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Effect of Feeding Frequency and Housing System on Physiological Responses and Performance of Male Lambs under Upper Egypt Hot Conditions

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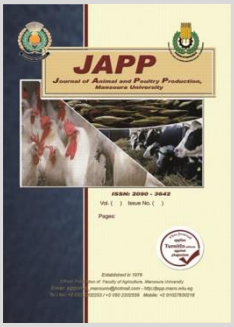

ABSTRACT

A total of 40 Farafra ram-lambs were used to investigate the effect of feeding frequency under different housing systems on physiological responses and growth performance under Upper Egypt hot conditions. Lambs were randomly allocated to 4 groups (10 lambs each); group (I) fed twice daily and housed in a semi-open pen, group (II) fed twice daily and housed in double-roofed pens, group (III) fed three times daily and kept in a semi-open pen and group (IV) fed three times daily and kept in a double-roofed pen. During the experimental period, the mean THI at pm was significantly higher in semi-open type than double-roofed one (90.2 ± 0.27 *vs.* 83.9 ± 0.29). At 12.00:14.00 h. pm, the lowest respiration rate was recorded in a group (IV) "56.0 ± 2.44" and the highest one was recorded in a group (I) "70.5 ± 3.3" and rectal and skin temperatures almost have taken similar trend. The results revealed that blood metabolites did not significantly ($P > 0.05$) affected by either housing type or feeding frequency. The results showed that group (III) had the highest final body weight (37.2 ± 0.97 kg) and total body weight gain (21.7 ± 0.68 kg) and average daily gain (148.2 ± 6.50 g/day) followed by group (I) then group (IV) and group (II). In conclusion, the feeding frequency of 3 times daily was more beneficial than feeding twice, and the physiological responses of lambs housed under double-roofed closed type were better compared to semi-open type.

Keywords: Feeding frequency, housing system, physiological responses, performance, lambs

INTRODUCTION

Maximization of farm animals productivity depends on the optimal feeding frequency and quantity to decrease feed wastage and consequently, the costs. Besides, a feed management strategy that maximizes animal growth is a significant issue. It was estimated that feeding cost is about 64-70% of the total cost in the animal production process *(Swelum et al., 2017a).* Studies that evaluated the effects of different feeding schedules on ruminants yielded conflicting results. It has been reported that feeding concentrate diets at more frequent intervals may benefit ruminants *(Jensen and Wolstrup, 1977; Bragg et al., 1986; French and Kennelly, 1990 and Robles et al., 2007).* Also, the feed efficiency of growing ruminants was improved by increasing feeding frequency *(Shabi et al., 1999*; *Schutz et al., 2011*; *Keogh et al., 2015).* Another study reported that offering the daily feed in small quantities at more frequent intervals tends to have a stabilizing effect upon ruminal fermentation *(Swelum et al., 2017a).* Furthermore, increasing feeding frequency more than twice daily tended to increase the daily quantity of total N and non-ammonia N reaching the abomasums *(Bunting et al., 1987).* In addition, animals subjected to DMI restriction reduced their energy needs for maintenance, which resulted in more energy for body gain *(Kamalzadeh et al. 2009).* On the other hand, many studies reported that increasing daily feeding frequency does not affect ADG and carcass characteristics *(Abouheif et al., 2010; Ribeiro et al., 2011; Schutz et al., 2011).* The variations between studies may be attributed to the number of daily meals, diet ingredients and or levels of dry matter intake *(Swelum et al., 2017b).*

Protecting farm animals from adverse climatic conditions is one of the most important aims for gaining maximum productivity. Upper Egypt's climate is characterized by high temperatures and humidity during the summer season, which negatively affects the physiological and productive performances of sheep *(Abozed et al., 2013).* Housing has a significant effect on both the physiological responses and the productive performance of sheep *(Bhatta et al., 2005).* Economical aspects besides animal status were chief factors for deciding the housing system, especially in upper Egypt, where many housing systems were used. Recently, animal buildings have changed as differing requirements have been imposed and new methods and materials have been developed. Many studies determined the effects of different housing systems on sheep productivity under adverse climatic conditions and with different result was obtained. It has been reported that using closed housing system (especially double-roofed) is beneficial during summer, that it may eliminate such effect of high air temperature on sheep and provide more comfortable environmental conditions compared to semi-open housing system *(Abozed et al., 2013).* Also, *Maurya et al. (2013)* found that protected lambs under roofed-closed system had higher body weight and daily gain. On the other hand, it has been reported that the outdoor feeding of Awassi lambs improved feed conversion ratios compared to indoor feeding

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(Serafettin, 2011). However, *Karabacak et al., (2015)* did not found significant differences between closed or opened housing systems. The aim of this study is to investigate the effect of feeding frequency under different housing systems on physiological responses and growth performance of male lambs under upper Egypt hot conditions.

MATERIALS AND METHODS

Animals and experimental design

This trail carried out during the period from (23 May to 10 October 2015) at Malawi Animal Production Research Station, Minya Governorate. A total of forty Farafra ram-lambs aged 3-4 months and with an average weight of 15.5 ± 0.6, were used in this trail. All lambs were chosen healthy and homogenized and then were randomly allocated to 4 groups (10 lambs each) as follows:

- **Group (I):** Fed twice daily and kept in the semi-open (shaded yard) housing system.
- **Group (II):** Fed twice daily and kept in the double-roofed housing system.
- **Group (III):** Fed three times daily and kept in the semi-open housing system.
- **Group (IV):** Fed three times daily and kept in the double-roofed housing system.

The semi-open type pen was 10.5 m length × 4.5 m width roofed with asbestos sheets at 4 m height with concrete floor (Figure, 1). While, the double-roofed close pen was 4.5 m length ×5.0 m width roofed with double asbestos roofs at 5.0 and 5.5 m height for two roofs, respectively with concrete floor (Figure, 2).

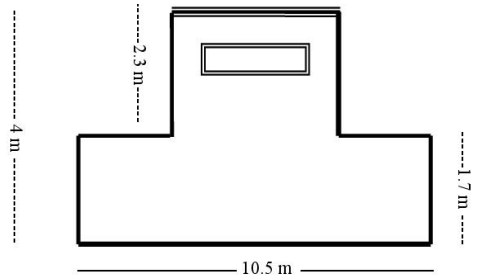

Figure 1. Semi-open pen.

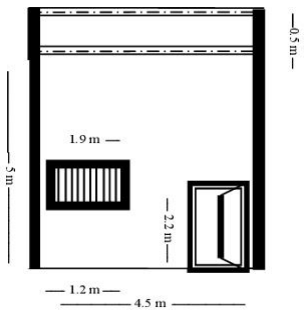

Figure 2. Double-roofed pen.

The Four groups fed on concentrate feed mixture, corn silage and wheat straw according to *NRC, (2007*) and the Approximate analysis of the used feedstuffs was presented in Table (1). Animals had free access to fresh water throughout the day. In groups (I & II), feed offered twice daily at 8:0 am and 1:0 pm however in groups (III & IV), feed offered three times daily at 8:0 am, 1:0 pm and 6:0 pm. Weights of animals were taken biweekly, and the amounts of feed were adjusted according to body weight changes, and body weight changes and average daily gain (ADG) were calculated.

The ambient temperature and relative humidity were recorded, and then, the temperature-humidity index (THI) was calculated according to the equation of *Hahn et al. (2003)*:

THI= [(TDB X 1.8) +32] - [(0.55 X (RH/100) X (TDB X 1.8) +32]-58.

Where: TDB = Dry bulb temperature in °C.
RH % = Relative humidity.

Thermal measurements and blood metabolites

Physiological parameters were taken biweekly in the morning, am (6:00 to 8:00) and afternoon, pm (12:00 to 14:00). Rectal temperature (RT, ºC) was measured by a clinical thermometer, skin temperature (ST, ºC) and wool temperature (WT, ºC) were measured by a portable infrared thermometer (model 22-325, Radioshack company, USA). Respiration rate (RR) was measured by visual counting of flank movement in one minute.

Blood samples were collected from each animal (6 ml) and divided into two parts; the first part was with EDTA to determine hematocrit (Ht) and haemoglobin concentration (Hb) and the second part was centrifuged at 1800 rpm for 20 minutes and the serum was separated, frozen and stored at -20°C until the analysis of blood metabolites that include total protein, albumin, glucose, urea, AST and ALT which were determined using commercial kits.

Statistical analysis.

Statistical analysis of the data was done by SPSS (v. 21.0) for Windows *(SPSS Inc., Chicago, IL, 2012).* One-way ANOVA test and Duncan's Multiple Range Test *(Duncan, 1955)* were used to test the significance among groups.

Table 1. Chemical composition of the experimental diet (% as DM basis).

Item	Concentrate feed mixture (CFM)*	Corn silage	Wheat straw
DM	92.4	23.9	87.3
OM	89.2	90.9	89.96
CP	14. 9	9.6	1.51
CF	15.5	38.3	42.90
EE	3.5	4.9	2.47
NFE	55.3	38.0	43.08
Ash	10.8	9.1	10.04

*** Concentrate feed mixture (CFM) was consisted of 40% wheat bran, 30% ground yellow corn, 24% undecorticated cotton-seed meal, 3% cane molasses, 2% lime-stone and 1% common salt.**

RESULTS AND DISCUSSION

Results

Meteorological data

The results presented in Table (2) showed a significant ($P < 0.01$) difference between semi-open and double roofed in ambient temperature, relative humidity, and temperature-humidity index at both am and pm periods. At am, both AT and THI were lower in semi-open pen compared to double roofed one and the opposite trend was found at pm. Similar findings were reported by *Ashour et al., (1998 a & b), Abozed (2009)* and *Abozed et al., (2013),* who found that both AT and THI were lower in double-roofed shaded pen compared to semi-open one and this may be attributed to the better insulation of these double-roofed shaded pens.

Table 2. Metrological data (ambient temperature, relative humidity and temperature-humidity index) under different housing systems.

Parameter	am		P. value (Sig.)	pm		P. value (Sig.)
	Semi-Open	Double roofed		Semi-open	Double roofed	
AT (°C)	26.31± 0.21	27.64± 0.18	<0.01**	36.22± 0.18	33.90± 0.21	<0.01**
RH %	69.29± 0.24	68.18± 0.27	<0.01**	32.64± 0.38	46.83± 0.62	<0.01**
THI	71.24± 0.24	72.84± 0.21	<0.01**	90.15± 0.27	83.98± 0.29	<0.01**

**** (p<0.01).**

Physiological parameters

At pm, the lowest RR was recorded in the group (IV) "double roofed, 3 times daily" which was 56.0 ± 2.44 and the highest one was recorded in group (I) "semi-open, twice daily" 70.5 ± 3.3 ($P < 0.01$). It has been reported that RR was the most sensitive parameter that reflected a faster response to the environmental condition so, the first observed response was the increase in RR when animals were exposed to rising AT *(Ashour et al., 1998a)*. Similar results were obtained by *Said (1985),* who found that providing shade resulted in decreased respiratory activities at 2.00 pm. Also, *Tharwat et al. (1991)* found that the shaded animals exhibited lower RR ($P < 0.01$) at pm compared to the un-shaded group (104.3 *vs.* 120.5 resp. / min.). Besides, *Abozed (2009)* stated that during summer at afternoon, Farafra ewes in close type shaded with double asbestos roofs had significantly ($P < 0.05$) lower RR than those in semi-open houses. This result may be attributed to the lower THI of double roofed pens than the semi-open ones. This low THI may result from the good insulation witch provided by double roof shading, which lowers the effect of direct solar radiation. There are no data available on the impact of feeding frequency on RR under the present experimental condition.

As regards rectal temperature, nearly similar trend of the results of RR was obtained at pm (the significantly lowest RT was recorded in group IV "39.70 ± 0.04 °C" and the highest one was found in group I "39.88 ± 0.04 °C ". Similarly, *Abozed (2009)* found that during summer at afternoon, Farafra ewes in close type shaded pens with double asbestos roofs had significantly ($P < 0.05$) lower RT than those housed in semi-open pen. *Abozed et al., (2013)* and *Ashour et al. (1998b)* confirmed these results on ram lambs and ewes, respectively. This decrease in RT of lambs housed in double roofed pens may be due to the lower AT and THI in these pens than semi-open ones resulting from the good insulation.

Regarding skin and wool temperatures, the results revealed that animals housed in double-roofed pens (either fed twice or 3 times) had lower ST and WT compared to those housed under semi-open pens. This result of ST matched with that of RT, as it has been reported that ST of the animal strongly correlated with RT *(Sayah, 2005 and Abozed et al., 2013)*. The current results agreed with many authors *(Abozed, 2009, Abozed et al., 2013; Ashour et al. 1998 b)* who found that animals housed in closed type shaded pens with double asbestos roofs had significantly lower ST than those housed in semi-open pens. In addition, the results of WT was comparable to those obtained by *(Abozed, 2009).*

Table 3. Physiological and thermal parameters under different housing types and feeding frequency during diurnal periods.

Parameter		Fed twice daily		Fed three times daily	
		Semi-open Group (I)	Double roofed Group (II)	Semi-open Group (III)	Double roofed Group (IV)
RR (resp. / min.)	Am	38.93 ^{ab}± 1.91	40.10 ^{a}± 1.51	34.99 ^{b}± 1.63	41.99 ^{a}± 1.62
	Pm	70.51 ^{a}± 3.31	60.28 ^{b}± 2.94	57.14 ^{b}± 2.38	56.02 ^{b}± 2.44
RT (°C)	Am	39.46 ^{a}± 0.04	39.51 ^{a}± 0.04	39.35 ^{b}± 0.03	39.50 ^{a}± 0.04
	Pm	39.88 ^{a}± 0.04	39.86 ^{a}± 0.04	39.77 ^{b}± 0.03	39.70 ^{b}± 0.04
ST (°C).	Am	32.17 ^{b}± 0.15	33.33 ^{a}± 0.14	32.00 ^{b}± 0.14	33.57 ^{a}± 0.14
	Pm	35.79± 0.12	35.52± 0.12	35.80± 0.12	35.49± 0.10
WT (°C)	Am	26.77 ^{c}± 0.22	28.53 ^{b}± 0.18	26.82 ^{c}± 0.24	29.32 ^{a}± 0.19
	Pm	35.48 ^{a}± 0.23	33.28 ^{b}± 0.18	35.35 ^{a}± 0.23	33.31^{b}± 0.16

a, b, c: Means in the same row are significantly different.

Blood constituents

Table (4) showed that blood metabolites were not significantly affected by either housing type or feeding frequency. Hematocrit, total protein, globulin and urea levels tended to slightly increase by feeding twice daily while in contrary, Hb, albumin and AST levels tended to slightly increase by providing 3 times. There was no prominent effect of the housing type on the studied blood metabolites. Similar to our findings, *Verma et al., (2012)* reported that different housing systems not significantly affected most the blood metabolites of ewes. In this study, the slightly lower Ht% in groups feed 3 times (group III and IV) may be attributed to the higher water consumption of lambs in these groups which causes a type of hemodilution that changes the blood volume and subsequently reduces blood Ht%. On the other hand, *Abozed, (2009)* illustrated that blood Hb and Ht and serum TP and its fractions were in ram lambs housed in the close type shaded with double asbestos roofs compared to those housed in semi-open houses. Also, *Sayah, (2005)* found similar results in growing male Friesian calves. *Kamal et al., (1984)* reported that increasing respiration rate of the animal during heat stress could cause a reduction in plasma protein. However, it is important to mention that more data will be needed to evaluate the effect of feeding frequency on blood metabolites of Frafra male lambs under hot condition.

Table 4. Blood constituents of lambs under different housing types and feeding frequency.

Parameter	Fed twice daily		Fed three times daily	
	Semi-open Group (I)	Double roofed Group (II)	Semi-open Group (III)	Double roofed Group (IV)
Ht (%)	27.73 ± 0.60	27.33 ± 0.85	26.20 ± 0.95	26.07 ± 0.88
Hb (g/dl)	11.07 ± 0.33	11.37 ± 0.28	11.68 ± 0.50	12.43 ± 1.19
TP (g/dl)	5.99 ± 0.11	5.98 ± 0.06	5.80 ± 0.13	5.80 ± 0.14
Alb (g/dl)	3.51 ± 0.18	3.67 ± 0.17	3.81 ± 0.18	3.88 ± 0.19
Globulin (g/dl)	2.48 ± 0.23	2.31 ± 0.19	1.99 ± 0.20	1.92 ± 0.21
Glucose (mg/dl)	62.00 ± 2.09	59.33 ± 1.74	59.73 ± 2.23	64.07 ± 1.42
Urea (mg/dl)	44.04 ± 3.11	44.77 ± 3.25	41.43 ± 2.16	38.83 ± 2.06
ALT (U/l)	36.40 ± 1.95	43.4 ± 1.11	43.80 ± 1.86	40.47 ± 2.68
AST (U/l)	21.73 ± 3.53	18.11 ± 1.93	15.25 ± 0.45	16.76 ± 1.98

Lamb's growth performance

Table (5) presents lambs' performance under different housing types and feeding frequency. The results revealed that group (III) that housed in semi-open pens and fed 3 times had the highest final weight (37.19 ± 0.97 kg) and total body weight gain (21.67 ± 0.68 kg) and average daily gain (148.2 ± 6.50 g/day) followed by group (I) that housed in semi-open pens and fed twice followed by group (IV) that housed in double roofed and provided 3 times and final, group (II) that housed in double roofed and fed twice. While, feed intake and water consumption almost did not differ among groups, groups with better performance had higher DMI intake , which may explain. These results revealed that the performance of animals that fed 3 times daily almost was the better (either housed under semi-open or double roofed closed housing). It has been reported that feeding concentrate diets at more frequent intervals may be beneficial to ruminants *(Jensen and Wolstrup, 1977 ; Bragg et al., 1986).* Also, *Shabi et al., (1999), Schutz et al., (2011)* and *(Keogh et al., 2015)* reported that the feed efficiency of growing ruminants was improved by increasing feeding frequency. In an earlier study, *Bunting et al., (1987)* found that increasing feeding frequency more than twice daily tended to increase the daily quantity of total N and non-ammonia N reaching the abomasum. Others reported that animals subjected to DMI restriction reduced their energy needs for maintenance, which resulted in more energy for body gain *(Kamalzadeh et al. 2009).* On the other hand, it has been reported that increasing feeding frequency did not affect ADG *(Abouheif et al., 2010* and *Ribeiro et al., 2011).* In addition, the present results demonstrated that the performance of animals housed under semi-open system was better compared to those housed under the closed one. Similarly, *Serafettin, (2011)* found that outdoor feeding of Awassi lambs improved feed conversion ratios compared to indoor feeding. However, *Abozed (2009)* found that housing types had no significant effect on body weight change of Farafra growing ram lambs.

Table 5. Growth performance of lambs under different housing types and feeding frequency.

Parameter	Fed twice daily		Fed three times daily	
	Semi-open Group (I)	Double roofed Group (II)	Semi-open Group (III)	Double roofed Group (IV)
Initial live body weight (kg)	15.4 ± 0.55	15.4 ± 0.51	15.5 ± 0.72	15.6 ± 0.57
Final live body weight (kg)	35.2 ±0.95^{ab}	33.1 ±1.28^{b}	37.2 ± 0.97^{a}	35.0 ± 0.75^{ab}
Total body weight gain (kg)	19.7 ± 1.03^{ab}	17.6 ± 0.82^{b}	21.7 ± 0.68^{a}	19.4 ± 0.69^{ab}
Average daily gain (g/day)	139.7 ± 5.63^{ab}	124.7 ± 6.51^{b}	148.2 ± 6.50^{a}	138.2 ± 6.54^{ab}
Concentrate intake (kg/h/d)	0.887 ± 0.06	0.862 ± 0.06	0.920 ± 0.07	0.887 ± 0.06
Roughage	0.822 ± 0.12	0.796 ± 0.12	0.825 ± 0.12	0.812 ± 0.12
Total DMI (kg/h/d)	1.71 ± 0.18	1.66 ± 0.17	1.75 ± 0.18	1.70 ± 0.17
Water intake (L/h/d)	3.10 ± 0.19	3.06 ± 0.19	3.37 ± 0.23	3.33 ±0.22

a and b: Means in the same row with different superscript letters are significantly different.

CONCLUSION

In general, the feeding frequency of 3 times daily was more beneficial than feeding twice. The physiological responses of lambs housed under double-roofed closed type were better compared to semi-open type. This housing type provided a more comfortable climatic condition that alleviated external heat stress on the animal. In contrast the lambs growth performance was slightly better in semi-open housing type. Finally, feeding lambs 3 times daily under double-roofed closed housing type outcome better performance during summer heat stress conditions.

REFERENCES

Abouheif, M.A., Saiady, M.Y., Makkawi, A.A., Ibrahim, H.A. and Kraidees, M.S. (2010). Effect of either once or twice daily feeding of pelleted high-concentrate diet on performance and digestion in growing lambs. Journal of Animal and Veterinary Advances, 9: 925-931.

Abozed G. F; M. H El-Shafie and H. A. Daghash (2013). Reflection of housing systems on the male reproductive performance of Frafra sheep under middle Egypt environmental conditions. 4th Scientific Conf. of Animal Production Research institute. Cairo, Egypt. 12-13.

Abozed, G. F. (2009). Influence of housing system on productive and reproductive performances of sheep. M.Sc. Thesis, Fac. Agric., Assiut Univ., Assiut, Egypt.

Ashour, G.; M. H. Hatem and S. F. Eid (1998b). Environmental studies of some housing systems for sheep under Egyptian conditions. 1th International conf. on Rationalization of Energy in Agriculture (I.C.R.E.A.). Mansoura University, Egypt. 17-18 March.

Ashour, G.; M. M. Shafie; S. A. Fawzy and M. S. Sayah (1998a). Influence of housing physical properties on physiological performance of suckling Friesian calves. Egyptian J. Anim. Prod. 35, (Suppl. Issue): 33-45.

Bhatta, R., N. Swain; D. L. Verma and N. P. Singh (2005). Effect of Housing on Physiological Responses and Energy Expenditure of Sheep in a Semi-arid Region of India. Asian-Aust. J. Anim. Sci., Vol. 18(8): 1188-1193

Bragg, D. St. A., M. R. Murphy and C. L. Davis (1986). Effect of source of carbohydrates and frequency of feeding on rumen parameters in dairy steers. J. Dairy Sci. 69:392.

Bunting L. D., M. D. Howard, R. B. Muntifering, K. A. Dawson and J. A. Boling. (1987). Effect of feeding frequency on forage fiber and nitrogen utilization in sheep. J ANIM Sci., 64:1170-1177.

Duncan, D. B. (1955). Multiple range and multiple F- test. Biometrics, 11:1.

French N. and J. J. Kennelly (1990). Effects of feeding frequency on ruminal parameters, plasma insulin, milk yield, and milk composition in Holstein cows. J. Dairy Sci. 73: 1857-1863.

Hahn, G. L., T. L. Mader and R. A. Eigenberg (2003). Perspective on development of thermal indices for animals' studies and management. Proceeding of the interaction between climate and animal production symposium, Viterbo, Italy, September, EAAP Technical Series No. 7: 31-44.

Jensen, K. and J. Wolstrup. (1977). Effect of feeding frequency on fermentation pattern and microbial activity in the bovine rumen. Acta Vet. Scand 18:108.

Kamal, T. H.; A. Z. Mehrez; M. M. El-Shinnawy and A. A. Abou El-Naga (1984). Effect of high environmental temperature on minerals metabolism in Friesian cattle. Proc. 1th Egyptian-British. Conf. Anim. Poul. Prod., Zagazig University, Egypt.

Kamalzadeh, A., Koops, W.J. and Kiasat, A. (2009). Effect of qualitative feed restriction on energy metabolism and nitrogen retention in sheep. South African Journal of Animal Science, 39: 30-39.

Karabacak A., I. Aytekin and S. Boztepe. (2015). Fattening performance and carcass traits of Anatolian Merino lambs in indoor and outdoor sheepfolds. Indian J. Anim. Res., 49 (1): 103-108

Keogh, K., Waters, S.M., Kelly, A.K. and Kenny, D.A. (2015). Feed restriction and subsequent realimentation in Holstein Friesian bulls: I. Effect on animal performance; muscle, fat, and linear body measurements; and slaughter characteristics. Journal of Animal Science, 93: 3578-3589.

NRC (2007). National Research Council. Nutrient Requirements of Small Ruminants: Sheep, Goats, Cervids and new world Camelids. National Academy of Sciences. Washington, DC., USA.

Maurya, V. P.; V. Sejian and S. M. K. Naqvi (2013). Effect of cold stress on growth, physiological responses, blood metabolites and hormonal profile of native Malpura lambs under hot semi-arid tropics of India. Indian J. of Anim. Scien. 83 (4): 370-373.

Ribeiro, E.L.A., Mizubuti, I.Y., Silva, L., Paira, F.H.P., Sousa, C.L. and Castro, F.A.B. (2011). Performance, ingestive behavior and carcass characteristics of feedlot lambs submitted to different feeding frequencies. Revista Brasileira de Zootecnia, 40: 892-898.

Robles V., L. A. González, A. Ferret, X. Manteca and S. Calsamiglia. (2007). Effects of feeding frequency on intake, ruminal fermentation, and feeding behavior in heifers fed high-concentrate diets. J. Anim. Sci. 85(10): 2538-2547.

Said, E. E. T. M. (1985). Reproductive performance in ram lambs as affected by heat stress. M.Sc. Thesis, Fac. Agric., Ain Shams Univ., Cairo, Egypt.

Sayah, M. S. (2005). Effect of housing conditions on Friesian calves performance. Ph.D. Thesis, Fac. Agric., Cairo Univ., Giza, Egypt.

Schutz, J.S., Wagner, J.J., Sharman, E.D., Davis, N.E. and Engle, T.E. (2011). Effect of feeding frequency on feedlot steer performance. The Professional Animal Scientist, 27: 14–18.

Serafettin K. (2011). The Effects of Outdoor Housing and Cafeteria Feeding on Growth Performance and Feeding Behaviour of Awassi Lambs. J. Anim. Vet. Adv., 10 (19): 2550-2556.

Shabi, Z., Bruckental, I., Zamwell, S., Tagari, H. and Arieli, A. (1999). Effects of extrusion of grain and feeding frequency on rumen fermentation, nutrient digestibility and milk yield and composition in dairy cows. Journal of Dairy Science, 82: 1252-1260.

SPSS (2012). IBM Corp. Released 2012. IBM SPSS Statistics for Windows, Version 21.0. Armonk, NY: IBM Corp.

Swelum A., F. Alshamiry, A. El-Waziry, M. Ali, T. Shafey and M. Abouheif. (2017a). Effect of Feeding Frequency on Plasma Metabolites Concentrations and Production Cost in Feed-restricted Lambs. Animal Nutrition and Feed Technology 17 : 279-291.

Swelum, A.A., Ayadi, M., Alhidary, I., Alowaimer, A.N. and Abouheif, M.A. (2017b). The relationships between body fatness, leptin, testosterone, and reproductive performance in ram lambs as affected by level and frequency of feeding. Theriogenology, 89: 79-85.

Tharwat, E. E.; S. O. Amin; A. A. younis and e. a. Kotby (1991). Physiological responses of growing rams to aspestos shading during summer. AJAS, vol. 4 (4): 395-398.

Verma, R. K., A. K. Ishwar, M. P. Sinha and A. Bharti. (2012). Effect of Different Housing Systems on Triidothyronine (T3) and Thyroxine (T4) in Chhotanagpuri Ewes. Vet. World, Vol. 5(2): 100-102.

تأثير عدد مرات تقديم الغذاء ونظم الإسكان المختلفة على الاستجابات الفسيولوجية وأداء الحملان تحت الظروف المناخية الحارة لصعيد مصر

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إستُخدِمَ عدد ٤٠ من الحملان الفرافرة لدراسة تأثير تكرار التغذية تحت أنظمة الإسكان المختلفة على الاستجابات الفسيولوجية والأداء الإنتاجي في ظل الظروف الحارة لصعيد مصر. تم توزيع الحملان بشكل عشوائي على اربع مجموعات (١٠ حملان لكل مجموعة). المجموعة الأولي غُذيت مرتين يومياً ووضعت في حظيرة شبه مفتوحة، المجموعة الثانية غُذيت مرتين يومياً ووضعت في حظيرة مغلقة ذات سقف مزدوج، المجموعة الثالثة غُذيت ثلاث مرات يومياً ووضعت في حظيرة شبه مفتوحة والمجموعة الرابعة غُذيت ثلاث مرات يوميًا ووضعت في حظيرة مغلقة ذات سقف مزدوج. خلال الفترة التجريبية ، كان متوسط معامل الرطوبة والحرارة ظهرا أعلى بشكل معنوي جدا في النوع شبه المفتوح مقارنةً بالمغلق ذو السقف المزدوج (٠,٢٧ ± ٩٠,٢ مقابل ٠,٢٩ ± ٨٣,٩). أوضحت النتائج أن أدنى معدل تنفس تم تسجيله في المجموعة الرابعة "٢,٤٤ ± ٥٦,٠ " وأعلى معدل تنفس تم تسجيله في المجموعة الاولي "٣,٣ ± ٧٠,٥" ($P < 0.01$) . وقد اتخذت درجات حرارة المستقيم والجلد تقريبًا نفس الاتجاه. أظهرت النتائج أن مكونات الدم لم تتأثر تقريبا بشكل معنوي بكلا من نوع الإسكان أو تكرار التغذية. أظهرت النتائج أن المجموعة الثالثة كان لها أعلى وزن للجسم عند نهاية التجربة (٠,٩٧ ± ٣٧,٢ كجم) وأعلى إجمالي زيادة وزن الجسم (٠,٦٨ ± ٢١,٧ كجم) وأعلى متوسط معدل نمو يومي (٦,٥٠ ± ١٤٨,٢ جم / يوم) تليها المجموعة الأولي ثم المجموعة الرابعة ثم المجموعة الثانية. في الختام ، كان تكرار التغذية ٣ مرات يوميًا أكثر فائدة من التغذية مرتين والاستجابات الفسيولوجية للحملان التي تم إيواءها تحت نظام مغلق بسقف مزدوج كانت أفضل مقارنة بالنوع شبه المفتوح.