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Effect of floor space allowance on serum cortisol level of Magra lambs in arid zone of Rajasthan

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Abstract

This experiment was conducted to find out the effect of different floor space allowance on cortisol level of Magra lambs. For this study, eighteen male Magra lambs between the age group of 3-6 months were randomly selected. The selected lambs were divided and kept into three different groups with different floor space comprising of 6 lambs in each group. Group T₀ (0.8m² floor space/lamb), Group T₁ (0.6m² /lamb) and Group T₂ (1m² /lamb). The feeding and other management practices for all the three groups were similar. The blood sample was collected from each lamb in fifteen days interval and the serum cortisol concentration (ng/ml) was determined with the help of Cortisol ELISA Kit. The average serum cortisol concentration was 9.28±1.07, 10.61±1.14 and 8.41±1.08 ng/ml in Group T₀, T₁ and T₂ lambs respectively. There was no significant effect.

Keywords: Floor space, stress behaviour, Magra lambs, serum cortisol concentration

1. Introduction

Sheep farming in semi-arid tropical part of India is affected by various environmental extremes such as high variability in the ambient temperature (as high as 48 s in summer and as low as 2 °C in winter), scanty rainfall (250–400 mm) and scarcity of feed, fodder and drinking water in summer (Sejian *et al.* 2011).

The total sheep in the country is 65.06 (3rd rank) million numbers in 2012, declined by about 9.07 percent over census 2007 (19th Livestock Census 2012, GOI).

Sheep farming has potential in India's agricultural economy as an increasing demand is being felt to diversify farm enterprise to maximize production. Sheep is most docile, easy to manage and earliest domesticated animal among all livestock for basic needs of human like food and clothing. Sheep is existing as a poor man `companion from a long time (Prasad, 1996). Sheep is very economical animal because it can convert food and low-quality roughage cheaply into good profitable products and fertilize land. They have short generation intervals, higher fertility and marketing of sheep meat is very easy.

Amongst the sheep breeds of India, the Magra breed is most adaptive breed which can be raised in range of temperate climates, including arid zones. The Magra sheep, also known as Bikaneri, Chokhla or Chakri and formerly known as the Bikaneri. It is reared, bred and well adapted in the Bikaner, Nagaur, Jaisalmer and Churu districts of Rajasthan. However, purebreds are mostly found in the eastern and southern parts of the Bikaner district. The Magra sheep is the most lustrous carpet wool-producing breed. Magra sheep is highly stabilized, capable to long journeys in desert area and it has high resistance to diseases and worms. Sheep of Magra breed are medium to large size. Ears are small and colour of skin is pink. Both sexes are polled. Tail is medium in length and thin. The Magra breed of sheep is well adapted in arid conditions and has high heat tolerance (Kaushish and Mittal, 1994) [7].

In animal husbandry housing management of livestock plays an important role in a profitable production. The basic principal functions of housing are that it should be suitable enough to keep them safe from adverse weather and harmful predators. It is necessary to allow animals a degree of choice and encourage a wide range of behaviors, including exercise, social behavior and foraging. Small ruminants are reared in sheds during night time and during the day time animals take out for grazing separate open paddock are not required (Sastry and Thomas, 2005) [15].

The floor space shows significant changes in social behavior of small ruminants which affect overall performance of the animals. The increase in space improves welfare and performance of farm animals (Boe *et al.* 2006). Stress is a normal physiological outcome of the individual when the animal is subjected to different situations. It may be due to environmental factors,

feeding management, housing etc. According to Lindberg (2001) the lack of adequate space for an animal in a group can also affect the level of aggression and thereby the state of stress. Sufficient space is extremely important for animals to establish a hierarchy (Lindberg 2001). Confinement and high densities in combination can give rise to stress, which can be measured by e.g. elevated cortisol concentration in faeces or cortisol level in blood (physical response). Cortisol is the primary glucocorticoid (hormone) in the body of mammals (Sjaastad *et al.* 2003). Moberg (2000) stated that under carefully controlled experimental conditions cortisol can be a reliable indicator of stress. Alam *et al.* (1986) and Nwe *et al.* (1996) [11] stated that plasma cortisol has been used as a reliable measurement of determining stress response. As per the research is concerned, different floor space provision that categorically comes under housing system, may be a factor to discriminate the animal's stress response. So it is now challenging to undergo an experiment bearing this aim so as to make a solid reason for the farmers whether they would go for a manageable situation regarding floor space provision.

2. Materials and Methods

This research work was conducted in Livestock Research Station (LRS), Kodemdesar, Bikaner and Department of Livestock Production Management, College of Veterinary and Animal Science, Bikaner.

2.1. Experimental Animals

Total 18 Magra lambs apparently healthy (approximately 3-6 months) were used in the experiments to study the effect of space allowance on their behaviour for approximately ninety days. All 18 lambs used in this experiment originated from the same experiment herd. The three groups were designed for the consideration and their distinguishing features were known by the different floor space allowances. The no. of animal remained same in all of the groups.

Gr. T0- 0.8m² floor space/lamb (total 6 lambs)

Gr. T1- 0.6m² /lamb (total 6 lambs)

Gr. T2- 0.6m² /lamb (total 6 lambs)

Accordingly pens of different sizes were built.

For Gr. T0- Pen size (8 ft X 6ft)

For Gr. T1- Pen size (6 ft X 6ft)

For Gr. T2- Pen size (10 ft X 6ft)

*1² m ≈ 10² ft

Table 1: Average serum cortisol concentration (ng/ml) of Magra lambs (n=6) under different floor space.

Fortnight	Group (T ₀)	Group (T ₁)	Group (T ₂)
1	9.99±3.13	8.85±2.86	11.08±2.74
2	6.79±2.42	10.04±2.39	7.42±2.98
3	10.14±2.9	12.04±4.06	7.62±2.6
4	8.45±2.59	11.52±2.82	9.55±2.69
5	10.55±2.8	11.1±2.63	7.28±3
6	9.78±2.71	10.1±2.89	7.53±2.75
Average (M±S.E.)	9.28±1.07	10.61±1.14	8.41±1.08

2.2. Housing and Animal Management

The housing of experimental animals was katcha housing type in which the flooring material is of natural soil and mud. This housing system is a very cost-effective housing taking the economic status of the sheep farmers in to account. The intention is to get maximum output by investing minimum costs. Ventillation aspect was also taken with high concern so

as not to influence the experiment by any mismanagement with the said one. Every attempt was given to make the pens dry, clean and hygienic. Each lamb was individually marked with ear tagging. Pens of experimental animals were cleaned out once a day, usually in the morning, and a layer of sawdust was added in the solid resting area to ensure a dry surface.

2.3. Blood sampling

Basal cortisol levels in the blood were measured from 18 Magra lambs once every 15 days as a indicator of stress. All the blood samples were labelled individually with the tag number of the lamb. The blood samples were collected in the morning, usually during one hour before the morning feeding, approximately between 8 to 9 a.m. Blood samples were drawn from all the lambs via jugular venepuncture, and taken immediately after each other, starting with different animals/group each time. The samples were collected as gently as possible, trying our best not to arouse the lambs. Sampling of one lamb took approximately 30 sec. All of the blood samples were kept in a cold room at 4° C for 24 h after they were collected and the samples were centrifuged for approximately 15 minutes at room temperature at 3000 rotations/minute. Two samples from each blood sample were thereby put into Eppendorf tubes. All of the tubes were individually marked with tag number of the kid and date of sampling and then put in a freeze at -18 °C. When all the 90 samples were collected, processed and labelled they were taken to ICAR- National Research Center on Equines, Bikaner for estimation of serum cortisol levels. Cortisol estimation was done by ELISA using a commercial kit

3. Statistical Analysis

The statistical analysis was done by statistical analysis by adopting appropriate methods of analysis of variance as described by Snedecor and Chochran (1994).

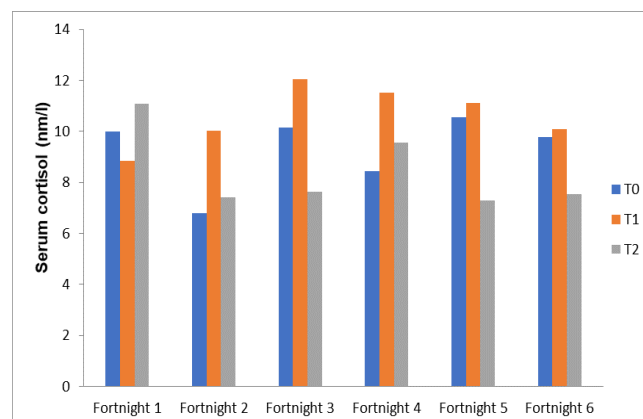


Fig 1: Average serum cortisol concentration (ng/ml) at different floor space

4. Results and Discussion

The serum cortisol concentration in blood serum of Magra lambs of three groups is presented in Table 1. At the start of the experiment; the basal values for serum cortisol concentration were 9.99, 8.85 and 11.08 ng/ml in T0, T1 & T2 respectively. The average cortisol concentration in serum was found to be 9.28±1.07, 10.61±1.14, and 8.41±1.08 ng/ml at the end of the experiment in T₀, T₁ and T₂ respectively. The highest level of cortisol was found in lambs of T1 group in 3rd reading which was 12.04 ng/ml and the lowest 6.79 in Gr. T0 in 2nd reading.

The cortisol concentration of first month was the highest which might be due to the complete confinement of Magra lambs with different floor space provision. However, in later weeks the lambs were adopted with new floor space allotted in confinement showed lower cortisol levels. The cortisol level did not change significantly ($P < 0.05$) when lambs reared in different group under different stocking density as evidenced by table no 1. Still, there was slight more concentration of serum cortisol levels observed in lambs of T₁ (0.6m² /lamb) than the lambs of T₀ (0.8m²) and T₂ (1m²). It is an indication that the Magra lambs can sustain stress even though the floor space allotted to them was lesser and higher than the standard ones.

The cortisol values varied from 4.0- 64.8 nm/l of the basal values, and between 0.6-75.8 nm/l for the experimental period in goats as reported by Kjoren (2012)^[8]. Olsson and Hydbring- Sandberg (2011)^[12] found cortisol level between 17 (± 1) and 49 (± 6) nm/l serum cortisol of goats exposed to fear-eliciting stimuli (as a stressor). Andersen *et al.* (2008)^[1] measured between 2-10 ng/ml of cortisol concentrations in adult goats exposed to social instability, while Nwe *et al.* (1996)^[11] measured between 42-166 ng/ml cortisol concentrations in goats exposed to transportation stress. There was no effect of space allowance on cortisol concentration of animals reported by Horten *et al.* (1991); Cockram *et al.* (1996)^[2]; Early and Riordan (2006); Fuente *et al.* (2010)^[5]; Uetake *et al.* (2011); Fuente *et al.* (2012)^[5]; Kjoren (2012)^[8]; Vas *et al.* (2013)^[16]; Panda *et al.* (2016)^[13]; which agrees with the present study. Basal cortisol concentrations were reported to be not elevated by space restriction in studies by Pearce and Paterson (1993) and Meunier-Salaun *et al.* (1987)^[10], which also concedes with the results of this study.

5. Conclusion

The lambs housed in 0.6m² space had effect level of cortisol in blood. This was an indicative of lack of welfare of lambs that directly affect the profitability of sheep farming

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