COMBINED EFFECT OF FLUSHING AND HORMONAL TREATMENT ON REPRODUCTIVE PERFORMANCE OF LOCAL GOAT.

Araz O. B. **E. Alkass** **M. S. Barwary**
Lecturer **Prof.** **Assist.Prof.**
Dept. Animal Produc., Col. Agricul. Engin. University Duhok, Kurdistan Region, Iraq
(araz.o.mohammed@uod.ac),(nljealkas2001@yahoo.com), (mwafaq.barwary@uod.ac)

ABSTRACT

This study was aimed to investigate the combined effect of flushing and hormonal treatment on reproductive aspects of local goats, 60 adult does were divided equally into two groups, the first was fed concentrate plus grazing commencing 3 weeks prior to mating and continue for 4 weeks post mating (flushed) F, whereas the 2nd group was raised on pasture only (P). All does were synchronized using impregnated with 40 mg medroxy acetate for 14 days. Following sponges withdrawn, the flushed and non- flushed does were then sub-divided in to four equal groups, the 1st flushed does were injected with 250 i.u hCG (T1), the 2nd only flushed (T2), the 3rd was only injected with hCG (T3) and the 4th was the control (T4). Results revealed that estrus response was significantly higher in T1 (100%), followed by T3 and T4 (86.66%) and T2 (80%). Fertility rate was significantly (P<0.01) higher in T1 (80%) followed by T3 (73.33%), T4 (66.66%) and T2 (60.0%). Highest kidding rate (120.0%) and litter size (1.50) was noticed in T1, while the lowest kidding rate (86.66%) were found in T2 and T4. Insulin level was significantly higher in flushed does (6.04) compared to non-flushed does (2.81 uIU/ML).

Keywords: flushing; insulin; fertility; conception; prolificacy; goat.

التاثير المشترك للدفع الغذائي والمعاملة الهرمونية في الاداء التناسلي للماعز المحلي

اراز عمر بامرني جلال اليا القس موفق سليمان برواري
مدرس استاذ استاذ مساعد
قسم الثروة الحيوانية – كلية علوم الهندسة الزراعية – جامعة دهوك

المستخلص:

لدراسة التاثير المشترك للدفع الغذائي والمعاملة الهرمونية في الاداء التناسلي للماعز المحلي ,فلقد تم توزيع 60 معزة بالغة الى مجموعتين حيث غذيت المجموعة الاولى على عليقة مركزة ولمدة ثلاث اسابيع قبل التلقيح واربعة اسابيع بعد التلقيح اضافة الى الرعي , في حين تركت المجموعة الثانية على الرعي فقط. تم توحيد الشبق للمعزات باستخدام الاسفنجات المهبلية الحاوية على 40 ملغم ميدروكسي استيت لمدة 14 يوم. بعد سحب الاسفنجات تم توزيع الحيوانات الى اربعة مجاميع. تم حقن الاناث المدفوعة غذائيا (م 1) وغير المدفوعة غذائيا (م 3) ب 250 وحدة دولية من كونادوتروبين المشيمة البشري (hCG). في حين تم حقن المجموعة التي دفعت غذائيا (م 2) وغير المدفوعة غذائيا (م 4) (بمحلول الملح الفسيولوجي كسيطرة). تشير النتائج بان اعلى استجابة للشبق معنويا كانت لدى م 1 (100%) تبعها م 3 و م 4 (86.66%) و م 2 (80%). حققت م 1 معنويا اعلى نسبة خصوبة (80%) ومن ثم م 3 (73.33%) و م 4 (66.66%) ومن ثم م 2 (60.0%). بلغت اعلى نسبة ولادات (120%) وعدد المواليد من البطن الواحدة (1.50) لدى م 1 , بينما كان اوطأ نسبة ولادات (86.66%) لدى المجموعتين م 2 وم 4. وجد بان مستوى الانسولين كان اعلى معنويا (6.04) لدى المجموعة المدفوعة غذائيا مقارنتا بغير المدفوعة غذائيا (2.81).

الكلمات المفتاحية: الدفع الغذائي, الانسولين, خصوبة, اخصاب, الخصب, ماعز.

Received:14/9/2021, Accepted:13/1/2022

INTRODUCTION

Small ruminant is one of the most important grazing animals that have impacts on the economic and social status of the people inhabiting semi-arid and arid regions (20, 41, 47). Moreover, the goats population in Iraq are estimated at 1.5 million heads (19), and are considered an important livestock and has significant function for meat and milk production especially under the agriculture system prevailing in the country (28). The optimization of the reproductive management is necessary for improvement and development of animal production in small ruminant (14). Modern husbandry is improving the efficiency of extensive production and in controlling the reproductive process for intensive production (35,52). For this reason, exogenous hormones are administered in order to increase the reproductive performance of small ruminants. The efficacy of estrous synchronization in small ruminants depends on many factors, including estrous synchronization protocol, body condition, feed intake, blood metabolites, hormonal response, and follicular development (4, 31, 32, 49, 70). Flushing generally recognized as a significant regulator of reproduction and can be accomplished either by allowing small ruminant to graze lush nutritious pasture or by feeding energy-rich supplements (68). Moreover, flushing has been indicated to be positively affecting the body condition, fertility and ovulation rate of dams with poor nutritional status just before or during mating breading season. (13, 29). The physiological processes that mediate the effect of nutrition on ovulation rate most probably involve interactions between reproductive and metabolic hormones (10, 43, 44, 45, 56, 64). Acute nutritional treatments induce dynamic changes in the metabolic homeostatic systems – for example, over the first 3 days of supplementation, the concentrations of glucose, insulin and leptin rise to peak values and then decline (65, 67). If these responses allow more follicles to remain viable on reduced FSH concentrations, resulting in an increase in ovulation rate (66). Therefore, the aim of this study was to investigate the combined effect of hormonal administration together with the flushing upon reproduction aspects of local black goats.

MATERIALS AND METHODS

Location, animals and treatments

This experiment was conducted at commercial farm located in Jom Jehany village, Summel region, Duhok governorate on native black goats during breeding season, 1-7-2021 to 1-5-2022.

Animal management and experimental treatment: Sixty mature does (4-5 years old) and 40.23 ± 0.45 in weight from our previous experiment were used in the present investigation. At the start of the experiment, does were subdivided equally into two main groups (30 each), the first was flushed and the second was not flushed. The flushed does were offered a concentrate mixture in the form of pellet containing 15% crude protein and 12.69 MJ. Energy at a rate of 1Kg/day/head started for a period of 3 weeks prior to mating and continues for 4 weeks post-mating. Additionally, all does in both groups are allowed to graze natural pasture from 8-30 a.m to 5.00 p.m. All does were synchronized using sponges impregnated with 40 mg medroxy acetate (MAP)* for 14 days. Following sponges withdrawn, the flushed (T1) and non-flushed (T3) does were intramuscularly injected with 250 i.u hCG**. Whereas, the flushed does (T2) and non-flushed (T4) control were injected intramuscularly with normal saline. After 24 hrs from withdrawal of sponge (15-08-2021), two active bucks were introduced to each group separately for estrus detection and mating and the bucks were rotated among groups for a period of 5 days. After 21 days, non-mated goats were introduced again to the bucks for the 2nd time (5-09-2021) and 3rd time (26-10-2021). Estrus was checked continuously by observation using a recording camera.

Blood sampling and assay

To determine the levels of insulin and glucose, blood samples from all animals in the experiment were collected from the jugular vein at 9:00 a. m. in the morning at the end of flushing, with approximately 5 ml for each sample was emptied into glass sterile test tube without EDTA, and left for 2 hrs in the room

temperature and then centrifuged (3000 RPM) for 15 minutes and the serum was separated by micropipette and emptied into tubes and stored at -20C° until analysis for insulin and glucose.

Determination of blood hormonal and biochemical level: Insulin and glucose was determined using kits from Roche Diagnostics Company (Germany), analysis for (GLU: ACN717) by automated method using biochemical and hormonal auto analyzer Cobas C 501 in ammer lab in Duhok.
*(40 mg medroxyacetate (MAP) SPAIN).
** hCG (Weser-HCG5000 IU,Germany).

Statistical analysis

Chi-square test was conducted to analysis the reproductive parameters by using SAS (53). t-Test was performed to detect difference in insulin and glucose between flushed and non-flushed does.

RESULTS AND DISCUSSION

Overall estrus activity : The overall estrus response among treated groups are differ significantly ($P<0.01$) though it was found that the highest activity (100%) was recorded for hCG and flushed does, followed by hCG (86.66%), Control (86.66%) and the least (80%) was observed in flushed does. (Table 1), Such differences between does exhibiting or not exhibiting estrus after estrus synchronization could be partly explained by differences in feed intake, blood metabolites, hormonal response and follicular development. Moreover, increased estrus activity in does synchronized estrus may result from increased size of follicle, low P4 and sufficient production of glucose during the follicle development (42). The decreased estrus percentage particularly in the first cycle could be attributed to the delayed ovarian follicular maturation and impaired reproductive endocrinology in undernourished does (60, 57). Similar reduced estrus percentage has been reported in Malpura ewes kept only on grazing (58). However, it has been indicated that ovarian responses are affected by the availability of nutrients such as glucose and amino acids (16). Thus, it appears that flushed does and treated with hCG attained the highest response of estrus synchronization (100%) as compared to other treatments. Previously, it has noticed that the use of hCG in goat was successful in inducing estrus in cyclic goats or during anestrus season (9, 21, 36). Similarly, Gonzalez-Alvarez et al (23) found that estrus response was 100% in group of goats treated with hCG and they suggest that hCG could be considered a viable option to induce estrus during the out- off season in goats. The reason behind using hCG in synchronization estrus is due to the similarity between the hCG and LH molecules, both bind to the same receptor (34). Also, hCG has been used in hormonal protocols as an ovulation induction agent in different species (18, 22). In the present study, the proportion of goats that showed response to estrus (100%) was in flushed does treated with hCG, while the least response was attained by flushed does only (80%). Similarly, Naqvi (49) concluded that supplemented concentrate at a rate of 1.5 % of body weights, had a significant effect on estrus percentage, estrus duration and onset of estrus in Malpura ewes. Also, it was found that feeding balanced energy and protein diets improves synchronization almost up to 100% as shown in group high energy-high protein. Similarly, Farrag (20) indicated that estrus intensity was higher ($p<0.05$) in synchronized estrus and flushing group as compared to control and non-flushed

Table 1. Effect of hormonal treatments and flushing on overall reproductive performance of does.

Group/Treatment	hCG+ Flushing (T1)	Flushing (T2)	hCG (T3)	Control (T4)	Chi-Square (χ^2)
No. of Does	15	15	15	15	
No. of Does exhibited estrus	15	12	13	13	--
Estrus Response (%)	100	80	86.66	86.66	6.07 **
No. of does Kidded	12	9	11	10	--
Fertility rate (%)	80	60	73.33	66.66	6.22 **
Barrenness (%)	20	40	26.67	33.34	6.22 **
No. of does aborted	3	3	2	3	--
Conception rate (%)	100	80	86.66	86.66	6.07 **
No. of kids at birth	18	13	16	13	--
Litter size	1.50	1.44	1.45	1.30	9.027 **
No. does with twin kids or triplet	6	4	5	3	--
Twinning rate %	50	44.44	45.45	30	6.21 **
Kidding rate (%)	120	86.66	106.66	86.66	11.63 **

*** (P≤0.05), ** (P≤0.01)**

group. However, the response to flushing are often variable and inconsistent depending on factors such as genotypes (12), condition of animals (50), timing and duration of flushing (54 , 29), the amount and quality of dietary supplements (2).

Fertility and Conception rate

In the current work, fertility rate of flushed does and treated with hCG had significantly (P<0.01) higher rate (80%) than flushed does (60%), treated with hCG (73.33%) and control (66.66%) (Table 1).Also, a similar trend was noticed in conception rate being 100, 80, 86.66 and 86.66% for T1, T2, T3 and T4, respectively (Table 1). The fertility and conception rates of does in flushed and treated with hCG as well as treated with hCG only was significantly higher than untreated groups, which is comparable to the results obtained in the first experiment in that treated does with hCG had the higher fertility (86.7%) and conception rates (100%) as compared with other treated groups eCG, GnRH and control (10). It was agreed that hCG have been successfully used to induce estrus in cyclic does in combination with progesterone administration (36, 21). The highest fertility and conception rates were attained by flushed and treated does with hCG demonstrate that a single injection of hCG is necessary for triggering the ovarian activity of does mediated through LH receptors that promote follicular growth and advanced follicular growth to ovulation (25). Such result is in accordance with other workers (53, 9). Similarly, a single injection of hCG given at the onset of a synchronized estrus increased ovulation rate, improved conceptus growth, implantation, conception rate and litter size, and suggesting that this treatment has a potential to improve fertility in ewe lambs (30). In contrast to the above results, it was found that hCG treatment reduced pregnancy rates of ewes (17), and this finding corroborates with that observed in ewes (72) and in cows (37). Such result may be attributed to the differences in breeds and hormonal protocol used. With regard to the effect of flushing, studies in small ruminants have shown that with flushing ovulation and fetal implantation in the uterus are improved (3, 32, 38). Similarly, Landau and molle (33) and Meza-Herrera et al. (40) concluded that flushing especially coupled with eCG treatment can improve reproductive performance in Nadooshan goat Also, Shahneh et al (62) and Abdulkareem et al (1) showed that the flushed group had significantly higher conception rate than control. An increase was

noticed in conception rate due to flushing in Abou-Delik sheep (20) and in does (11, 46). It was worth to note that a high rate of abortion for unknown reasons (18.3%) was responsible for reducing the fertility rate.

Kidding rate and Prolificacy

In the current investigation, kidding rate of flushed does and treated with hCG resulted in a significantly (P<0.01) higher (120.0%) kidding rate than those flushed (86.66%), treated with hCG (106.66%) and control (86.66%). (Table1). Such higher kidding rate in flushed and treated does with hCG is resulted from higher conception rate (100%) and twinning rate in this group (50%). However, kidding rate obtained in this study (86.66-120.0%) was higher than the value 84.94% recorded previously by Alkass et al (6) on native goat, but it is lower than those reported earlier (91-23-95%) by Alkass et al (7); Alkass et al (8) and Alkass and May(5), as well as with our previous paper (100.0 - 146.7%) (10). Similarly, Daghigh et al (15) and Shahneh et al (61) and Farrag, (20) concluded that flushing especially coupled with hormonal treatment can improve reproductive performance in terms of fertility, kidding rate, pregnancy rate and twinning rate in Markhos and Nadooshan goats and in Abou-Drlik sheep. Also, flushing was found to increase ovulation rate in Rasa Aragonesa ewes (33, 40). On the same line, it was noticed that enhancing ration during breeding period is enough to improve reproductive performance of ewes (39) and does (29). In the current work, A significant (P<0.01) difference was noted in the litter size at birth among groups being 1.50, 1.44, 1.45 and 1.30 for does flushed and treated with hCG, flushed, hCG and control groups, respectively. (Table 1). Such values recorded herein is higher than the values (1.15-1.19) found by Alkass et al (8) and Alkass and May (5) on does maintained on commercial herds and the value 0.133 noticed by Juma et al (27) raised in station farm. Also, Marzouk et al (39) demonstrated that flushed Ossimi ewes had significantly higher litter size at birth as compared to other treatments. Similarly, Karikari and Blasu (29) found that supplemented does had a higher litter (1.81) than the unsupplemented does. In contrast to the above results, De Santiago-Miramontes et al. (16) demonstrated that flushing did not improve prolificacy and reduced significantly (P<0.05) kidding rates (40%) and 35% for the flushed and stimulated- flushed groups compared to 67% and 55% for the control and stimulated groups, respectively due to high fetal losses in the flushed goats. Responses to flushing, however, are often variable and inconsistent depending on factors such as genotypes (12), body conditions of the animals (50), timing and duration of flushing (54, 29), the amount and quality of dietary supplements (2).

Level of insulin and glucose

In the present work, blood samples were collected once from flushed and non-flushed does at the end of the period of flushing for determination the levels of insulin and glucose. Result revealed that insulin was significantly (P<0.01) increased (6.04 uIU/ML) in flushed does compared to non-flushed does (2.81 uIU/ML); whereas, a reverse result has been detected in the level of glucose being 30.50 mg/dl and 36.67 mg/dl for flushed and non-flushed, respectively (Table 2).

Table 2. Effect of flushed and non-flushed does on the levels of insulin and glucose.

	Treatment	N	Mean	±Std. Error	Sig.
Glucose mg/dl	Flushed	30	30.50 b	1.032	0.01
	Not Flushed	30	36.67 a	0.998	
Insulin uIU/ML	Flushed	30	6.04 a	0.577	0.01
	Not Flushed	30	2.81 b	0.176	

a,b with each characters are different significantly (p<0.01)

It is known that glucose is one of the most important metabolic substance required for proper function of the reproductive processes in the livestock (48) and inadequate availability of utilizable glucose reduces hypothalamic release of GnRH (26, 69, 51). It has been indicated that significantly (P<0.01) changes in the concentration of glucose was noticed between ewes maintained only on grazing (46.18 mg/dl) as compared to ewes raised on grazing and supplemented with concentrate (53.29 mg/dl), and supplement resulted in an increase of ovulation rate by 71.4% (47).Also, it was known there is ample

evidence to indicate beneficial effect of insulin on follicilogensis and steriodogenesis (42), and application of insulin to modulate reproductive function in livestock is a fairly recent development (59). It has been found that metabolic responses to short-term high levels of feeding resulted in an increase in the concentrations of glucose and insulin in goats (24, 65, 67, 71). However, Karikari and Blasu, (29) reported that treatment (pasture alone vs. pasture plus concentrate) in West African dwarf goats has no effect on serum glucose which confirm the observation by Tanaka et al (63) that dietary restriction caused no variation in plasma glucose between pasture grazing and pasture plus concentrate. However, supplemented does had a higher ($P<0.05$) serum concentration of insulin (19.1 vs. 15.1 FIU/ml). In the ovary, the effect of nutrition is to stimulate folliculogenesis. These changes are associated with intra-follicular alterations in the insulin-glucose, IGF and leptin metabolic systems. The stimulation of these intra-follicular systems leads to a suppression in follicular oestradiol production. The consequence of these direct actions on the follicle is a reduced negative feedback to the hypothalamic-pituitary system and increased FSH secretion that leads to a stimulation of folliculogenesis (56).

Conclusion

From the result obtained in the current investigation, it can be concluded that an improvement in reproductive aspects of local goats can be attained by flushing does and hormonal treatment with hCG.

Acknowledgment

The author wishes to express their thanks to Prof. Dr. Nasr Al-Anbari for his valuable help in statistical analysis of the data.

REFERENCES

1. Abdulkareem, T.A., S.M. Eidan, L.A.M.F. Al-Saidy, and M.R. Mahdi. 2014. Reproductive performance of Iraqi Awassi ewes owned by sheep owners and extension farms in response to flushing and estrus synchronization regimes. The Iraqi Journal of Agricultural Sciences, 45(3): 328-334

2. Acero-Camelo, A., E. Valencia, A. Rodríguez, and P.F. Randel. 2008. Effects of flushing with two energy levels on goat reproductive performance. Livestock Research for Rural Development, 20(9): 10-16

3. Acurero, M. D. 2000. Estrategias de suplementación en ovejas. Fonaiap Divulga (Venezuela).(Abr-Jun 2000),(66), 13-15

4. Ali, A. 2007. Effect of time of eCG administration on follicular response and reproductive performance of FGA-treated Ossimi ewes. Small Ruminant Research, 72(1): 33-37

5. Alkass, J. E., and V.J. Mayi. 2011. A survey study of sheep and goats raised under farm conditions. J. Duhok Univ, 14(1): 120-125

6. Alkass, J. E., H.N. Hermiz, and M. I Baper. 2021. Some aspects of reproductive efficiency in awassi ewes: A review. Iraqi Journal of Agricultural sciences, 52(1): 20-27. https://doi.org/10.36103/ijas.v52i1.1232

7. Alkass, J. E., M.K. Asofi, and H.I. Ammar. 2003. Effect of time of insemination on some reproductive performances in Iraqi local goats. Dirasat, 30, 79-83

8. Alkass, J.E., M.S. Barwary, and K.H. Derwesh. 2009. Observation on reproductive traits of goats maintained under farm condition. J.Duhok University. 12 (2): P 87-89

9. Alvarado-Espino, A. S., C.A. Meza-Herrera, E. Carrillo, V.H. González-Álvarez, J.M. Guillen-Muñoz, O. Ángel-García, M. Mellado, and F. G. Véliz-Deras. 2016. Reproductive outcomes of Alpine goats primed with progesterone and treated with human chorionic gonadotropin during the anestrus-to-estrus transition season. Animal reproduction science, 167, 133-138

10. Araz, O. B., J.E. Alkass, and M.S. Barwary. 2022. Reproductive performance in response to different hormonal treatments in local goats. Iraqi Journal of Agricultural Sciences. 53(3):604-610. . https://doi.org/10.36103/ijas.v53i3.1570

11. Birhanie, M., M. Zenebe, and H. Hagos. 2020. Effect of nutritional flushing on reproductive and body weight performance of Abergelle goat does. International Journal of Livestock Production, 11(2): 68-71

12. Chemineau, P., A. Daveau, Y. Cognié, G. Aumont, and D.Chesneau. 2004. Seasonal ovulatory activity exists in tropical Creole female goats and Black Belly ewes subjected to a temperate photoperiod. BMC

Physiology, 4(1): 1-11
13. Chowdhury, S. A., M. S. A. Bhuiyan, and S. Faruk. 2002. Rearing Black Bengal goat under semi-intensive management 1. Physiological and reproductive performances. Asian-Australasian Journal of Animal Sciences, 15(4): 477-484
14. Contreras-Solis, I., B. Vasquez, T. Diaz, C. Letelier, A. Lopez-Sebastian, and A. Gonzalez-Bulnes. 2009. Ovarian and endocrine responses in tropical sheep treated with reduced doses of cloprostenol. Animal reproduction science, 114(4), 384-392
15. Daghigh. H. K.. W.C. Mohamadi, A.K. Hossein, G. Moghaddam, A. Rashidi, H. Sadri, and S. Alijani. 2011. Effects of flushing and hormonal treatment on reproductive performance of Iranian Markhoz goats. Journal of Animal Physiology and Animal Nutrition. 96(6): 1157-1164.DOI:10.1111/j.1439-0396.2011.01234.x
16. De Santiago-Miramontes., M. Angeles, J. R. Luna-Orozco, C. A. Meza-Herrera, R. Rivas-Muñoz, E. Carrillo, and M. Mellado. 2011. The effect of flushing and stimulus of estrogenized does on reproductive performance of anovulatory-range goats. Tropical Animal Health and Production, 43(8): 1595-1600
17. Dias, L. M. K., J.N.S. Sales, P. Viau, M.B.P. Barros, S.S. Nicolau, L.M.S. Simões, N.G. Alves, M.A. Alonso, R. Valentim, and C.A.D. Oliveira. 2018. Although it induces synchronized ovulation, hCG reduces the fertility of Santa Ines ewes submitted to TAI. Arquivo Brasileiro de Medicina Veterinária e Zootecnia, 70(1):122-130
18. Diaz, T., E.P. Schmitt, R.L. De La Sota, M.J. Thatcher, and W.W. Thatcher, 1998. Human chorionic gonadotropin-induced alterations in ovarian follicular dynamics during the estrous cycle of heifers. Journal of Animal Science, 76(7), 1929-1936
19. FAO (Food and Agriculture Organization).2014. Global information and early warning system on food and agriculture (GIEWS) Special Alert. Available at http://www.fao.org. No. 332(3):1-45
20. Farrag, B. 2019. Productive characteristics and reproductive responses to estrus synchronization and flushing in abou-delik ewes grazing in arid rangelands in halaieb-shalateen-Abouramad Triangle of Egypt. World's Veterinary Journal, 9(3): 201-210
21. Fonseca, J. F., J.H. Bruschi, F.N. Zambrini, E. Demczuk, J.H.M. Viana, and M. P. Palhão, 2005. Induction of synchronized estrus in dairy goats with different gonadotrophins. Animal Reproduction.2(1): 50– 53
22. Ginther, O.J., M.A. Beg, E.L. Gastal, M.O. Gastal, and D.A. Cooper. 2009. Treatment with human chorionic gonadotropin (hCG) for ovulation induction is associated with an immediate 17β-estradiol decrease and a more rapid LH increase in mares. Animal reproduction science, 114(1-3): 311-317
23. Gonzalez-Alvarez, V. H., C.A. Meza-Herrera, C. Leyva, A.S. Alvarado-Espino, J.M. Guillén-Muñoz, R. Rodríguez-Martínez, and F.G. Véliz-Deras. 2016. Effectiveness of different hCG and GnRH based protocols in progesterone primed goats on estrus induction and reproductive outcomes in out-off-season goats. Journal of Animal Research, 6(2): 177-182
24. Haruna, S., T. Kuroiwa, W. Lu, J. Zabuli, T. Tanaka, and H. Kamomae. 2009. The effects of short-term nutritional stimulus before and after the luteolysis on metabolic status, reproductive hormones and ovarian activity in goats. Journal of Reproduction and Development, 55(1): 39–44.
25. Henderson, K.M., L.E. Kieboom, K.P. McNatty, S. Lun, and D.A. Heath. 1984. [125I] hCG binding to bovine thecal tissue from healthy and atretic antral follicles. Molecular and cellular endocrinology, 34(2): 91-98
26. Hess, B.W., S.L. Lake, E.J. Scholljegerdes, T.R. Weston, V. Nayigihugu, J.D.C. Molle, and G. E. Moss. 2005. Nutritional controls of beef cow reproduction. Journal of Animal Science, 83(suppl_13), E90-E106
27. Juma, K. H., K.M. Asofi, and M.A.G. Alkirma. 2001. Study of fertility and prolificacy in goats and some factors affecting them. Dirasat, 28:40-46
28. Juma, k.H. and J.E.Alkass. 2005. Native goats of Iraq :A reviews Dirasat: 32(2):180-188
29. Karikari, P. K., and E. Y. Blasu. 2009. Influence of nutritional flushing prior to

mating on the performance of West African Dwarf goats mated in the rainy season. Pakistan Journal of Nutrition, 8(7): 1068-1073
30. Khan, T. H., P. M. Hastie. N. F. G. Beck, and M. Khalid. 2003. hCG treatment on day of mating improves embryo viability and fertility in ewe lambs. Animal reproduction science, 76(1-2): 81-89
31. Khanthusaeng, V., C. Navanukraw, T. Moonmanee, J. Thammasiri, and S.Boonkong .2012. Effect of short-term and long-term synthetic progesterone on estrous synchronization and conception rate in Thai-native goat. Chiang Mai University Journal of Natural Sciences, 11, 449-454
32. Kusina, N.T., T. Chinuwo, H. Hamudikuwanda, L.R. Ndlovu, and S. Muzanenhamo. 2001. Effect of different dietary energy level intakes on efficiency of estrus synchronization and fertility in Mashona goat does. Small Ruminant Research, 39(3): 283-288
33. Landau, S., and G.Molle. 1997. Nutrition effects on fertility in small ruminants with an emphasis on Mediterranean sheep breeding systems. Options Mediterraneennes. Serie A: Seminaires Mediterraneens (CIHEAM). pp: 203-216
34. Lapthorn, A., D.C. Harris, A. Littlejohn, J.W. Lustbader, R.E. Canfield, K.J. Machin, F.J. Morgan, and N.W. Isaacs. 1994. Crystal structure of human chorionic gonadotropin. Nature, 369(6480), 455-461
35. Lindsay, D. R. 1991. Reproduction in the Sheep And Goat. In Reproduction In Domestic Animals (pp. 491-515). Academic Press
36. Machado, R, and A. A. Simplício. 2001. Evaluation of hormonal programs to induce and synchronize estrus in goats. Pesquisa Agropecuária Brasileira, 36, 171-178
37. Marquezini, G. H. L., C.R. Dahlen, S.L. Bird, and G.C. Lamb. 2011. Administration of human chorionic gonadotropin to suckled beef cows before ovulation synchronization and fixed-time insemination: replacement of gonadotropin-releasing hormone with human chorionic gonadotropin. Journal of animal science, 89(10): 3030-3039
38. Martínez de Acuero, M., G. Mazzarri, J. Rodríguez, H. Quintana, and C. Chicco. 1986. Suplementación energética y proteica pre-servicio en ovejas West African. Zootecnia Trop, 4(1-2): 19-28
39. Marzouk, K.M., A.I. El Zanouny, and M.A. Kaoud, 2018. Flushing vs. Hormonal treatment, which better improve the reproductive performance of Ossimi ewes. Egyptian Journal of Sheep and Goats Sciences, 13(2): 18-25
40. Meza-Herrera, C. A., T. Ross, D. Hallford, D. Hawkins, and A. Gonzalez-Bulnes. 2007. Effects of body condition and protein supplementation on LH secretion and luteal function in sheep. Reproduction in Domestic Animals, 42(5): 461-465
41. Mohammed, N. J., and J. E. Alkass. 2021. The combined effect of suckling system and weaning weight on milk traits of native sheep. Iraqi Journal of Agricultural Sciences, 52(3):691-696.
https://doi.org/10.36103/ijas.v52i3.1360
42. Moonmanee, T., and S.Yammuen-art. 2015. Relationships among feed intake, blood metabolites, follicle size and progesterone concentration in ewes exhibiting or not exhibiting estrus after estrous synchronization in the tropics. Agriculture and Agricultural Science Procedia, 5, 151-158
43. Munoz-Gutierrez, M., D. Blache, G. B. Martin, and R.J. Scaramuzzi. 2004. Ovarian follicular expression of mRNA encoding the type I IGF receptor and IGF-binding protein-2 in sheep following five days of nutritional supplementation with glucose, glucosamine or lupins. Reproduction, 128(6): 747-756
44. Munoz-Gutierrez, M., D. Blache, G.B. Martin, and R.J. Scaramuzzi. 2002. Folliculogenesis and ovarian expression of mRNA encoding aromatase in anoestrous sheep after 5 days of glucose or glucosamine infusion or supplementary lupin feeding. Reproduction-Cambridge-, 124(5): 721-731
45. Munoz-Gutierrez, M., P.A. Findlay, C.L. Adam, G. Wax, B.K. Campbell, N.R. Kendall, M. Khalid, M. Forsberg, and R.J. Scaramuzzi. 2005. The ovarian expression of mRNAs for aromatase, IGF-I receptor, IGF-binding protein-2,-4 and-5, leptin and leptin receptor in cycling ewes after three days of leptin infusion. Reproduction, 130(6): 869-881
46. Muthuramalingam, T., P. Pothiappan, P.T. Gnanaraj, T. Devi, and S.Rangasamy. 2014.

Effect of flushing on reproductive performance and synchronization of estrus in tellicherry does. Indian J. Anim. Reprod, 35, 34-35

47. Mustafa, K. N. S. 2021. Effect of formaldehyde-protected diets on milk yield, composition and some blood biochemical parameters in karadi ewes. Iraqi Journal of Agricultural Sciences, 52(5):1094-1100. https://doi.org/10.36103/ijas.v52i5.1447

48. Naqvi, S. M. K., N.M. Soren, and S.A. Karim. 2011. Effect of concentrate supplementation on performance, ovarian response, and some biochemical profile of Malpura ewes. Tropical Animal Health and Production, 43(5): 905-913

49. Naqvi, S. M. K., V. Sejian, and S.A. Karim. 2012. Effect of feed flushing during summer season on growth, reproductive performance and blood metabolites in Malpura ewes under semiarid tropical environment. Tropical Animal Health And Production, 45(1): 143-148

50. O'Callaghan, D., H. Yaakub, P. Hyttel, L.J. Spicer, and M.P. Boland. 2000. Effect of nutrition and superovulation on oocyte morphology, follicular fluid composition and systemic hormone concentrations in ewes. Journal of reproduction and fertility, 118(2): 303-314

51. Ohkura, S., T. Ichimaru, F. Itoh, S. Matsuyama, and H.Okamura. 2004. Further evidence for the role of glucose as a metabolic regulator of hypothalamic gonadotropin-releasing hormone pulse generator activity in goats. Endocrinology, 145(7): 3239-3246

52. Ozyurtlu, N., I. Kucukaslan, and Y.Cetin. 2010. Characterization of oestrous induction response, oestrous duration, fecundity and fertility in Awassi ewes during the non-breeding season utilizing both CIDR and intravaginal sponge treatments. Reproduction in Domestic Animals, 45(3): 464-467

53. Rowe, J. D., and N.B. East. 1996. Comparison of two sources of gonadotropin for estrus synchronization in does. Theriogenology, 45(8): 1569-1575

54. Sabra, H. A., and S.G. Hassan. 2008. Effect of new regime of nutritional flushing on reproductive performances of Egyptian Barki ewes. Global Veterinaria, 2(1): 28-31

55. SAS. 2012. Statistical Analysis System, User's Guide. Statistical. Version 9.1th ed. SAS. Inst. Inc. Cary. N.C. USA

56. Scaramuzzi, R.J., B.K. Campbell, J.A. Downing, N.R. Kendall, M. Khalid, M. Muñoz-Gutiérrez, and A. Somchit. 2006. A review of the effects of supplementary nutrition in the ewe on the concentrations of reproductive and metabolic hormones and the mechanisms that regulate folliculogenesis and ovulation rate. Reproduction Nutrition Development, 46(4): 339-354

57. Sejian, V., V.P. Maurya, and S. M. K. Naqvi. 2011. Effect of thermal, nutritional and combined (thermal and nutritional) stresses on growth and reproductive performance of Malpura ewes under semi-arid tropical environment. Journal of animal physiology and animal nutrition, 95, 252-258

58. Sejian, V., V.P. Maurya, S. M. K. Naqvi, D. Kumar, and A.Joshi. 2010. Effect of induced body condition score differences on physiological response, productive and reproductive performance of Malpura ewes kept in a hot, semi-arid environment. Journal of Animal Physiology and Animal Nutrition, 94(2): 154-161

59. Selvaraju, S., S.K. Agarwal, S.D. Karche, and A.C. Majumdar. 2003. Ovarian response, embryo production and hormonal profile in superovulated goats treated with insulin. Theriogenology, 59(5-6): 1459-1468

60. Serin, I., G. Serin, M. Yilmaz, F. Kiral, and A.Ceylan. 2010. The effects of body weight, Body Condition Score, age, lactation, serum trygliceride, cholesterol and paraoxanase levels on pregnancy rate of Saanen goats in breeding season. Journal of Animal and Veterinary Advances, 9(13): 1848-1851

61. Shahneh, Z., A. Sadeghipanah, H.J. Barfourooshi, and M.A. Emami-Mibody. 2008. Effects of equine chorionic gonadotropin (eCG) administration and flushing on reproductive performance in Nadooshan goats of Iran. African Journal of Biotechnology, 7(18): 3373–3379

62. Shahneh, Z., A., H. Deldar Tajangookeh, H. Sadeghipanah, and A.A. Saki, 2006. Effect of controlled internal drug release device treatment duration and eCG dose on reproductive performance of seasonally

anestrous fat-tailed Iranian ewes. Pak. J. Biol. Sci, 9, 1552-1555

63. Tanaka, T., K.I. Fujiwara, S. Kim, H. Kamomae, and Y.Kaneda. 2004. Ovarian and hormonal responses to a progesterone-releasing controlled internal drug releasing treatment in dietary-restricted goats. *Animal reproduction science*, *84*(1-2): 135-146

64. Tayeb, M. A. M. O. A. G. Al-Zeadan, and N. M. Basher. 2020. Effect of using sodium bicarbonate and mixture of vitamin e and selenium in production performance of awassi ewes. Iraqi Journal of Agricultural Sciencesm 51(1):311-316. https://doi.org/10.36103/ijas.v51i1.929

65. Teleni, E., J.B. Rowe, K.P. Croker, P.J. Murray, and W.R. King. 1989. Lupins and energy-yielding nutrients in ewes. II. Responses in ovulation rate in ewes to increased availability of glucose, acetate and amino acids. Reproduction, Fertility and Development, 1(2): 117-125

66. Viñoles, C., A. Gonzalez de Bulnes, G.B. Martin, F. Sales, and S.Sale. 2010. Chapter 11: Sheep and goats. In 'Atlas of Ruminant and Camelid Reproductive Ultrasonography'.(Eds L. DesCôteaux, J. Colloton and G. Gnemi.) pp. 181–210

67. Viñoles, C., M. Forsberg, G.B. Martin, C. Cajarville, J. Repetto, and A.Meikle. 2005. Short-term nutritional supplementation of ewes in low body condition affects follicle development due to an increase in glucose and metabolic hormones. Reproduction,129 (3): 299-309

68. Webb, E.C., and M.J. Mamabolo. 2004. Production and reproduction characteristics of South African indigenous goats in communal farming systems. South African Journal of Animal Science, 34(5):236-239

69. Wettemann, R.P., C.A. Lents, N.H. Ciccioli, F.J. White, and I. Rubio. 2003. Nutritional-and suckling-mediated anovulation in beef cows. Journal of Animal science, 81(14-suppl2) ,E48-E59

70. Ying, S., Z. Wang, C. Wang, H. Nie, D. He, R. Jia, and F.Wang. 2011. Effect of different levels of short-term feed intake on folliculogenesis and follicular fluid and plasma concentrations of lactate dehydrogenase, glucose, and hormones in Hu sheep during the luteal phase. Reproduction, 142(5): 699-710

71. Zabuli, J., T. Tanaka, W. Lu, and H.Kamomae. 2010. Intermittent nutritional stimulus by short-term treatment of high-energy diet promotes ovarian performance together with increases in blood levels of glucose and insulin in cycling goats. Animal Reproduction Science, 122(3-4): 288-293

72. Zamiri, M. J., and M. Hosseini. 1998. Effects of human chorionic gonadotropin (hCG) and phenobarbital on the reproductive performance of fat-tailed Ghezel ewes. Small Ruminant Research, 30(3): 157-161.