EFFECTS OF ENVIRONMENTAL ENRICHMENT ON BEHAVIOURS AND WELFARE OF MERIZ GOAT

NAWROZ AKRAM KAKARASH [1]; DEREEN OMER RAMZI [2];
DANA OMER ISMAEEL [3] AND HARDI FATTAH MARIF [4]

[1] Department of Anatomy and Histopathology, College of Veterinary Medicine, University of Sulaimani, New Sulaimani, Street 27, Sulaymaniyah, Kurdistan Region, Northern Iraq

[2] Department of Basic Sciences, College of Veterinary Medicine, University of Sulaimani, New Sulaimani, Street 27, Sulaymaniyah, Kurdistan Region, Northern Iraq

[3] Department of Surgery and Theriogenology, College of Veterinary Medicine, University of Sulaimani, New Sulaimani, Street 27, Sulaymaniyah, Kurdistan Region, Northern Iraq

[4] Department of Clinic and Internal Medicine, College of Veterinary Medicine, University of Sulaimani, New Sulaimani, Street 27, Sulaymaniyah, Kurdistan Region, Northern Iraq

ABSTRACT

The aim of the present study was to evaluate the behaviour of Meriz goats using environmental enrichment technique. Sixteen goats aged two-four years, were divided into two equal groups, one group was placed in a stall without any enrichment (control), while the other group placed in another stall with enrichment. The enriched stall had six objects including canopy, grooming brush, suspended tire, trunk of tree, and plastic PET bottle suspended and freely move on the floor. The goats' behaviours were observed for eighty minutes in the morning and eighty minutes in the evening for fifteen consecutive days. Focal-animal sampling methods were used to record the behaviours, in which each animal was observed for ten-minutes period each day. Results revealed that the animals of enriched environment group displayed lower frequency of stereotypic and abnormal behaviour than control group. The mean frequencies of the groups were significantly different (P<0.001) for all recorded behaviours except for stall interaction which showed similar behaviours frequencies (P=0.56). The highest percentage of frequency interaction for grooming brush and suspended tire was detected (27%). It was also found that the frequency interaction between the goats and objects of the enriched environment increased daily and showed significant difference between 1st and 15th days (P<0.001). It was therefore concluded that animals on enriched environment express more behaviours, show greater preference for some objects, and spent more time on objects than non-enriched environment.

Keywords: Animal welfare, Ethology, Enriched environment, Goat.

INTRODUCTION

Among the domestic animals, goat is one of the widespread species raised in many different environments around the world.

Corresponding author: Hardi Fattah Marif
E-mail address: Hardi.marif@univsul.edu.iq
Present address: Department of Clinic and Internal Medicine, College of Veterinary Medicine, University of Sulaimani, New Sulaimani, Street 27, Sulaymaniyah, Kurdistan Region, Northern Iraq

Goat farming is relatively common in Kurdistan Region of Iraq and is a habit of some Kurdish farmers. Therefore, it is important for the famers to have high productive goats. According to Unal (2004), Yakan *et al.* (2007) and Koknaroglu and Akunal (2013) animal production has direct relationship with welfare and the animal welfare is evaluated by the animal behaviour. In this regards, understanding and improvement of animal welfare and

behaviour are quite necessary to increase animal products. In addition, the demand for animal products has increased constantly due to growth of human population and increase national and international consumption of products (Tuncer *et al.,* 2016). Using methodological and technological advances are contributing in improvement of animal welfare and production. Enriched environment is one of the methods can improve animal welfare and behaviour (Resende *et al.,* 2010). Animals' physiology and stress associated with the animals' environment. When the stress is developed, atypical behaviour can be noticed which has negative effect on their welfare, and subsequently affects the production and reproductive performances (Marai *et al.,* 2007).

Environmental enrichment composes of introducing objectives to reduce the feedlot monotony that are commonly seen in housed animal. In feedlot, animals are restricted and cannot express their behaviours compatible with those that the environment allows them to perform, subsequently the animals fail in performing of their natural behaviours and start to express of abnormal behaviour such as stereotypies (Peramas, 2018). Stereotypy is disorder in behaviours recognised by constant repetition of specific behaviour such as biting, fighting or scratching each other that is described as agonistic behaviour between the animals (Campos *et al.,* 2010). Furthermore, repetitive and non-functional behaviour usually happen as a result of animal frustration. Hence, environmental enrichment is introduced in terms of environmental improvement to fulfil behavioural need of the animals. Moreover, species can express their natural behaviours in enriched environment and don't suffer from any harm that could affect the physical and psychic welfare as well as productivity (Foppa *et al.,* 2014). This management type composes of introducing objects for instance, placing ball, tire, tree trunk and other objects in the farms that can provide the opportunity for the animals to express behaviours and breakdown the monotony of the feedlot. Climbing objects such as vertical structure is quite important for

goat, since this animal has a natural desire to go to high places for both feed and hide purposes from predators (Ribeiro *et al.,* 2009).

The aim of this research was therefore to assess the effect of enriched environment on welfare of Meriz goats via their behavioural analysis.

MATERIALS AND METHODS

Study site
The study was conducted in a Khrajyan village. The village is located in the east of Sulaymaniyah city, Iraq. The animals were housed previously in routine barn designed by our local farmers (intensive farming).

Preparation of animals and stalls
In the present study, sixteen Meriz goats (n=16) were used, the goats' age ranging from 2 to 4 years old. The goats were randomly allocated into two stalls (8.50 x 9.60 m), eight goats (n=8) in each. Nipple drinkers and bunk feeding were prepared in the both stalls with safety fences. In addition, the animals had water's *ad libitum* access, roughage (silage) and concentrate in the stalls. Two different treatments were used to evaluate the animals. In stall number one (control group), the animals were not applied to any enrichment, while the animals in stall number two were applied to enriched environment. The animals previously lived together and they already adapted with each other so that new territorial disputes by dominant animals already avoided in the stalls that may possible led to make stress for others.

Objects of enriched environment
The objects used in stall number two (enriched environment), including canopy which consisted of a roof fixed to the stall fences via two legs, green leave of tree such as grape and chickpea leaves put on roofs of canopies (three canopies), the roofs' direction were toward inside of the stall and the height of the canopies was about 110 cm so that the animals could eat the green leaves, three brush cleaning fixed to the wall of the stall at 60 cm height, in order that the animals could use them to scratch and clean their backs,

suspended tires (three tires), three trunk of tree with 30 cm height and 1 metre long for climbing, and six plastic PET bottles, three of them are freely move on the floor and the rest are suspended up to animals back height (for visual attractive and auditory stimulation, the bottles were filled about 75% of their spaces with corn).

Recording of behaviours
After preparing the stalls, the goats' behavioural evaluations were performed for five days as pre-experimental period. Furthermore, during the period, the most common behaviours of goats of the both stalls were observed and recorded in order to create an ethogram (Table 1). The period was helpful to increase the observations accuracy of the observers for the main study. Focal-animal sampling method was used to record the behaviours. Each animal was observed for ten-minutes per day for fifteen consecutive days (Gomes *et al.,* 2018), resulting in 150 observations per animal during the experimental period. Eighty minutes in the morning from 10:00 - 11:20 and eighty minutes in the evening from 15:00 - 16:20. The chosen times in the days was considered, because the animals consumed their feed, and their rumination rate had already decreased. The behaviours which were recorded, including standing, lying, bipedal, grooming

and self-cleaning, intake of water and nipple drinker interaction, intake of food and feeding bunk interaction, stall interaction, social interaction, stereotypic behaviours, fight and competition (Table 1). For the animals in the group of enriched environment, interactions with enrichment objects (canopies, cleaning brushes, suspended tires, tree trunks, suspended PET and free PET bottles) were also recorded. Moreover, the proportion time that animals spent on the enrichment objects were recorded for each single day of the experimental period.

Statistical analysis
All recorded data were projected to Microsoft Excel spreadsheet to be analysed. The data were analysed using IBM SPSS Statistics 24.0 and GenStat Software Program (17th edition, VSN International Ltd, UK). Independent-Samples T Test was used to make the comparison between the two groups for all recorded behaviours. In addition, One-Way ANOVA was used first to find the differences in the means of the objects of enriched environment and second to find the differences in the means of the days were the goats spent their time on the objects during the fifteen-experimental period. Fisher's Unprotected Least Significant Difference (LSD) test was used for post hoc comparisons.

Table 1: Ethogram of Meriz goats' behaviours recorded during experimental period.

Behaviour	Definition (description of behaviour)
Standing	All feet touching the ground, body not moving, the animal no showing activity.
Lying	Animals lying down in the stall and taking rest or ruminating.
Bipedal	The animal is standing only on its hind legs.
Grooming and self-cleaning	Animals are using their teeth, horns or hind limb to scratch themselves. Additionally, the animals rub any of their body parts in brush cleaning in order to remove ectoparasites.
Water intake and nipple drinker interaction	The animals visit the nipple drinker, does or does not drink water.
Food intake and Feeding bunk interaction	The animals visit the feeding bunk, does or does not eat the feed.
Stall interaction	The animals lean on the wall of the stall.
Social interaction	It is some kind of interaction between two or more animals for instance, play, sniff or lie down on each other.
Stereotype behaviour	It is repetition of some kind behaviour without useful purposes, like biting, repetitive movement (pacing), kicking or excessive grooming.
Fight and competition	It is having an aggressive behaviour against each other.

RESULT

The groups' behaviours

Figure 1 displayed the differences in behaviours between the two groups of Meriz goat during fifteen-day experimental period. The result showed that except for stall interaction, there was significant difference in the behaviours of the two groups. Both groups had almost similar stall interaction behaviour (P=0.56), while there was significant difference in standing (P<0.001), laying (P<0.001), Bipedal (P<0.001), grooming and self-cleaning (P<0.001), water intake and nipple drinker interaction (P<0.001), food intake and feeding bunk interaction (P<0.001), social interaction (P<0.001), stereotyped (P<0.001), and fight and competition (P<0.001) behaviours.
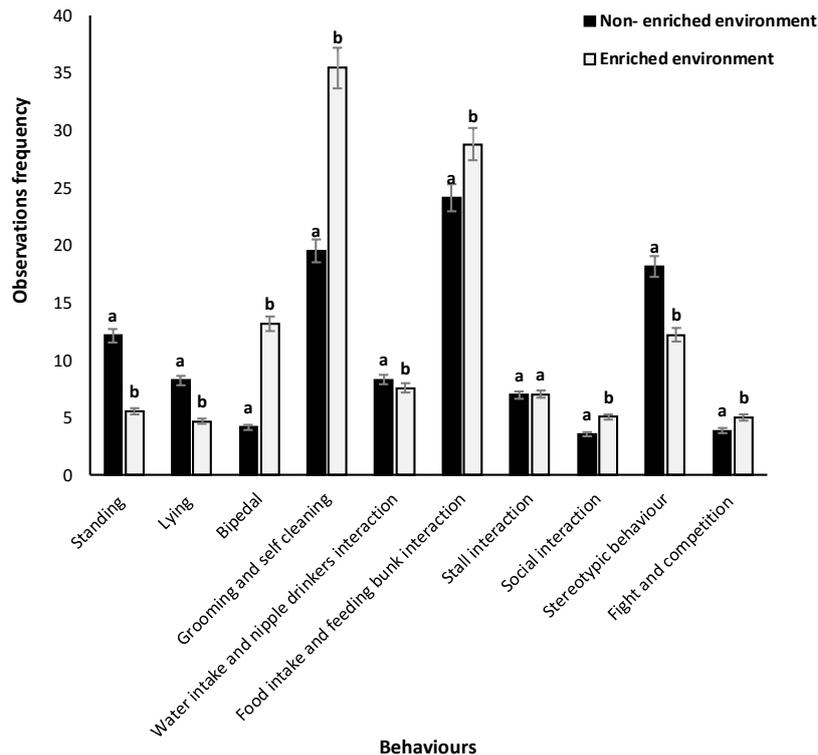

Figure 1: Frequency of different behaviours of Meriz goat housed in non-enriched and enriched environment during experimental period. Values are means and standard error of means. Different small letters show significant difference (P≤0.05), while same letter show not significant difference.

Percentage of frequency interaction

The percentage of frequency interaction between Meriz goats and objects of the enriched environment were shown in the Figure 2. The desire of the goats for interaction with grooming brush and suspended tire were the same which was 27% and there was no difference between grooming brush and suspended tire (P=0.89), while each of the grooming brush and suspended tire were significantly different (P<0.001) from other enrichment objects, including plastic PET bottle on the floor and canopy, suspended plastic PET bottle and tree trunk. Significant difference was also seen between plastic PET bottle on the floor 3% and canopy 10% (P<0.001), plastic PET bottle on the floor 3% and suspended plastic PET bottle 15% (P<0.001), plastic PET bottle on the floor 3% and tree trunk 18% (P<0.001). In addition, canopy 10% was different from suspended plastic PET bottle 15% (P<0.001) and tree trunk 18% (P<0.001). Furthermore, suspended plastic PET bottle 15% and tree trunk 18% were also significantly different (P<0.001).

Percentages of frequency interactions
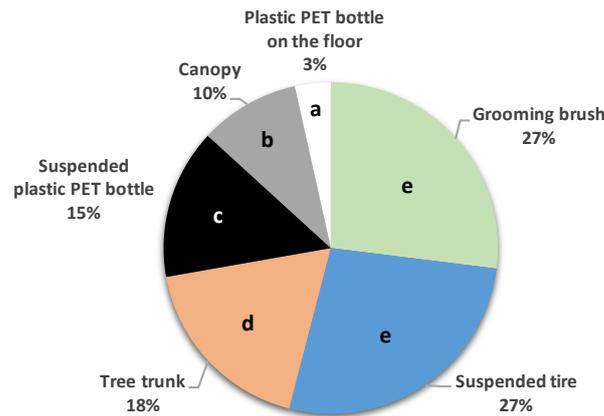
Figure 2: Percentage of frequency interactions between Meriz goats and objects of environmental enrichment. a, b, c, d, e present statistically significant by Fisher's protected LSD Test-One-Way ANOVA (P≤0.05).

Daily spent time on objects

The proportion of time which goats spent on objects of the enriched environment during fifteen-day experimental period illustrated in figure 3. The goats' spent time on the objects gradually increased. Generally, significant difference was found between the beginning and ending days of the experimental period in terms of increasing desire of the goats to visit the objects. In the 15th day, the goats' spent time on the objects dramatically increased and significantly different from 1st day (P<0.001).
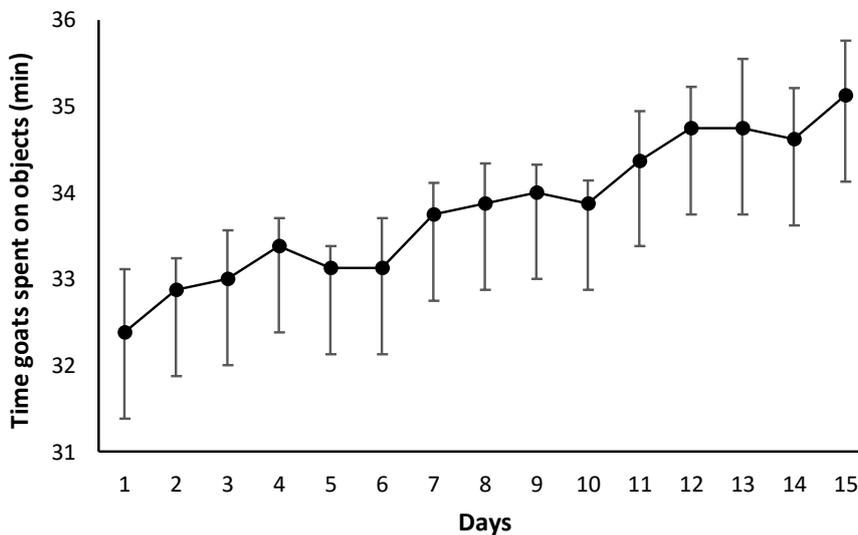
Figure 3: The average proportions of time goat spent on enrichment objects during fifteen-days experimental period.

DISCUSSION

Environmental enrichment improved the goats' behaviour and welfare significantly. In addition, it reduced the feedlot monotony and stereotypic behaviours by increasing the mean time spent on the provided objects.

The results of current study for enriched environment which decreased the stereotypic behaviours and feedlot monotony are in line

15

with the findings of Almeida *et al.* (2008) which conducted a study on effect of enriched environment on behaviour of genus Ateles in captivity and Oliveira *et al.* (2015) performed a research on social and abnormal behaviour in goat. Their findings revealed that behaviour of animals changes via using enrichment objects in their ambient; hence, suitable environment makes the animals more comfortable, reduces stereotypic behaviour as well as decreases the apathy in feedlot. Furthermore, enriched environment led to change in behaviours of animals, consequently changed their physical and psychological conditions by eliminating stress of the animals and resulting in improving of their welfare as well as production.

In the present study, standing, lying, water intake and nipple drinker interaction, and stereotypic behaviours were higher in non-enriched environment compare to enriched environment. The study findings support Moria *et al.* (2010) and Mkwanazi *et al.* (2019) which stated that non-enriched environment led to increase stereotypic behaviour or spend more time on non-useful behaviour such as more lying down.

The current study findings similar to the results of Gomes *et al.* (2018) for grooming and self-cleaning, food intake and feeding bunk interaction behaviours which confirmed that animals on enriched environment were more comfortable compare to non-enriched environment. On the other hand, the result of Gomes *et al.* (2018) for bipedal behaviour showed no difference between enriched and non-enriched environment, in this regard the result disagrees with the present study finding in which the score of bipedal behaviour much higher and more recorded in enriched environment. This result potentially caused by presence of canopies in the current study which contributed in the performing of bipedal behaviour, this was documented by Malechek and Provenza (1983), which stated that goats under natural condition, using their legs to stand and catch leaves from trees and bushes. Furthermore, when a good quality pasture and a high located leaves are available, goats prefer the high located leaves and justify their bipedal behaviour.

Doulames *et al.* (2014) stated that enriched environment led to increase social interaction and stimulate cognitive performance in mice. In addition, Oliveira *et al.* (2015) and Gomes *et al.* (2018) found that environmental stimulation led to increase social interaction. These findings support the present study results that enriched environment increase social behaviour. Furthermore, environmental enrichment led to increase competition and sometimes fight during the competition, for instance fight to get high area on the tree trunk.

The current research was also found that there were differences between the objects of the enriched environment. These differences relate to preference and desire of the animals to visit of some objects than others. Results revealed that suspended tire and cleaning brush recorded higher score of visiting. Regarding the suspended tire may due to its movability which made the animals to spent more time on and do play with it, this result is supported by (Gomes *et al.,* 2018). Cleaning and grooming themselves are a natural behaviour of most animals (Broom and Fraser, 2007) so that availability of cleaning brush as an object of enriched environment in the current study may led to more visited and used by the animals.

The present study revealed that mean of spent time on the objects of enriched environment had increased gradually, this was mean that the animals compatible with the provided objects, and their welfare improved by the time. This result supports the findings of Akunal (2013) and Oliveira *et al.* (2015) which stated that provides of enriched environment for long-term period led to improve animal welfare and production.

CONCLUSION

Activities of animals were influenced according to their environment. In enriched environment, animals were more active compare to non-enriched environment. In conclusion, behaviours and welfare of Meriz goats in intensive housing were improved by influence of different forms of environmental enrichment.

ACKNOWLEDGMENTS

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آثار الإثراء البيئي على سلوكيات ورفاهية ماعز المريز

نوروز اكرم كاكاراش ، ديرين عمر رمزى ، دانا عمر اسماعيل ، هاردى فتاح ماريف
كليه الطب البيطرى، جامعه السليمانيه، السليمانيه، العراق

E-mail: Hardi.marif@univsul.edu.iq　　Assiut University web-site: **www.aun.edu.eg**

هدفت الدراسة الحالية إلى تقييم سلوك ماعز المريز باستخدام تقنية الإثراء البيئي. تم تقسيم ستة عشر ماعزًا تتراوح أعمارهم بين عامين وأربعة أعوام إلى مجموعتين متساويتين، تم وضع مجموعة واحدة في كشك دون أي تخصيب (مراقبة)، بينما وضعت المجموعة الأخرى في كشك آخر مع الإثراء. يحتوي الكشك المخصب على ستة أشياء بما في ذلك المظلة وفرشاة الحلاقة والإطار المعلق وجذع الشجرة وزجاجة PET البلاستيكية المعلقة وتتحرك بحرية على الأرض. لوحظ سلوك الماعز لمدة ثمانين دقيقة في الصباح وثمانين دقيقة في المساء لمدة خمسة عشر يوما متتالية. تم استخدام طرق أخذ العينات من الحيوانات البؤرية لتسجيل السلوكيات، حيث تمت ملاحظة كل حيوان لمدة عشر دقائق كل يوم. أظهرت النتائج أن حيوانات مجموعة البيئة المخصبة أظهرت انخفاضًا في معدل تكرار السلوك النمطي والشاذ عن المجموعة الضابطة. كان متوسط الترددات للمجموعات مختلفًا بشكل كبير (P > 0.001) لجميع السلوكيات المسجلة باستثناء تفاعل المماطلة الذي أظهر ترددات سلوكية متشابهة (P = 0.56). تم الكشف عن أعلى نسبة للتفاعل الترددي لفرشاة الاستمالة والإطار المعلق (27٪). كما وجد أن التفاعل التكراري بين الماعز وأشياء البيئة المخصبة زاد يومياً وأظهر فرقاً معنوياً بين اليوم الأول واليوم الخامس عشر (P > 0.001). لذلك تم استنتاج أن الحيوانات في البيئة المخصبة تعبر عن سلوكيات أكثر، وتظهر تفضيلًا أكبر لبعض الأشياء ، وتقضي وقتًا أطول على الأشياء أكثر من البيئة غير المخصبة.