Egyptian J. Anim. Prod. (1997) 34 (2):75-88.

EFFECT OF TWO HOUSING SYSTEMS ON SOME PRODUCTIVE AND REPRODUCTIVE TRAITS OF BUFFALO CALVES

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SUMMARY

Twenty male and female buffalo calves, six months old were divided into two comparable groups. Group (a) was housed in closed tie-stalls, and group (b) in open free-stalls. The experimental animals were fed and watered alike. Some behavioural criteria under closed tie-stalls or open free-stalls during a 12 month period were recorded at biweekly intervals. Males were slaughtered and dressed at 18 months of age. Some reproductive observations were recorded on females from first service to services per conception.

Results of the study showed that the diurnal distribution of eating, rumination, idling, standing and lying frequency and time spent in each during day (24:00h) significantly differed between the two housing groups. Male calves in group (b) showed significantly higher average daily gain (ADG) than those in group (a) during the 6-12 months of growth period. An opposite trend was noticed during the fattening period (12-18 months). Feed conversion followed a similar trend as ADG. It was improved in the open free-stalls from 6-12 months of age and an opposite trend was observed during fattening period. Dressing percentage and meat including fat/bone ratio (coefficient of meat) were greater under the closed housing system.

In females, age and weight at first service were 21.5 months and 344.5 kg in group (a) versus 19.2 months and 312.2 kg in group (b), respectively. The corresponding estimates at first conception were 25.2 months, 360.3 kg for group (a) and 21.1 months, 351.1 kg for group (b), respectively. Number of services per conception was greater in heifers of group (b). Body measurements were comparatively higher under open free-stalls, except fore girth and rump width, where the opposite was true.

Keywords: Buffaloes , sing system , productive and reproductive traits

INTRODUCTION

The relationship between housing system and performance of buffalo calves is of significant importance. Calves housed outdoors showed higher daily weight gains than those housed indoors during 24 weeks (El-Badawy *et al.* 1994). In studies with sheep, Gabr *et al.* (1986a) and Houria (1995) demonstrated that an open housing system allowed better body performance. However, under intensive production, the closed-system is usually the re applied.

The present study was carried out to evaluate changes in body weight and carcass traits of male buffalo calves, as well as some reproductive performance traits of female buffalo calves raised under two systems of housing(i.e. closed tie- and open free-stalls).

MATERIALS AND METHODS

The' work comprised two experiments to study the effects of two housing systems on productive performance of male calves and the reproductive performance of female ones. The work was carried out at the Experimental Farm of Faculty of Agriculture, Menofiya University at mid Nile delta, Egypt.

Experiment (1): Male calves response

Twenty male buffalo calves, 6 months olf were divided at random into two comparable groups and raised under two systems of housing (closed tie-stalls [group a] and open free-stalls[group b]). Calves were group-fed in partitioning feeders and received their allowances according to El-Ashry (1980). Fresh water was available for the animals *ad. lib.* Ration was formulated from 70% concentrate feed mixture plus 30% roughages (Egyptian clover hay and wheat straw, during dry season, and wheat straw and Egyptian clover during green season).The concentrate feed mixture (CFM) was composed of 28% undecorticated cotton seed meal, 44% wheat bran, 19% yellow maize, 3% rice bran, 2% limestone, 1% salt and 3% molasses. The proximate chemical analysis of the feedstuffs was determined according to A.O.A.C. (1980) as shown in Table (1).

Table 1. Chemical composition of the feed ingredients used

Item	CFM	Berseem hay	Wheat straw	Berseem
Dry matter	93.58	90.00	95.00	13.00
		.....On dry matter basis.....		
Crude protein	16.00	13.00	3.00	16.62
Crude fiber	10.00	21.20	34.44	15.20
Ether extract	5.20	2.10	1.41	2.64
Ash	9.82	13.90	11.52	13.00
Nitrogen free extract	58.98	49.80	49.63	52.54
Starch value *	51.0	32.0	26.0	57.83
Digestible protein *	11.8	8.0	--	13.45

* Calculated according to Abou-Raya (1967).

Males within each experimental group were colour marked on their back for specific behavioural observations. For each of the marked individuals, frequency and time spent eating, ruminating, standing and lying were recorded by well trained persons and a time-lapse Video recorder connected with two light intensity television cameras for 24 hour periods at biweekly intervals over 12 months. Normally, natural light entered the stable through windows during the day. During the evening and night, artificial light was necessary to enable observations to be recorded in both closed tie-stalls and open free-stalls.

At the end of the study, each calf was placed on a horizontal floor and by the use of a cloth tape meter, the following body measurements were recorded: 1) Body

length: the distance from the top point of the withers to the point of the pin bone. 2) breast girth: the distance around the body just behind the fore legs. 3) Chest depth: the vertical distance from the sternum floor just behind the fore legs to the top of withers. 4) Thigh girth: the circumference of the thigh girth of the right leg of the animal. 5) Rump width: the width at pin bone. 6) Rump extension: length between hips and tail head. 7) Height at withers: the vertical distance from the floor to the top of withers. 8) Height at rump: the vertical distance from the floor to the top of the rump Fasting live body weight was recorded twice a month, to determine average daily gain (ADG).

At 18 months of age, all calves were fasted and weighed just before slaughter. Weight of head, hide, legs, heart, liver, kidneys, testes, spleen, lungs and trachea, empty digestive tract and kidney fat also recorded. The warm carcass was weighed without any attached offals and then split into left and right sides. Best ribs cut (9, 10 and 11) was separated from the left side and weighed. The cut was physically dissected into lean, fat and bone, and those were separately weighed. Shape index was calculated according to Darwish (1963). Area of ribeye was measured by clean plastic grid placed over the cut surface as described by USDA (1968).

Experiment (2): Female calves response

Twenty female calves six months old and over 110 kg body weight were selected and divided at random in two groups and housed as those in experiment 1. The study continued until the animals reached 18 months of age and at least 300 kg of body weight. The following reproductive parameters were recorded: Age and weight at first mating as well as at conception. The period lapsed between these was taken as time loss. Average number of services per conception was calculated by dividing total number of services by total number of animals conceived. Fertility or conception rate was determined as the percentage of animals conceived from one, two, three or four services. One sire was used for natural mating in this study. It was highly fertile as indicated by his previous reproductive history. Data were statistically analyzed after Gill (1978).

RESULTS AND DISCUSSION

Experiment (1): (Male calves)

A- Behavioural activities.

Frequency and time spent in eating activity for group (b) was significantly higher during day time as compared to group (a). The eating time/24 h averaged 230.5 minute and and 310.5 minutes in group b. Such finding was confirmed by Gabr *et al.* (1986 b) who demonstrated that open stalls housing system allows the animals to spend more time eating than closed stable systems (Table 2).

The diurnal frequency distribution of rumination and time spent/day showed significantly lower values in group (b) than in group (a). The ruminating time /24 h varied from 360.0 (group b) to 430.5 minutes (group a). Sharafeldin and Shafie (1965) reported that animals tended to ruminate more when lying down in shade than when standing in shade or sun. Gabr *et al.* (1986 b) found that animals in general spent more time in rumination under closed than open housing.

Table 2. Frequency and time spent (minutes) by buffaloe male calves in eating, ruminating, idling, standing and lying/24 h day as affected by two housing systems (values represent an average of 24 estimations)

Item	Group	
	Closed tie-stalls (a)	Open free-stalls (b)
Eating:		
Frequency	8.5 ± 1.3*	13.2 ± 2.1
Total time (24 hrs)	230.5 ± 17.6*	310.5 ± 15.7
% Total time (24 hrs)	16.0	21.6
Ruminating		
Frequency	6.1 ± 1.8*	9.8 ± 1.6
Total time (24 hrs)	430.5 ± 20.5*	360.0 ± 10.5
% Total time (24 hrs)	29.9	25.0
Idling		
Frequency	6.5 ± 1.2	7.1 ± 1.5
Total time(24 hrs)	779.0 ± 30.8	769.5 ± 28.6
% Total time (24 hrs)	54.1	53.4
Standing		
Frequency	5.4 ± 1.3*	8.7 ± 1.5
Total time (24 hrs)	395.0 ± 18.9**	780.5 ± 30.6
% Total time (24 hrs)	27.4	54.2
Lying		
Frequency	5.1 ± 1.2*	7.2 ± 1.5
Total time (24 hrs)	1045.0 ± 20.6**	659.5 ± 22.5
% Total time (24 hrs)	72.6	45.8

*P< 0.05 **P<0.01

Idling includes the time between periods of eating and ruminating, whether animals are lying or standing. The time spent in idling (day time) was less in the open free-stalls as compared to closed tie-stalls. This indicates that the increase in eating activity caused reduction in the time spent idling. However, the difference between the two experimental groups was not statistically significant (Table 2). In the open free-stalls, the animals spent more time standing than in the closed tie-stalls during the day. The opposite was true for lying activity (Table 2). Schmissur *et al.* (1966) reported that animals rested more in loose housing system than in free stalls.

In general, during the 24 hour observations, the averages of times spent by male calves kept under open free-stalls for eating, ruminating, idling, standing, and lying were 21.6, 25.0, 53.4, 54.2 and 45.8%, respectively. The corresponding values were 16.0, 29.9, 54.1, 27.4 and 72.6% for those kept in closed tie-stalls.

B- Body weight:

Calves of group (b) performed better than those of group (a) during the growth stage (from 6 to 12 months of age) (Table 3 and figure 1). The average body weight at 12 months of age was 205.8 and 227.8 kg for groups (a) and (b), respectively. Average daily gain was significantly higher in group (b) (596.1 g / day) than in group (a) (475.6 g / day) by 25.3%. Also, animals in group (b) consumed 10.7 % more dry matter per day than those in group (a). Feed efficiency of group (b) was also better by

13.5%. However, during the fattening period (from 12 to 18 months of age) the opposite was noticed. Average daily gain and feed efficiency were significantly higher in group (a) than in group (b). ADG was 875 and 721 g / d for animals in groups (a) and (b), respectively, showing a significant improvement of 21.3 % for group (a) (Table, 3). A kilogram gain required 9.4 kg DM in group (a) *vs.* 10.8 kg in group (b) (an important of 14.9%). During the whole experimental period (from 6 to 18 months) the average daily gain and feed efficiency were almost similar in the two experimental groups. At the growth stage, animals kept under the open free-stalls attained higher rate of gain simply by stimulating appetite and feed consumption. In an open system, animals are more active (playing, walking, running...etc.) and that would lead to energy loss as heat and metabolites (Hafez, 1975). It is, therefore drifting toward a deficit state with respect to immediately available body energy stores. At this point, animals must search for the fuel (feed) they need to reverse the energy deficit. This mechanism is called the total body energy balance (LeMagnen, 1971). During the later stage, animals kept under the closed tie-stalls showed better body performance. This may be explained, according to Schmisseur *et.al.* (1966), by the fact that animals during fattening period rested more in loose housing systems than in free-stalls. Gabr *et al.* (1986 b) noticed that under loose housing system the animals spent more time eating and consequently ruminated less than in a tie-barn system. Harper (1970) stated that when animals are reared in isolation (closed tie-stall system) from other members of their species, they often exhibit deficiencies in their sexual behaviour and therefore they may orient their energy to deposit more fat. This is in accordance with data in Table(6).

Data presented in Table (4) show that calves in group (b) are, in general, characterized by larger body measurements compared to animals in group (a). The higher estimates of body measurements scored by calves in group (b) could be explained in the fact that the animals of this group were raised in free open-stalls in their early stages of age, which led to more playing activities (Hafez, 1975). However, these animals scored lower estimates of slaughter weight and the reason could be that male buffalo calves raised under free-open stalls were very active in sexual behavioural specially at late stage of age(Harper, 1970). Therefore, it is recommended to raise male buffalo calves during fattening period (12 to 18 months) under closed tie-stalls. Omar (1982) showed that Egyptian farmers prefer to apply closed housing system away from direct sunlight in fattening cattle and buffalo male calves.

C- Carcass traits:

Data presented in Tables (5 and 6) show that some carcass traits were affected by housing system. Animals in group (a) had heavier fasted weights, empty body weights and warm carcass weights as compared to group (b). No significant differences were detected between the two groups regarding the average weights of head, legs and internal organs. The weight of the separable fat was significantly higher in group (a) than that in group (b), which may be due to less activity (Harper, 1970) and consequently, the net energy was used in fat deposition rather than in muscling. The percentage of skin to fasting body weight was significantly lower in group (a). The

present results illustrate that dressing percentage tended to be slightly higher in group (a) than in group (b). It should be noted that dressing weight, taken as percentage of carcass weight/empty weight- a more reliable measure-, did not show any significant difference between the two groups, with the highest estimate obtained for animals in group (a) being 64.3% vs. 60.8% for animals in group (b). The meat/bone ratio in whole carcass was 4.13 and 3.65 for (a) and (b) group, respectively.

The best ribs cut (9, 10 and 11) is widely used for the prediction of the lean, fat and bone percentages in the whole carcass. Table (6) shows means of weights and percentages of these tissues in the best ribs cut. With respect to the absolute weights, it can be seen that the lean, fat and bone in cuts of group (b) were less than that in group (a). However, when calculated as a percentage, the fat tends to increase in group (a) and lean and bone tend to increase in group (b). Differences, however, were only significant for fat tissues. Generally, the present results regarding percentages of lean, fat and bones in ribs agree with those reported by Afifi *et al.* (1974) (69.3, 12.1 and 18.4, respectively) at 18 months of age.

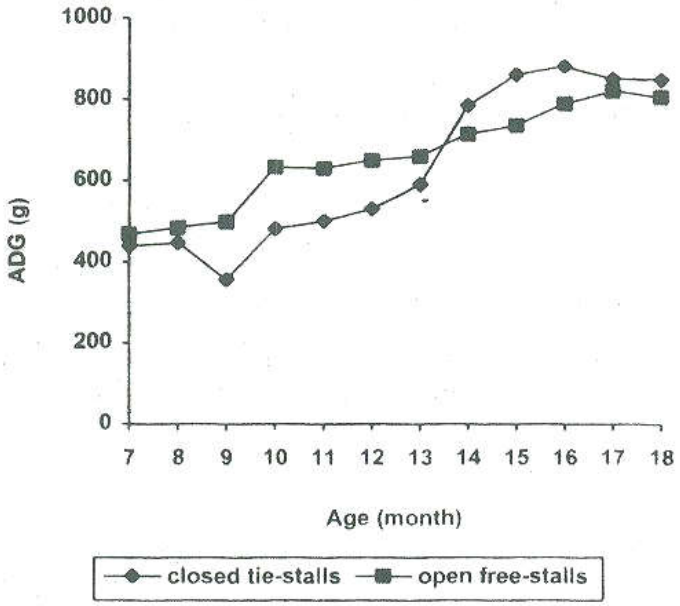

Fig. 1. Average daily gain (ADG) of male buffalo calves raised under two housing systems

Table 3. Growth characteristics of male buffalo calves as affected by two housing systems

Item	Group	
	Closed tie-stalls (a)	Open free-stalls(b)
From 6-12 months of age:		
No. of calves	10	10
Initial weight, kg at 6 months of age	120.2 ± 0.5	120.5 ± 0.3
Final weight, kg at 12 months of age*	205.8 ± 1.6	227.8 ± 1.3
Daily gain , gm / day*	475.6 ± 10.5	596.1 ± 9.5
Feed intake, kg D M / day	5.6	6.2
Feed efficiency, kg D M / kg gain	11.8	10.4
From 12-18 months of age:		
No. of calves	10	10
Initial weight, kg at 12 months of age	205.8 ± 1.6	227.8 ± 1.3
Final weight, kg at 18 months of age*	363.3 ± 2.5	357.6 ± 2.9
Daily gain, gm / day*	875.0 ± 12.1	721.1 ± 11.5
Feed intake, kg D M / day	8.2	7.8
Feed efficiency, kg D M / kg gain	9.4	10.8

* Difference between means of the 2 groups is significant (P<0.05).

Table 4. Body weight and measurments of male buffalo calves as affected by two housing systems

Item	Group	
	Closed tie-stalls(a)	Open free-stalls (b)
No. of calves	10	10
Initial weight, kg at 6 months of age	120.2 ± 0.5	120.5 ± 0.3
Final weight, kg at18 months of age	363.3 ± 2.5	357.6 ± 2.9
Daily gain, gm / day	675.3 ± 10.2	658.6 ± 12.6
Feed intake, kg D M / day	6.6	6.8
Feed efficiency, kg D M / kg gain	9.8	10.3
Body length (cm)	111.2 ± 5.6	122.3 ± 6.5
Heart girth (cm)	150.5 ± 9.5	170.5 ± 5.2
Chest depth (cm)	55.1 ± 2.6	60.5 ± 3.2
Thigh girth (cm)	112.5 ± 5.2	105.3 ± 2.9
Rump width (cm)	45.5 ± 2.1	40.2 ± 3.2
Rump extension (cm)	40.2 ± 3.2	45.1 ± 4.5
Height at withers (cm)	120.2 ± 4.5	131.5 ± 5.2
Height at rump (cm)	126.2 ± 3.8	136.1 ± 3.8

Table 5. Carcass traits of male buffalo calves as affected by two housing systems

Item	Group	
	Closed tie-stalls (a)	Open free-stalls(b)
Fasting weight, kg	355.1 ± 4.2	350.2 ± 3.9
Empty weight, kg	319.8 ± 5.5	316.7 ± 3.6
Warm carcass weight, kg	205.5 ± 3.8	192.4 ± 3.5
Head weight, %	5.1	4.7
Skin weight, %*	8.7	10.1
Fore legs, %	2.5	2.2
Empty digestive tract, %	4.2	3.5
Edible offals, kg [3]	15.6 ± 0.8	13. 2 ± 0.7
Separable fat, kg [4]*	10.5 ± 0.6	6.1 ± 0.5
Separable fat, %*	3.0	1.7
Dressing [1]%	57.9	54.9
Dressing [2]%	64.3	60.8
Separable bone in whole carcass:		
Weight, kg	40.0 ± 1.5	41.4 ± 1.3
% of warm carcass	19.5	21.5
Boneless carcass:		
weight, kg*	165.5 ± 6.5	151.0 ± 3.9
% of warm carcass	80.5	78.5
Coefficient of meat in whole carcass [5]	4.13	3.65
Shape index, %	55.8	52.2
Longissimus muscle area/cm^2	105.2 ± 5.5	101.5 ± 3.6

1- warm carcass weight relative to fasting body weight, 2- warm carcass weight relative to empty body weight. All percentages are related to fasting body weight ,3- Edible offals included heart, liver, kidneys, spleen, tests and lungs. 4- Separable fat included : Omentum and kidney fat, 5- Meat (including of lean and fat) : bone ratio * $P < 0.05$

Table 6. Physical components of 9, 10 and 11*th* ribs cut of male buffalo calves as affected by two housing systems

Item	Group	
	closed tie-stalls (a)	Open free-stalls (b)
No. of ribs cut	10	10
Weight of ribs cut, kg*	5.6 ± 0.8	4.8 ± 0.6
Lean, kg	3.95 ± 0.5	3.53 ± 0.2
% of cut	70.6	73.5
Fat, kg*	0.64 ± 0.1	0.36 ± 0.1
% of cut*	11.5	7.5
Bone, kg	1.06 ± 0.1	0.96 ± 0.2
% of cut	18.9	20.0
Coefficient of meat in ribs cut[1]	4.3	4.1

* ($P<0.05$) 1 Meat + fat: bone ratio

Experiment 2 (Female calves)

A- Age and weight at first mating

Female calves raised under close tie-stalls system showed higher daily gain compared to these under open free-stalls system during the growth stage. On contrast, during fattening period no differences were detected between the two systems (Figure 2). The average age at first mating was 21.5 ± 0.06 and 19.3 ± 0.05 months, and the average weight was 344.5 ± 0.5 and 312.2 ± 0.6 kg for (a) and (b) groups, respectively (Table 7). The average age is a little lower while the body weight is almost similar to that reported by many investigators on Egyptian buffalo heifers (Ahmed and Tantawy, 1954; Ragab and Abdel-Salam, 1963; El-Fouly, 1966 and El-Nouty, 1971). Their values varied from 20.8 to 24 months of age and 331 to 366 kg body weight. The difference may be due to the management practices of the breeding stock, housing system and system of feeding. Any attempt to decrease age at first service before 24 months is not effective without taking into consideration its corresponding live body weight, which can be accelerated through better feeding and care.

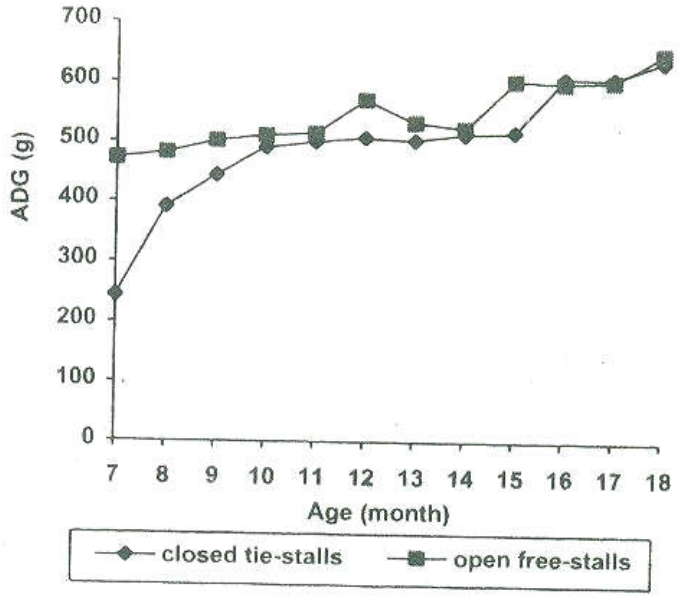

Fig. 2: Average daily gain (ADG) of female buffalo calves raised under two housing systems

B- Age and weight at first conception

The average age at first conception was 25.2 ± 0.7 and 21.1 ± 0.07 months and 360.3 ± 0.3 kg. and 351.1 ± 0.5 kg for group (a) and (b) respectively (Table 7). Values obtained in the present study are relatively higher than those obtained by Hafez (1954) and El-Nouty (1971). They reported 21.5, 22.8 months of age and 319, 347.5

kg body weight respectively. Theoretically, differences may be due to one or more of the following causes, 1) the small number of animals studied by those workers, 2) the high variations among the animals studied in the present work, particularly, that these animals were kept in different housing of the same year. On the contrary, the present values are lower than that obtained by El-Fouly (1966) in Egyptian buffaloes. He reported greater age (31.4 months) and attributed this mainly to an increased time loss from first to fertile service.

Table 7. Reproductive performance of buffalo heifers as affected by housing systems

Item	Group	
	Closed tie-stalls (a)	Open free-stalls (b)
No. of animals	10	10
Average age (month) at :		
1st mating	21.5 ± 0.06*	19.3 ± 0.05
1st fertile service	25.2 ± 0.03*	21.1 ± 0.07
Average body weight(kg)at:		
1st mating	344.5 ± 0.5*	312.2 ± 0.6
1st fertile service	360.3 ± 0.2	351.1 ± 0.5
No. of services per conception	1.4 ± 0.01	1.6 ± 0.08
Conception rate (%) from:		
One service	60.0	40.0
Two services	30.0	30.0
Three services	10.0	20.0
Four services or more	--	10.0

* $P < 0.05$

C- Number of services per conception

The average number of services per conception was 1.4 ± 0.01 in group (a) and 1.6 ± 0.08 in group (b), (Table 7). Both averages are comparatively similar to those reported by Hafez (1954) and Ragab *et al.* (1956), 1.5 and 1.51, respectively, but lower than those obtained by El-Fouly (1966) and Mohamed (1974) (2.92 and 2.2), respectively. Mohamed (1974) attributed the high number of services required for conception to the non-ovulatory services that constituted 1.33 services from the total number of services required per conception, the remaining numbers of services (1.59) were associated with ovulation. Also the averages obtained in the present study are lower than those reported by Shukla *et al.* (1970) in Murrah and Surti buffaloes in India (1.75 and 1.67 respectively). Out of the ten heifers inseminated in (b) group, 40, 30, 20 and 10% conceived from one, two, three and four or more services (Table 7). The corresponding values were 60, 30 and 10% from one, two and three service in group (a). rom these results, it is recommended to carry out such a study on larger numbers of female animals for confirmative results. However, from the present results, it could be concluded that male calves could be raised in a free system up to 12 months of age, then transferred to a closed system for a period up to 18 month of age for fattening or reaching the marketing body weight. Regarding the female calves, they are better raised under the free system.

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تأثير نظامين من المسكن على بعض الصفات الإنتاجية والتناسلية لعجول وعجلات الجاموس.

سعيد سعيد عمر

قسم الإنتاج الحيوانى - كلية الزراعة - شبين الكوم - جامعة المنوفية

أستخدم في هذه الدراسة ٢٠ عجلاً ومثلها من العجلات الجاموس في عمر ٦ شهور. قسمت العجول والعجلات إلى مجموعتين متماثلتين في الوزن. المجموعة الأولى من كل جنس ربُيت في مساكن مقفلة (مربوطة) أما المجموعة الثانية فقد ربُيت في مساكن مفتوحة (حرة).

كانت ظروف الرعاية والتغذية متماثلة في المجموعتين. تم تسجيل بعض الأنماط السلوكية للحيوانات كل أسبوعين فى كلتا المجموعتين ثُم ذُبحت العجول في عمر ١٨ شهراً بينما أستخدمت العجلات الجاموس فى دراسات تناسلية لتحديد العمر والوزن عند أول تلقيح وكذا عند التلقيح المخصب وعدد التلقيحات اللازمة.

وقد دلت النتائج على الآتى:

١. أوضحت نتائج بعض الأنماط السلوكية للحيوانات المرباة فى مساكن مفتوحة (حرة) والحيوانات التى تم تربيتها فى مساكن مقفلة (مربوطة) عن وجود فروق معنوية لكل من سلوك التغذية والاجترار والوقوف والرقاد خلال فترات الملاحظة.

٢. سجلت العجول الذكور التى نشأت في مساكن مفتوحة (حرة) قيماً أعلى معنوياً في معدل النمو مقارنة بتلك التى ربُيت في مساكن مقفلة (مربوطة) وذلك فى الأعمار المبكرة من العمر (٦-١٢ شهراً) وكان العكس صحيحا خلال فترة التسمين، ما بين ١٢-١٨ شهراً من العمر وأظهرت الكفاءة الغذائية نفس الاتجاه بالنسبة لمعدل النمو اليومى.

٣. أدت تربية العجول الجاموسى في مساكن مقفلة خلال التسمين النهائى (١٢-١٨ شهر) إلى زيادة نسبة التصافى ومعامل اللحم فى الذبيحة .

٤. كان متوسط العمر ٢١,٥ ± ١٩,٢ شهراً والوزن ٣٤٤,٥ و ٣١٢,٩ كجم عند أول تلقيح للعجلات المرباة في مساكن مقفلة (مربوطة) وتلك المرباة في مساكن مفتوحة على الترتيب.

٥. سجلت العجلات المرباة تحت النظام المفتوح (الحر) قيماً أقل بالنسبة لمتوسط العمر عند حدوث الحمل (٢١,١ شهراً) مقابل ٢٥,٢ شهراً للعجلات المرباة تحت النظام المقفول. هذا وقد لوحظ من النتائج أن عدد التلقيحات اللازمة لحدوث الحمل كان أكثر في العجلات المرباة تحت النظام المفتوح (الحر) مقارناً بالعجلات المرباة تحت النظام المقفل (المربوط).