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Effect of Some Managerial Practices on Behaviour and Performance of Egyptian Balady Goats

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Abstract: Provision of adequate housing is essential to assure the welfare of farm animals. The objective of this study was to determine the effect of space allowance and tethering on behaviour and performance of Egyptian balady goats. Total 42 castrated bucks, 8 months of age, were randomly allocated to 2 experiments. Experiment one; 28 animals were divided into groups of 7 bucks with space allowances of 0.5, 1, 1.5 or 2 m^2/buck. Experiment two; 14 bucks were allocated to 2 equal groups (tethered and loosed groups). The most patterns of behaviour were significantly affected ($P < 0.05$) by space allowance, where eating, rumination, resting and grooming behaviors were increased significantly with the increase in space allowance. Nevertheless, aggressive and walking behaviors were the highest significantly in the small floor space. The performance was increased in large space allowance, but the differences didn't reach the significance ($P > 0.05$). Tethering the animals had effect in behaviour, but the most of the differences didn't reach the significance. Even though, tethered group was the highest in rumination and the lowest in walking behaviors, with significant differences. Total body weight gain and average daily gain were significantly higher in loosed group.

Key words: Floor Space · Tethering · Goats · Behaviour · Performance

INTRODUCTION

Studies on the welfare of small ruminant have developed slowly, due to some of their physiological peculiarities and their prevalent extensive production system. Ruminants are of great economic importance in livestock industry in Africa and small ruminants play a very important role in the socio-economic life of people [1]. In fact, Goat plays a significant economic role for the farming communities living in lowland, midland provision as well as highland agro ecologic zones [2]. Goats being smaller sized animal and more prolific, requirements in terms of capital and maintenance costs are with less risk in investment. It constitutes the majority of animal wealth and plays an important role in maintaining in human life [3]. Goats are considered very rustic animal, cope with prohibitive environmental conditions and inadequate management practices. This was based on the fact that the highest standard of livestock wellbeing associated with minimal behavioural restriction and man's intervention in the biological cycle of the animal [4]. Housing protects animals from adverse weather conditions and provides structured management (feeding, drinking, etc.) under controlled conditions. New regulations for organic goat farming (Council Regulation (EC) No. 1804/1999) demand a minimum of 1.5 m^2 total area per animal and half of this (0.75 m^2 per goat) should be a resting area with a solid floor [5]. However, insufficient space allowances induce a repeated state of stress that alters the activity of the pituitary-adrenal axis, immune function; behaviour and growth rate [6, 7].

Common definitions of behavior are "anything that an organism does involving action and response to stimulation," and "the response of an individual, group, or species to its environment," [8]. However, it is well known that space limitations have negative consequences for the welfare of production animals [9, 10], as well as on

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performance. The decrease in space allowance reduces resting time and increases the aggressive interactions [11]. Bøe *et al.* [12] stated that the increase in space allowance improves welfare and performance of farm animals. When offering a total floor space of 1.0, 1.5 or 2.0 m^2 per animal in horned and hornless groups of goats, Loretz *et al.* [13] cited that a lower resting time at the lowest space allowance, but the level of aggression remained surprisingly stable across treatments. Toussaint [14] recommends a space allowance for adult goats of 1.5 m^2, which corresponds to the requirements in the European regulations for organic farming. While regulations both in Switzerland and Sweden have lower demands for space allowance (1.0 and 1.2 m^2 per goat, respectively). Tethering is a commonly practice technique in the management of small ruminants in tropical countries for property, controlling animals and preventing them from damaging crops [15]. Large numbers, particularly in small ruminants are restricted in movement often with a tether, especially in zero-grazing production systems. Furthermore, tethering the animals may rise in the future with increasing urban and per-urban production in developing countries of the world [16]. In addition, tethering the animals allows the farmers close control of forage resources during the crop-growing. But restricting the grazing area by tethering could impact plant species and part selectivity [17]. The objectives of this study were to determine how the floor space and tethering of goats influence the behaviour and performance.

MATERIALS AND METHODS

All experiments were conducted at the animal farm belonged to faculty of veterinary medicine, Zagazig University, Egypt.

Experimental Animals: Total, 42 apparently healthy castrated balady bucks (approximately 8 months age with averaged 20±0.5 kg live body weight) were used in two experiments to study the effect of space allowance and tethering on their behaviour and performance. First experiment, 28 castrated bucks were divided into 4 groups of 7 bucks with space allowances of 0.5, 1, 1.5 or 2 m^2/buck [13] in 4 experimental pens (3.5, 7, 10.5 and 14 m^2 in size, respectively). Second experiment, 14 bucks within two equal groups (7 bucks / group) were randomly allocated in 2 equal experimental pens (14 m^2 / pen) with the same space allowance (2 m^2 / buck). One group was tethered and the second was left free.

Housing and Animal Management: Through this study, the experimental pens were natural ventilated by windows, which allowing natural lighting. Straw bedding was provided and fresh straw was added periodically as required to maintain adequate bedding conditions. Ration was consisted of 50% concentrate (50% Corn, 28 % Wheat bran, 20% Soybean meal, 1% Sodium chloride, 0.5% Di-calcium phosphate, 0.5% Premix) and 50% from green feed (berseem). The total ration was supplied to the goats twice daily at 6.00 am and 13.00 pm, while fresh water was available for ad libitum consumption. The bucks were identified by numbers put on the sides of body by paint.

Behavioural Observation: To get accustomed to the different pen treatments, the groups stayed one week in each pen. After that behavioural observation was done using focal sample technique [18] through a stop watch, multipurpose counter and field notice (observation sheet). Behavioural observation was done during three consecutive days / week, through direct observation with 3 minuets intervals to calculate the time and frequency of behaviors for 8 hours / each group / 2 week "through 12 weeks". The behavioural patterns [19, 20] were as the following:

- Feeding Behaviour: including the time of eating, drinking and rumination.
- Eliminative Behaviour: including the frequency of urination and defecation.
- Resting Behaviour: including the time of laying, idling, drowsiness and sleeping.
- Grooming Behaviour: including the time of self and mutual grooming.
- Aggressive Behaviour: including the frequency of fighting, butting and chasing.
- Other Behaviors: including the time of standing and walking.

Growth Performance Parameters: These parameters were represented in total body weight gain (BWG), average daily gain (ADG), concentrate and berseem intake [21]. Feed intake (concentrate and berseem) was offered to each group daily and residues were measured in next morning to calculate voluntary feed intake [22]. The body weights of bucks were taken initially and thereafter every two weeks intervals. After that, BWG and ADG were calculated at the end of experimental periods.

Statistical Analysis: The obtained data were statistically analyzed for variance ANOVA, LSD (Least significant difference) according to Snedecor and Cochran [23]. Differences among treatment means were compared using Duncan's multiple range tests [24]. The results were presented as mean ± SE and significance was declared at ($P < 0.05$).

RESULTS

First Experiment: The results as shown in Table (1) revealed that the mean values (± SE) of eating, rumination, laying, idling, sleeping and grooming behaviors were increased significantly ($P < 0.05$) with increasing the space allowance. Even though aggressive and walking behaviors were higher significantly in the small floor space. While drinking, eliminative and drowsiness behaviors were higher under large space allowance, but the observed differences did not reach significance. As well as, standing behaviour had no significant difference among the experimental groups, although it was higher in small space allowance. There is no significance difference ($P > 0.05$) in performance parameters, although they were higher in large floor space, as shown in Table (2).

Second Experiment: The effect of tethering in behaviour as mentioned in Table (3) showed that the time spent ruminating was significantly higher ($P < 0.05$) in the tethered than loosed bucks. Nevertheless, the time spent walking was the highest significantly in the loosed animals. While the differences in eating, drinking, eliminative, resting, grooming, aggressive and standing behaviors didn't reach significance ($P > 0.05$). All performance parameters were the highest in loosed animal with significant differences in total BWG and ADG as shown in Table (4). While the differences in other parameters didn't reach the significance.

DISCUSSION

In this study, the differences in some managerial practices "space allowance and tethering" in management of goats were significantly influenced on behaviour and performance.

Experiment One: The results in Table (1) revealed that the most of behavioural patterns were significantly affected by space allowance [7]. The behavioural changes maybe due to the close relationship between physiology and behaviour [25], hence the changes in adrenal response under different space allowances [26, 27]. Animal habitat consists of five essential elements: food, water, shelter, space and the arrangement of these elements [28]. Although requirements differ in composition and quantity from species to species, all animals require these elements to survive. A complete understanding of the feeding behaviour requires a through study of its three main components: eating, ruminating and drinking [29]. Where the space allowances of 1.5 and 2 m^2 were significantly higher than 0.5 and 1 m^2 in time of eating (165.52 ± 5.89^{ab} and 172.17 ± 6.01^{a}, respectively) and rumination (49.83 ± 1.18^{ab} and 53.52 ± 2.27^{a}, respectively). This result agreed with Petherick [30], who stated that linear space required per animal for behaviors such as feeding or drinking. Nevertheless, Fregonesi and Leaver [11] found that space allowance had no significant effect on feed intake or feeding time. There is no significant difference in frequency of eliminative behaviour (urination and defecation) among experimental groups. The patterns of resting behaviour (sitting, idling and sleeping) were significantly differed ($P < 0.05$) among experimental groups. Where bucks with space allowances at 0.5 m^2 had the lowest time of laying, idling and sleeping (50.25 ± 6.10^{b}, 4.02 ± 1.05^{b} and 2.42 ± 0.36^{b}, respectively) with significant differences [6, 31, 32]. Fregonesi and Leaver [11] cited that the decrease of space allowance reduces resting time and its synchrony. Grooming behaviour "self and mutual grooming" was increased linearly with the increase space allowance, where it was significantly higher in bucks at 2 m^2 than other groups. Comfort behaviour patterns representing in lying, drowsiness, sleep, grooming behaviors [33, 34] were considered as indicator of animal welfare [35]. These findings maybe due to bucks require sufficient space to rest comfortably, performance of comfort, foraging, social or exploratory behavior [36]. Moreover, space allowance is a major factor influencing animal welfare [30]. The frequency of aggressive behaviour was significantly higher in goats on small spaces (0.5 and 1 m^2) compared to goats in large spaces (1.5 and 2 m^2). This result may be due to increase social interaction in small spaces and leading to the competition among the animals. This finding agreed with Fregonesi and Leaver [11, 32, 37]. This result revealed the adverse effects of small space allowance on animal welfare [38]. The goats at 0.5 and 1 m^2 had higher standing times in compare with those at 1.5 and 2 m^2, but the

Table 1: Mean (± SE) of behavioural patterns in goats managed under different space allowances

Behavioural patterns		0.5 m^2	1 m^2	1.5 m^2	2 m^2
Feeding behaviour (Minutes / 8 hrs)	Eating	141.08±8.23^{b}	145.30±11.47^{b}	165.52±5.89^{ab}	172.17±6.01^{a}
	Drinking	2.80±1.05	2.07±0.15	3.08±0.48	4.25±1.39
	Rumination	45.57±0.23^{c}	48.55±0.92^{bc}	49.83±1.18^{ab}	53.52±2.27^{a}
Eliminative behaviour (Frequencies / 8 hrs)	Urination	3.58±0.31	4.12±0.13	5.03±0.91	4.68±1.57
	Defecation	±0.30 3.58	3.93±0.20	3.65±0.23	3.52±0.17
Resting behaviour (Minutes / 8 hrs)	Laying	50.25±6.10^{b}	57.65±1.80^{ab}	60.02±2.23^{ab}	67.38±0.60^{a}
	Idling	4.02±1.05^{b}	3.60±0.97^{b}	7.18±1.51^{ab}	8.2±1.49^{a}
	Drowsiness	5.03±0.29	7.78±0.44	7.63±2.35	8.06±1.32
	Sleeping	2.42±0.36^{b}	2.32±0.40^{b}	6.00±0.58^{ab}	8.93±2.79^{a}
Grooming behaviour (Minutes / 8 hrs)	Self grooming	3.89±0.19^{b}	4.88±0.39^{b}	4.08±0.15^{b}	10.22±2.51^{a}
	Mutual grooming	0.87±0.17^{b}	0.68±0.04^{b}	1.00±0.04^{b}	1.42±0.20^{a}
Aggressive behaviour (Frequencies / 8 hrs)		175.00±13.99^{a}	133.00±29.12^{ab}	101.00±20.93^{b}	78.50±12.91^{b}
Other behaviors (Minutes / 8 hrs)	Standing	73.33±2.03	73.17±2.23	68.83±5.89	67.5±1.26
	Walking	54.00±3.15^{a}	30.00±0.97^{b}	34.00±6.72^{b}	24.50±0.43^{b}

^{abc} Means in the same row with different superscripts are significantly different at ($P < 0.05$).

Table 2: Some performance parameters of goats managed under different space allowances (Mean± SE)

Performance parameters	0.5 m^2	1 m^2	1.5 m^2	2 m^2
BWG (kg)/9 weeks	1.32±0.21	1.75±0.22	2.10±0.34	2.36±0.26
ADG (g)	22.20±3.38	31.55±4.38	35.33±4.74	36.52±4.49
Berseem (g)/day	281.52±21.98	303.74±26.71	318.56±21.21	325.97±24.79
Concentrate (g)/day	±1.36433.82	434.83±1.62	434.29±1.25	436.59±0.54

Table 3: Mean (± SE) of behavioural patterns in goats managed under the tethering

Behavioural patterns		Loosed group	Tethered group
Feeding behaviour (Minutes / 8 hrs)	Eating	158.74±7.14	153.59±13.07
	Drinking	2.85±0.22	2.53±0.17
	Rumination	47.86±0.60^{b}	52.53±1.28^{a}
Eliminative behaviour (Frequencies / 8 hrs)	Urination	3.00±0.38	2.83±0.32
	Defecation	2.51±0.32	2.75±0.26
Resting behaviour (Minutes / 8 hrs)	Laying	61.30±1.66	56.35±3.65
	Idling	6.24±1.40	5.26±0.45
	Drowsiness	7.78±0.99	6.47±0.96
	Sleeping	6.40±1.67	3.43±0.33
Grooming behaviour (Minutes / 8 hrs)	Self grooming	4.52±0.25	7.02±1.54
	Mutual grooming	0.93±0.07	1.06±0.15
Aggressive behaviour (Frequencies / 8 hrs)		75.75±6.42	78.89±4.02
Other behaviors (Minutes / 8 hrs)	Standing	70.50±4.49	60.50±3.75
	Walking	41.75±4.27^{a}	29.50±3.20^{b}

^{ab} Means in the same row with different superscripts are significantly different at ($P < 0.05$).

Table 4: The effect of tethering on some performance parameters of goats (Mean ± SE)

Performance parameters	Loosed group	Tethered group
BWG (kg)/9 weeks	2.20±0.16^{a}	1.57±0.22^{b}
ADG (g)	37.87±2.59^{a}	24.92±2.84^{b}
Berseem (g)/day	318.56±14.30	296.30±18.42
Concentrate (g)/day	440.31±0.34	439.79±0.45

^{ab} Means in the same row with different superscripts are significantly different at ($P < 0.05$).

difference didn't reach the significance. This result may be due to inversely correlation among standing, idling and feed intake [21]. Walking behaviour was significantly higher in small space allowance (0.5 m^2) than other group, as mention by Napolitano *et al.* [39]. There weren't significant differences in performance parameters among different space allowances [36], although all parameters were higher in large space allowance (2 m^2). Fisher *et al.* [7] mentioned that heifers at 1.5 m^2 space allowance had a lower daily live-weight gain compared with those at 3.0 m^2. Fregonesi and Leaver [11] stated that space allowance had no significant effect on body weight gain.

Experiment Two: The results, as shown in Table (3) revealed that the time spent eating and drinking didn't differ significantly ($P > 0.05$) between loosed and tethered bucks. But, rumination time was significantly higher ($P < 0.05$) in tethered bucks [40]. The decrease of rumination time in loosed bucks maybe due to direction of its activities to other behaviour, as exploration behaviour [41]. Patra *et al.* [42] cited that the time spent grazing and ruminating was similar between tethered goats and ones given free movement. Walking time increased significantly ($P < 0.05$) in loosed animals than other group. This may be due to increase other activities as playing, wandering and exploration [41]. The performance parameters as shown in Table (4) were higher in loosed bucks with significant difference ($P < 0.05$) in BWG [43] and ADG [44, 45], while the difference in feed intake (berseem and concentrate) didn't reach significance. These results disagreed with Moniruzzaman *et al*. [40], who noted that feed intake and growth weren't affected by tethering.

CONCLUSION

The behaviour of animals may be interpreted as a stress response and sign of inadequate welfare. The most maintenance behaviors were significantly higher with the increase in space allowance. The performance parameters were better in large space allowance, but the differences didn't reach significance. Animals need sufficient space to ensure physical health and permit the performance of important behaviour. Time spent ruminating was significantly higher in tethered bucks. Nevertheless, total body weight gain and average daily gain were higher significantly in loosed animals. Hence, the changes in space allowance and tethering in management of goats play the important role in behaviour and performance, as indicators of animal welfare.

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