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Sabek A. A., Satoh T., Karousa M., Abdelfattah S. and Mahmoud E.

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Original Article

Using Behavior, Performance and Blood Profile to Evaluate the Effect of Group Size on Domestic Goat

[*1,2]Sabek A. A., [1]Satoh T., [2]Karousa M., [2]Abdelfattah S. and [2]Mahmoud E.

[1] Laboratory of Animal behavior, Department of Veterinary Medicine, Tokyo University of Agriculture and Technology, Fuchu, Tokyo 183-8509, Japan.

[2] Department of Animal Hygiene, Behavior and Management, Faculty of Veterinary Medicine, Benha University, Moshtohor, Kalyobiya 13736, Egypt.

Abstract

A study was carried out to evaluate the effect of group size on some behavioral patterns, body weight, body measurements and hematological parameters of domestic goat. Adult female Shiba goats *(Capra hircus)* (n=12) were divided randomly to 2 groups according to the group size. The first group contains 4 animals (small size group) while the second one contains 8 animals (large size group). Behavior was recorded by using continuous focal sampling throughout the period of the study, growth parameters were measured every two weeks along the whole period of the study and blood samples were collected monthly to estimate the effect of group size on blood picture. Results revealed that group size affected significantly on some behavioral patterns of goat ($P<0.05$), while growth parameters and hematological parameters not significantly ($P>0.05$) affected by the group size.

Keywords: Goat, group size, behavior, performance, blood.

*Corresponding author: Laboratory of Animal behavior, Department of Veterinary Medicine, Tokyo University of Agriculture and Technology, Fuchu, Tokyo 183-8509, Japan.

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Introduction

Group size is defined as "the number of individuals that form a group" (Estevez *et al.,* 2007). Small ruminant livestock occur widely, including many developing countries, which use traditional extensive production systems designed to meet the needs of the families. In the more developed countries, to be more efficient and to increase production, the systems are changing from traditional to semi-intensive or intensive conditions (Miranda-de la Lama *et al.,* 2010).

Despite the major impact that variations in group size have for the welfare, health and performance of farm animals, it is still unclear how these factors affect social dynamics of animal (Fraser and Rushen, 1987). Under natural conditions, goats live in fairly small, stable groups, which are reported to consist of between 4 and 6 goats (Shank, 1972), 14 goats (Riney and Caughley, 1959) and infrequently of more than 20 individuals (Yocom, 1967). All farm animals are social species with a strong tendency to form groups. Living in groups has associated cost and benefits that have been studied extensively in wild animal populations (Pulliam and Caraco, 1984). For animals living in a group there are some advantages and some disadvantages, the benefits of group living are increased foraging efficiency, reduced risk of predation, increased access to mates and help from others. The disadvantages of living in a group can be competition for food, increased risk of disease or parasites, attraction of predators, brood parasitism, and loss of paternity and loss of individual reproduction (Krebs, 2009). In larger size groups, there is more intragroup competition for food resources than smaller groups (Chapman and Chapman, 2000). Previous study of (Mendl and Held, 2001) reported that there is a negative correlation between the group size and the behavioral frequency of animals.

Increasing group size does not appear to have any adverse effect on performance when the animals are given enough space and ad libitum feeding (Randolph *et al.,* 1981; Kornegay and Notter, 1984; McConnell *et al.,* 1987). Larger group sizes appear to have a consequent higher number of encounters between individuals and higher aggression, which leads to a reduction in performance (Petherick, 1983). Because of the lack of studies on the effect of group size on domestic goat, we conducted this study which showed the impact of group size on some behavioral patterns, body weight, body measurements and hematological parameters of goat.

Materials and Methods

Study Area

This study was conducted at goat farm of Tokyo university of Agriculture and Technology, in Fuchu, Tokyo, Japan, from June to September 2016. All procedures were carried out in accordance with guidelines established by the Tokyo University of Agriculture and Technology, Japan, for the use of animals.

Animals

Adult female Shiba goats *(Capra hircus)* (n=12), 3 – 4years old. The animals were divided randomly to 2 groups according to the group size. The first group contains 4 animals (small size group) while the second one contains 8 animals (large size group). The initial body weight was (23.23±1.5) and (23.325±0.88) kg, for the small and large size group respectively.

Housing and Management

All goats were housed at goat farm of Tokyo university of Agriculture and Technology, each animal received a maintenance diet of 375 g of hay cubes (Eckenberg #1®, made of pure alfalfa with no binders, these cubes are green, soft, cube has an average protein level of 18% and high fiber and nutrient levels) two times per day, clean water and salt rocks were available ad libitum, food was applied on plastic feeders, also water was supplied on plastic drinkers. For the small size group there was a pen with the dimensions (2.30 m × 2.45) in length, width respectively, while the dimensions of the pen of the large size group were (2.30 m × 4.90 m) with a constant space allowance for each goat per group about 1.40 m^2 . The pens were naturally ventilated, with 16hrs natural lighting and artificial lighting was used for 8hrs. All animals were individually identified with plastic numbered band hanged on the neck.

Experimental Procedures

Behavioral Observations

Behavior was recorded by using continuous focal sampling method described by Altman (1974) and Averós *et al.,* (2014), focal sampling was conducted by the same observer using observation sheet and stop watch during each sampling period. Behavior of each group was recorded in three consecutive days per week for two times daily, at morning and at after noon, the behavior of randomly selected goat was recorded for 15 minutes before morning feeding and for 15 minutes during feeding and for 15 minutes after feeding, with the same schedule at afternoon period. Frequency (total number) of each behavior: calculated as the total number of occurrences of each behavior per unit time. The most observed behavioral categories were mentioned in (Table 1).

Table 1: Ethogram for continuous focal sampling observations of goat behavioral patterns as affected by group size.

Behavior	Description	Category
Feeding	collect food from feeders	Maintenance behavior
Foraging	Searching and collecting food from the pasture by using the mouth (Paulo and Lopes, 2014)	Maintenance behavior
Rumination	Regurgitating food from the rumen to the mouth and re-chewing and re -swallowing it. Rumination occurs while the goat standing or lying down (Paulo and Lopes, 2014).	Maintenance behavior
Drinking	Goat inserts its mouth on drinker and drink	Maintenance behavior
Eliminative behavior	Including urination: during which the female goat takes squat position and urinates, and defecation: during which the goat wags its tail back and defecates	Maintenance behavior
Standing alert	Goat stands upright, focuses its gaze in one direction (Markegard , 2014)	Posture
Laying down	Laying or resting on the ground with open eyes (Markegard , 2014)	Posture
Sleep	Lying down with eyes closed	Posture
Self-grooming	Ggoat grooms itself by scratching its head and neck with the hind hoof and using the mouth (oral grooming) for the rest of the body (Mooring *et al.*, 1998)	Other behavioral category
Walking	Moving slowly from one place to another (Markegard , 2014)	Other behavioral category
Vocalization	Vocal communication, making sound with the mouth (Markegard , 2014)	Other behavioral category
Aggression	Butting is the main observed type of aggression in goat in which goat lowers its head and sweeps the horn upward and hit the other goat in head or in any other parts of the body(Hillmanna *et al.,* 2014)	Other behavioral category

Growth Performance Parameters

For evaluating the growth performance, at the start of the study, all animals of the first group and 4 animals from the second group were randomly selected to represent the pen throughout the experiment. Body weight was obtained at the day of grouping as initial BW, which was (23.23±1.5) and (23.325±0.88) kg, for the small and large size group respectively. Animals' body weight was measured every two weeks by using electric balance; the body weight gain was calculated as the difference between two successive weights. Hip height, heart girth and chest depth were measured every two weeks by using measuring tape. Hip height was measured as the distance from the floor beneath the goat to the top of the hip**,** while chest girth was measured as the minimal circumference around the body just behind the scapula and chest depth was the vertical distance from sternum to withers.

Blood Sampling

Every month 10ml of blood from each goat was collected into an evacuated heparinized tube (Venoject II, Terumo, Tokyo, Japan). Hemoglobin

concentration was measured, Erythrocytes and leucocytes were counted to estimate the effect of group size on blood picture, this occurred by using automatic cell counter at animal medical Centre of Tokyo university of Agriculture and Technology.

Statistical Analysis

The statistical difference of the frequency of each behavior during 45 minutes, means of body weight, hip height, chest girth, chest depth and hematological parameters were tested using SPSS software version 23 independent t-test. The data are presented as means ± standard errors and difference was declared as significant when P<0.05.

Results

Table 2 shows the means and standard errors of goats' maintenance behaviors frequency as affected by group size. The frequency of feeding was (24.66±0.58 and 22.00±0.45) for small and large size group respectively. From the obtained results it is clear that the frequency of feeding in small size group was higher than frequency of feeding in large size group *(P<0.001).*

Table 2: Behavioral patterns of goat observed as affected by group size.

Items	Frequency of behavior (total number of behavior)		
	Small size group	Large size group	P-value
Feeding	24.66±0.58[a]	22.00±0.45[b]	<0.001
Foraging	8.3889±0.84[a]	4.2361±0.57[b]	<0.001
Rumination	4.15±0.47[a]	5.62±0.63[a]	0.06
Drinking	0.59±0.11[a]	0.51±0.12[a]	0.6
Urination	0.4722±0.07[a]	0.26±0.05[b]	0.03
Defecation	0.76±0.09[a]	0.43±0.09[b]	0.01
Stand alert	0.6528±0.16[a]	0.61±0.14[a]	0.8
Lay down	1.0417±0.11[b]	1.95±0.18[a]	0.001
Sleep	0.02±0.01[a]	0.06±0.03[a]	0.2
Self-grooming	12.55±0.90[a]	9.9583±0.53[b]	0.01
Walking	18.16±1.07[a]	14.06±0.87[b]	0.004
Vocalization	12.84±2.00[a]	7.70±1.50[b]	0.04
Aggression	3.98±0.50[b]	5.90±0.61[a]	0.01

Means (± SE) in the same row with different superscripts letter are significantly different at (P<0.05).

The frequency of foraging was (8.38±0.84 and 4.23±0.57) for small and large size group respectively. There was a significant difference in foraging frequency between size groups and the small size group had higher foraging frequency compared to the large one *(P<0.001).* The total number of rumination was (4.15±0.47 and 5.62±0.63) for small and large size group respectively, from this results we suspected that the frequency of rumination was higher in the large size group than the small size one but the difference in frequency of rumination was not significant *(P=0.06).*

The frequency of drinking was (0.59±0.11 and 0.51±0.12) for small and large size group respectively. From the obtained results it is clear that there was no significant difference in drinking due to group size *(P=0. 6).* The frequency of urination was (0.47±0.07 and0.26±0.05) and the frequency of defecation was (0.76±0.09 and 0.43±0.09) for small and large size group respectively. From the obtained results there were significant differences in urination *(P=0. 03)* and defecation *(P=0. 01)* of goats as affected by group size. Table 2 shows the means and standard errors of goats' posture frequency as affected by group size. The frequency of stand alert was (0.65±0.16 and0.61±0.14) for small and large size group respectively, the results revealed that there was a difference in standing alert of goats, but this difference was not significant *(P=0. 8).* The frequency of laying down was (1.04±0.11 and1.95±0.18) for small and large size group respectively, the results revealed that there was a significant difference in laying down of goats as affected by group size *(P=0. 001).* The frequency of

sleep was (0.02±0.01 and 0.06±0.03) for small and large size group respectively, the results revealed that there was no significant difference in sleep of goats as affected by group size *(P=0. 2)*.

Table 2 shows the means and standard errors of other behavioral categories of goats as affected by the group size. The frequency of self-grooming was (12.55±0.90 and 9.95±0.53) for small and large size group respectively, the data revealed that there was a significant difference in self-grooming due to group size as the frequency of self-grooming was higher in small size group than the large one *(P=0. 01)*. The frequency of walking was (18.16±1.07 and 14.06±0.87) for small and large size group respectively, the data revealed that there was a significant difference in walking due to group size as the frequency of walking was higher in small size group than the large one *(P=0. 004)*. The frequency of vocalization was (12.84±2.00 and 7.70±1.50) for small and large size group respectively. There was a significant difference in vocalization as affected by group size for the small size group than the large one *(P=0.04)*. The frequency of aggression was (3.98±0.50 and 5.90±0.61) for small and large size group respectively, the results revealed that there was a significant difference in aggression of goats as affected by group size *(P=0. 01)*.

Table 3 shows the means and standard errors for growth performance parameters of goats as affected by the group size. The average of body weight was (23.41±1.13 and 24.06±0.72), (23.92±1.27 and 25.73±0.72) and (24.3±1.45 and 27.7±0.74) kg, for the first, second and third month respectively for small and large size group respectively. The current results revealed that , there was no effect of group size in the body weight of goats, as for both groups the body weight increased monthly , but the differences in the body weight between the two groups were not significant *(P=0. 6)*, *(P=0. 2)* and *(P=0. 6)* for first , second and third month respectively. The average of these parameters was (55.25±0.62 and 53.50±0.64), (69.92±0.48 and 71.1±0.32) and (36.75±0.87 and 36.92±0.45) cm, for hip height, chest girth and chest depth respectively, for small and large size group respectively, from the obtained results it was clear that there was no significant effect of group size on hip height *(P=0. 1)*, chest girth *(P=0. 05)* and chest depth *(P=0. 8)* of goats.

Table 3: Growth performance parameters of goat as affected by group size.

Items	Body weight in Kg., Hip height, Chest girth and Chest depth in Cm		
	Small size group	Large size group	P-value
Body weight (First month)	23.41±1.13[a]	24.06±0.72[a]	0.6
Body weight (Second month)	23.92±1.27[a]	25.73±0.72[a]	0.2
Body weight (Third month)	24.3±1.45[a]	27.7±0.74[a]	0.06
Hip height	55.25±0.62[a]	53.50±0.64[a]	0.1
Chest girth	69.92±0.48[a]	71.1±0.32[a]	0.052
Chest depth	36.75±0.87[a]	36.92±0.45[a]	0.8

Means (± SE) in the same row with different superscripts letter are significantly different at (P<0.05).

Table 4 reveals the means and standard errors of different hematological parameters of goats as affected by the group size, the average of these values was (1330±47.87 and 1298±41.76) 10^4/ul, (116.2±10.49 and 126.6±18.18) 10^2/ul and (9.72±0.14 and 9.11±0.49) g/dl, for Erythrocyte count, Leucocyte count and Hemoglobin concentrations respectively for the small and large size group respectively. Current results revealed that the effect of the group size on the hematological parameters of goats was not significant *(P=0. 6)* for Erythrocyte count, Leucocyte count and *(P=0. 2)* for Hemoglobin concentrations.

Table 4: Hematological parameters of goat as affected by group size.

Items	Hematological parameters		
	Small size group	Large size group	P-value
Erythrocyte count 10^4/ul	1330±47.87[a]	1298±41.76[a]	0.6
Leucocyte count 10^2/ul	116.2±10.49[a]	126.6±18.18[a]	0.6
Hemoglobin concentration g/dl	9.72±0.14[a]	9.11±0.46[a]	0.2

Means (± SE) in the same row with different superscripts letter are significantly different at (P<0.05).

Discussion

Maintenance Behavior

Feeding

Results of this study confirmed that the frequency of feeding in small size group was higher than frequency of feeding in large size group. This result may be attributed to in the small size group the animals had the chance to visit the feeders more frequent than animals of large size group. Our result agrees with Nielsen *et al.,* (1995) who investigated the effect of group size on feeding behavior of growing pigs as the group size in which the pigs were kept influenced all the feeding behavior variables, with pigs kept in groups of 20 making fewer *(P* < 0.01) but longer *(P* < 0.05) visits to the feeder, than pigs kept in the smaller groups. De Haer (1992) compared the group housed pigs to individually housed animals and found that pigs kept individually had more frequent, but shorter, visits to the feeder. The result of the current study also in agreement with Tölü and Savas (2007) who mentioned that a larger group size decreased synchrony in feeding behavior in goat and with Jorgensen *et al.*, (2009) who found that the larger the group size, the shorter the time spent in front of the feed barrier in ewes. In contrast Abdelfattah *et al.,* (2013) found that group size had no (*P* ≥ 0.09) effect on frequency of eating of veal calves, also the results do not agree with Færevik *et al.,* (2007) who found that there was no effect of group size on feeding behavior of weaned cattle.

Foraging

Group size affected on foraging behavior of goats this might be due to decrease the number of goats per group gives the chance for animals to walk freely and forage the yard easily compared to large size group where the goats might spend majority of time in conflict with each other's. This result doesn't agree with Kenneth and James (1985) who found that the rate of foraging in goats increased with group size.

Rumination

This behavior does not affect significantly by the number of animals per group this may be attributed to animals received the same amount and the same type of food. Rafiuddin *et al.,* (2009) observed the same results in buffalo calves as he found no significant effect of group size in the rumination time per calf, also this results in agreement with Abdelfattah *et al.,* (2013) who found that group size does not have any effect on rumination of veal calves. In contrast Hesham and Mohamed (2013) reported that in male goat the time of rumination increase, with increase the number of animals per group and this increase was significant.

Drinking

We found no effect of group size on drinking rate of goats, previous study of Abdelfattah *et al.,* (2013) revealed the same result on veal calves, but our study does not agree with Hesham and Mohamed (2013) who found a significant effect of increasing the group size in the drinking time per male goat, also not agree with Barton and Broom (1985) who showed that calves are social drinkers, and when one animal is drinking water other animals are stimulated to drink more so increase the number of calves per group resulted in increased drinking rate, also in pig, group size affected on drinking time as mentioned by Turner *et al.,* (2000) who found that pigs in larger groups(60 pigs) spent less time drinking per day than pigs in smaller groups (<20 pigs).

Eliminative Behavior

In the current study the frequency of urination and defecation was higher in small size group than large size group and this result in contrast with the

study of Hesham and Mohamed (2013) who reported that the frequency of urination and defecation was higher in a group of 8 bucks than the group of 4 bucks.

Posture

Stand Alert

Frequency of standing alert decrease as the number of animals per group increased This result agrees with Treves (2000) who said that individuals' vigilance does not necessarily decrease with increasing group size, these results agree with Elgar (1989) who said that the increase in group size result in reduced need for animal vigilance, also agree with Hesham and Mohamed (2013) who found that bucks in small group stand for longer time than those in large group, but the difference was not significant, further agree with Beauchamp (2008) who said that individual vigilance decreases with increasing group size. Pulliam (1973) said that an increase in flock size resulted in a decrease in individual vigilance; Ridley and Hill (1987) said that a decline in individual vigilance levels as group size increased was predicted to operate in pheasants**.** Our result does not agree with Abdelfattah *et al.,* (2013) who mentioned that in veal calves standing increase with increasing the number of animals per group.

Lay Down

Throughout the period of the study the laying down frequency and duration was higher on large size group than the small one. These results may be attributed to increase the number of goats per group make the ability of standing, walking through the pen difficult and also the incidence of aggression was high in large group, so goats spent most of their time laying down. The current results agree with (Roberts, 1996, Boissy and Dumont, 2002) who said that both individual vigilance and behavioral synchrony declines as group size increases, making more time available for resting, also Rind and Phillips (1999) found that cows in groups of eight had spent the longest time lying down than cows in the small group of 4 animals**.** In contrast Abdelfattah *et al.,* (2013) reported that reducing of laying behavior in groups of 4 and 8 calves than groups of 2 calves, also Færevik *et al.,* (2007) concluded that time spent lying decreased with increasing group size. The result does not agree with Hesham and Mohamed (2013) who said that laying was significantly declined in large group size than small group size in bucks.

Sleep

We observed higher frequency of sleep in large size group than the small size group, and it is logic and correlated to the results of laying down. The results agree with Childress and Lung (2003) who found that in mammals increase the number of animals per group lead to more time of resting and sleep is one form of resting behavior. These results do not agree with from Hesham and Mohamed (2013) who said that sleep time was significantly declined in large group size of bucks.

Other Behavioral Categories

Self-Grooming

Small size group of goat characterized by higher frequency of self-grooming than the large size group. This result may be attributed to in large group goats spent more time fight with each other's, while in small group higher frequency of self-grooming may be due to large chance of these goats to perform comfort behavior which represented in self –grooming. Our result agrees with LEHMANN *et al.,* (2007) who said that if groups become too large, individuals cannot afford to spend the necessary time grooming and group cohesion will decrease, leading eventually to group fission, further increases in group size do not result in the expected increase in grooming time, also in long-tailed macaques Van Schaik *et al.,* (1983) found that total number of grooming bouts observed per day and the total number of observed grooming per minutes were highest in the smallest group than the largest group. More ($P < 0.001$) calves in groups of 2 were observed self-grooming than calves in groups of 4 and 8 (Abdelfattah *et al.,* 2013). The opposite data was previously reported by Hesham and Mohamed (2013) who found great significant effect of group size on grooming of bucks as bucks in large size group had higher grooming than bucks in small size group. Hopewell *et al.,* (2005) said that increase in group size give the animal chance to spend more time for grooming. (Dunbar, 1992b;

Hill, 1999) found a positive relationship between group size and grooming in baboons. In the group of 16 cows, grooming frequency was higher than group of 4 and eight cows (Rind and Phillips, 1999).

Walking

There was a significant difference in walking due to group size. This result may be due to decrease the number of animals per pen gives the chance to these animals to move freely without any problem of fighting and conflict with other members of the group. Group size and time spent moving were correlated (r =−0.418, p = 0.002), as sheep in smaller groups spent more time moving (Hopewell *et al.,* 2005).In contrast Abdelfattah *et al.,* (2013) found that Calves housed in groups of 8 and 4 walked more than calves housed in small groups of 2, suggesting that increased group size was accompanied with increased locomotion. Telezhenko *et al.,* (2012) found that group size had no effect on movement of cows, also the result does not agree with Kenneth and James (1985) who recorded higher movement rate with increase group size, also Hesham and Mohamed (2013) said that walking time of bucks increased with increasing of group size. Croney and Newberry (2007) said that the increased locomotion with increasing group size may both be explained by an increased level of social stimuli in larger groups, but also that individuals are moving more to avoid others.

Vocalization

There was a significant difference in vocalization as affected by group size for the small size group than the large one. Increasing vocalization in the small size group may be due to the small number of animals enable these animals to memorize and define each other's and communicate easily. Same results were obtained in bucks by Hesham and Mohamed (2013) who found that vocalization which a method of communication was highest in the group of 4 and 6 bucks than the group of 8 and 10 bucks.

Aggression

The frequency of aggression was higher in large size group than the small size group. This result might be due to increase number of animals per group leads to increase the rate of competition between the group members. The same results of the effect of group size previously reported in domestic fowl by Estevez *et al.,* (2002) who reported that aggressive interactions increased with increasing group size, also these results agree with Fregonesi and Leaver (2002) who stated that in dairy cows larger group sizes combined with high densities lead to more social conflict resulting in increased aggression, Jensen (2004) demonstrated evidence of an increased competition in calves in groups of 24 compared to calves in smaller groups (12 calves). Petherick (1983) concluded that larger group sizes appear to have higher levels of general activity, with a consequent higher number of encounters between individuals and higher aggressions.

Current result agrees with Hesham and Mohamed (2013) who found that the most prevalent aggressive interaction was the frequencies of threaten, butting and fighting. In general, the level of aggression was significantly higher in large group sizes compared to small group sizes. Large group sizes may be related to increased levels of aggression and stress (Barnett *et al.,* 1983; Tan *et al.,* 1991). The incidence of aggressive behavior increased as the number of lambs in the stalls increased (Van *et al.,* 2007). Chadwick (1977) who studied goats on native range, he reported increasing rates of agonistic behavior as group size increased. In contrast Jorgensen *et al.,* (2009) said that the mean number of aggressive interactions per ewe were similar in both group sizes. In calves no effect of group size on aggression was found (Kondo *et al.,* 1989). Andersen *et al.,* (2011) found that agonistic interaction was negatively correlated with group size.

Growth Performance

Body Weight

The current results revealed that, there was no effect of group size in the body weight of goats. This result might be due to the equal amount of food received daily by the animals of the two groups. The same result was observed by Abdelfattah *et al.,* (2013) who found that

throughout the 5-mo study, no ($P \geq 0.50$) differences among group sizes were found regarding initial and final BW of veal calves. These results are in agreement with Fæverik *et al.,* (2007) and De Paula Vieira *et al.,* (2010) who reported similar growth performance among different group sizes. Rommers and Meijerhof (1998) found that there was no effect of group size on growth and feed intake of rabbit, also the same results were observed in pig by McGlone and Newby (1994) who observed no differences in growth rate in grow-finish pigs in groups of 40, 20, or 10 when kept at constant floor-space allowance (.74 m2/pig). In contrast (Barnett *et al.,* 1983; Tan *et al.,* 1991) found lower growth rate of pigs in large group size. Czako (1983) mentioned that animals kept in large groups with high density have reduced individual performance. Gelhbach *et al.,* (1966) reported decreased performance with increased number of pigs per pen (8 vs16 pigs) in the grower period.

Hip Height, Chest Girth and Chest Depth

Our study revealed that there was no significant effect of group size on hip height, chest girth and chest depth of goats. The same results were obtained by Abdelfattah *et al.,* (2013) who found that neither hip height (P = 0.38) nor heart girth ($P = 0.82$) were affected by the number of calves in a pen. In contrast Rafiuddin *et al.,* (2009) found that the body height and girth increase significantly by increasing the number of buffalo calves per pen.

Hematological Parameters

In this study there was no significant effect of group size on hematological parameters which may be due to all animals move at the same space area and received the same amount of food. On veal calves the same results were obtained by Abdelfattah *et al.,* (2013) who found that no differences ($P = 0.14$) were found in Hb concentrations due to housing of veal calves in groups of 2, 4, or 8, the Hb concentrations were (9.0 ± 0.1, 8.5 ± 0.2, and 8.6 ± 0.2 g/dl) respectively.

Conclusion

From the current study we concluded that, some of the most important behavioral patterns of goats affected by the group size as feeding, foraging affected significantly by the group size, the lower the group size, the higher of these behaviors also increase of group size leads to lower activity of goats and higher rates of laying down, the larger the group size the higher aggression was observed.

For growth performance and hematological parameters, no significant effect of the number of goats per group in growth parameters and hematological parameters as the whole animals received the same amount of food and had the same space area, so within the optimal manage mental conditions; number of goats per group does not affect the performance and blood profile.

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