearing (0-time) with mean values being 52.1 ± 4.1, 68.3 ± 4.8 and 66.5 ± 4.0 mg/dl for G1, G2 and G3, respectively. This rise disappeared again reaching the base line level within 90 min after shearing (Figure 3). The effect of the time of day of shearing was significant only till 30 min after shearing. In fact, during stress, glucose metabolism increases simultaneously with increase secretion of cortisol, as well as an elevation of blood glucose (Burton, 1995). It is believed that during stress cortisol acts antagonistically to insulin, preventing entry of glucose into muscles and adipose tissue and sparing it for tissues of high demand (e.g. liver and brain). The results agreed to some extent with that reported by Holms *et al.* (1992) and were in harmony with those reported by Fayed (2001) on Barki sheep.



EM; early morning shearing AN; after noon shearing.

Figure 3. Glucose (mg/dl) level of different sheep groups as affected by shearing

Increase glucose level within the short time after shearing could be a vast response to produce energy for the internal *meliu* due to fear stress. It has been reported that wool removal is the most potent component in eliciting a sympathetic adrenal medullary or pituitary-adrenal response to shearing and consequently secretion of adrenalin and noradrenalin from adrenal medulla which causes elevation of Ht% and glucose levels (hyperglycemia) in blood. The secretion of adrenaline and noradrenalin as a result of stress factor (shearing) produce glucose from either the non carbohydrate source or causing breakdown of glycogen through glycogenlysis producing hyperglycemia (Holms *et al.*., 1992).

3. Weight gain response

As shown in Table 2, there were significant ($P< 0.05$) differences, in this short period (2 weeks), among sheep in control and those shorn groups regarding their body weight gain. Sheep in the shorn groups attained lower body weight gain (1.3 ± 0.7 and 1.0 ± 0.5) in comparison with the control group (2.8± 0.6 kg). On the other hand, there was no significant effect of shearing time on the body weight gain.

The low body weight gain recorded for shorn groups (1.3 and 1.0) might be attributed to either the reduced eating frequency or the less time spent resting following shearing which may have lead to high energy expenditure. These results coincided with those reported by El-Hadi (1988); Holms, *et al.*. (1992) and Aksoy (1996). In contrast, Sumner *et al.*., (1992) and Newman *et al.*, (1996) stated that, there was no significant effect of shearing as handling procedure on the body weight gain of sheep.

Table 2. Effect of sheep shearing on body weight gain of different groups of sheep (Mean ± SE)

Parameters	Experimental groups		
	Not shorn	Hand shorn (early morning)	Hand shorn (afternoon)
Initial body weight (kg)	32.1 ± 2.1	32.8 ± 1.9	32.8 ± 2.3
Final body weight (kg)*	34.9 ± 2.8	34.1 ± 2.3	33.8 ± 2.9
Body weight gain (kg)	2.8 ±0.6^{a}	1.3 ± 0.7^{b}	1.0 ± 0.5^{bc}

Means with different superscript in the same column are differed significantly at P<0.05

It could be concluded that, sheep shearing is an important management practice to take in account when improving techniques of sheep husbandry in order to attain high productivity without neglecting animal welfare, so shearing could be made less stressful by minimizing physical manipulation and social disruption to sheep. Mechanical shearing could be other criteria for search.

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تأثير عملية الجز على الاستجابات السلوكية والفسيولوجية لأغنام أبو دليك بمثلث حلايب- شلاتين- أبو رماد

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قسم فسيولوجيا الحيوان والدواجن- شعبة الانتاج الحيوانى والدواجن- مركز بحوث الصحراء

أجريت الدراسة بمحطة بحوث حدربة فى اقصى الركن الجنوبى الشرقى من صحراء مصر والتابعة لمركز بحوث الصحراء. استخدم فى هذة الدراسة 45 ذكر من أغنام ابو دليك (عمر 12-15 شهر) قسموا الى ثلاث مجموعات (15 بكل مجموعة). المجموعة الاولى تركت بدون جز بينما المجموعة الثانية جزت فى الصباح الباكر (الساعة السابعة) والمجموعة الثالثة جزت وقت الظهيرة (الساعة الثانية عشر ظهرا) بهدف دراسة الاستجابات الفورية لتأثير عملية الجز ووقت الجز على بعض الأنشطة السلوكية (السلوك الغذائى -السلوك الحركى) والاستجابات الفسيولوجية (النسبة المئوية للهيماتوكريت فى الدم، مستوى الجلوكوز وهرمون الكورتيزول فى البلازما) بالاضافة الى التغير فى معدل الوزن بعد اسبوعين من نهاية الجز.

أظهرت النتائج أن للجز تاثيراً معنوياً على سلوك الغذاء وعدد مرات الاجترار حيث انخفضت قيم هذه المقاييس فى المجاميع المجزوزة مقارنة بالكنترول وكذلك انخفض وقت الراحة وزاد الوقت المستغل فى النشاط الحركى مما كان له أثر على معدل الزيادة فى الوزن بينما لم يكن لوقت الجز تاثيراً على هذه القياسات.

أظهرت النتائج وجود زيادة معنوية فى النسبة المئوية للهيماتوكريت والجلوكوز وكذلك هرمون الكورتيزول بعد الجز مباشرة وعادت الى معدلاتها قبل الجز فى خلال 90 دقيقة فى المجاميع المجزوزة مقارنة بالكنترول.

خلصي الدراسة إلى ضرورة الاهتمام بعملية تداول الحيوانات أثناء عملية الجز لتقليل الآثار السلبية للخوف والألم والإزعاج وما يصاحبه من تغيرات سلوكية وفسيولوجية