INTRODUCTION

Lipids play major role in the animal body by providing energy, making several essential reproductive hormones, participating in cellular membrane component and reproductive performance (Guzel and Tanriverdi, 2014; Nemeth et al., 2017). Reproductive performance in livestock is strongly associated with litter size (Nowak et al., 2020). Increased reproductive performance can be obtained from ewes with the potential for increased litter size (Atoui et al., 2018). Litter size (birth type) is one of the most important economic traits because it has a noticeable impact on profitability in the sheep industry, which is influenced by reproductive hormones and ovulation rate (Ekiz et al., 2005; Tesema et al., 2020, Al-Thuwaini, 2021). Besides, reproductive performance could be assessed from the levels of reproductive hormones in livestock (El Tahawy and Sharkawy, 2014). High levels of reproductive hormones exert marked effects on the development and maturation of ovarian follicles that result in increasing litter size (Luo et al., 2018). The ovaries and placenta are used cholesterol for reproductive hormone synthesis (Arfuso et al., 2016). Moreover, the higher concentration of serum lipids especially cholesterol, triglyceride and high-density lipoprotein (HDL) are considered as good indicators of the physiological state and reproductive performance of livestock. Therefore, this study aimed to evaluate the association of progeny type with the lipid profile on the status of the reproductive hormones in Iraqi Awassi ewes. A total of 200 sexually mature ewes (114 ewes with single progeny and 86 ewes with twin progeny), non-pregnant and non-lactation, aged between 2.5 to 5 years were included in this study. The blood samples were collected and the sera were separated from blood to determine lipid profile assay and reproductive hormones. The result referred to the significant differences (P < 0.05) in cholesterol and sex hormones levels between ewes with single compared to the twin progenies. The strongly positive correlation (P < 0.01) was recorded between ewes with twin progeny with cholesterol (r=0.52, P=0.01), high-density lipoprotein (HDL) (r=0.31, P=0.04), estradiol (r=0.46, P=0.02), and progesterone (r=0.50, P=0.03) respectively. In conclusion, birth progeny type is associated with lipid profile and sex hormones levels in Awassi ewes. The ewes with twin lambs are associated with the highest cholesterol and sex hormones levels than ewes with a single lamb.

Keywords | Awassi sheep, Estradiol, Litter size, Lipid profile, Progesterone

Received | April 14, 2021; Accepted | May 12, 2023; Published | July 28, 2021
*Correspondence | Tahreer Mohammed Al-Thuwaini, Department of Animal Production, College of Agriculture, Al-Qasim Green University, Al-Qasim, Babil 51001, Iraq; Email: tahrearmohammed@agre.uoqasim.edu.iq
Citation | Mohammed MH, Al-Thuwaini TM, Al-Shuhaib MBS (2021). The association of the single-and twin-bearing with the lipid profile on the status of the reproductive hormones in iraqi awassi ewes. Adv. Anim. Vet. Sci. 9(9): 1456-1459.
DOI | http://dx.doi.org/10.17582/journal.aavs/2021/9.9.1456.1459
ISSN (Online) | 2307-8316; ISSN (Print) | 2309-3331
Copyright © 2021 Al-Thuwaini et al. This is an open access article distributed under the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.
ty lipoprotein cholesterol (HDL-c) in livestock could play a vital role in fetal number and growth (Geraghty et al., 2016). Few reports evaluate the changes in serum lipid levels concerning physiological status in livestock. Petkova et al. (2008) and Arfuso et al. (2016) revealed a significant difference \( (P<0.05) \) in blood lipid profile in lactating cows and late pregnancy and the early postpartum in dairy cows. Based on the above aforementioned, no research yet on the association of progeny type with lipid profile levels and reproductive hormones have been reported in Awassi ewes. Therefore, the objectives of this study were to evaluate the association of progeny type with lipid profile levels and reproductive hormones in Awassi ewes.

**MATERIALS AND METHODS**

**Animals and lipid profile analysis**

This study was approved and conducted at the Al-Qasim Green University’s and followed the international recommendations for the care and use of animals with approval number Agri, No. 020,7,18, during the period from July 2020 to March 2021 on Awassi ewes. A total of 200 sexually mature ewes (114 ewes with single progeny and 86 ewes with twin progeny), non-pregnant and non-lactation ewes aged between 2.5 to 5 years were included in this study. Animals were collected randomly from two stations for raising sheep (Babylon and Karbala, Iraq). They were fed ad libitum on seasonal grass, concentrate food (2.5% of their live body weight daily, comprising a mixture of barely (59%), bran (40%), salt (1%) concentrates), and fresh water. Blood samples were collected in the morning before feeding from the jugular vein of the sheep using vacutainer tubes with EDTA. Serum was separated from blood by centrifugation at 3,000 rpm at room temperature for 15 min where it was kept frozen at \(-20^\circ\text{C}\) to determine lipid profile and hormonal assays. Serum concentrations of total cholesterol, high density lipoprotein cholesterol (HDL-c), and triglycerides were analyzed according to the manufacturer’s instructions of Randox Laboratories kits. Low-density lipoprotein cholesterol (LDL-c) was calculated using the equation of Friedewald et al. (1972): 

$$ \text{LDL-c} = \frac{(\text{Total Chol} - \text{TRIGS})}{2.2 - \text{HDL-Chol}} $$

Biochemical parameters including lipid profile are good indicators of the physiological state and reproductive performance of animal (Piccione et al., 2009; Nemeth et al., 2017). Cholesterol levels increased in ewes with multiple lambs compared to the ewes with single lambs (Pesantez-Pacheco et al., 2019), this may be due to diminished target tissue response to insulin, which combined with increased fatty acid mobilization from adipose tissue provides new sources for fetal growth and the synthesis of the steroid hormones (Piccione et al., 2009). Steroid hormones directly influence reproductive performance and the prolificacy in animals that had significant correlations with increased litter size (Luo et al., 2018).

**Statistical analyses**

The association of progeny type with traits of interest was analyzed through the general linear model (GLM) procedure by SPSS (version 23.0) with the following model and compared by Tukey-Kramer test:

$$ Y_{ijk} = \mu + B_i + P_j + A_k + e_{ijk} $$

where \( Y_{ijk} \) = value for studied traits, \( \mu \) = overall mean, \( B_i \) = fixed effect of \( i \)th progeny type \( (i = \text{singleton, twin}) \), \( P_j \) = fixed effect of \( j \)th parity \( (j = 1, 2, 3, 4) \), \( A_k \) = fixed effect of \( k \)th age group \( (2.5-3.5,>3.5-5) \), and \( e_{ijk} \) = random error associated with \( Y_{ijk} \) observation and assumed to be NID \((0, \sigma^2e)\). Preliminary statistical analysis indicated the effect of factor interaction, season and nutrition did not have a significant effect on studied traits, so they were excluded from the model. The correlation was analyzed using the Pearson correlation coefficient, and significance was set at \( P \leq 0.05 \).

**RESULTS AND DISCUSSION**

**Association analysis of progeny type with lipid profile levels of Awassi ewes**

The ewes with twin lambs have higher cholesterol levels, estradiol and progesterone concentrations \((97.63\pm1.54), \ (49.44\pm0.53) \) and \((6.51\pm0.02)\) respectively compared to the ewes with single lambs. While no statistically significant differences were observed for the FSH and LH hormones \((P>0.05)\) as shown in (Table 1).

The result refers that the ewes with twin lambs were associated with the highest cholesterol level and sex hormones compared to the ewes with single lambs (Table 1). Blood biochemical parameters including lipid profile are good indicators of the physiological state and reproductive performance of animal (Piccione et al., 2009; Nemeth et al., 2017). Cholesterol levels increased in ewe with multiple lambs compared to the ewes with single lambs (Pesantez-Pacheco et al., 2019), this may be due to diminished target tissue response to insulin, which combined with increased fatty acid mobilization from adipose tissue provides new sources for fetal growth and the synthesis of the steroid hormones (Piccione et al., 2009). Steroid hormones directly influence reproductive performance and the prolificacy in animals that had significant correlations with increased litter size (Luo et al., 2018).

**Correlation analysis of progeny type with lipid profile of Awassi ewes**

The strongly positive correlation \((P \leq 0.01)\) was recorded between ewe with twin lambs with cholesterol \((r=0.52, P=0.01)\), HDL \((r=0.31, P=0.04)\), estradiol \((r=0.46, P=0.02)\), and progesterone \((r=0.50, P=0.03)\) respectively, whereas it was non-significant \((P \geq 0.05)\) for the other variables as shown in Table 2.

The result refers to the presence of a positive and significant correlation \((P \leq 0.05)\) between ewes with twin lambs with sex hormones and lipid profile levels. This result consistent with the study of Kakous et al. (2003) and Petkova et al. (2008) that reported a positive correlation between sex hormones and total cholesterol concentration with better reproductive performance. Estradiol and progesterone...
Table 1: Relationship of progeny type with lipid profile levels of Awassi ewes.

| Indices                  | Birth type (LSM ± SE) | P-value |
|--------------------------|-----------------------|---------|
|                          | Single (114)          | Twin (86) |
| Cholesterol (mg/dl)      | 85.32 ± 1.42b         | 97.63 ± 1.54a | 0.04 |
| Triglyceride (mg/dl)     | 33.82 ± 0.89b         | 35.21 ± 0.74a | 0.34 |
| HDL (mg/dl)              | 42.52 ± 0.11b         | 44.63 ± 0.93a | 0.52 |
| LDL (mg/dl)              | 40.67 ± 0.21b         | 42.31 ± 0.50a | 0.81 |
| Estradiol (pg/ml)        | 35.62 ± 0.74b         | 49.44 ± 0.53b | 0.02 |
| Progesterone (ng/ml)     | 3.21 ± 0.06b          | 6.51 ± 0.02a  | 0.01 |
| FSH (ng/ml)              | 10.94 ± 1.24a         | 11.62 ± 1.03a | 0.42 |
| LH (ng/ml)               | 5.01 ± 0.31a          | 5.61 ± 0.42a  | 0.26 |

LSM ± SE, Least square means ± Standard error. Different superscript in the same raw within each classification indicates significant differences (P<0.05). HDL, high density lipoprotein, LDL, low density lipoprotein, FSH, Follicle stimulating hormone, LH, Luteinizing hormone.

Table 2: Correlation between progeny type and lipid profile in Awassi ewes

| Variables      | Singleton | | Twin | |
|----------------|-----------|-----------|
| Cholesterol    | 0.37      | 0.03      | 0.52  | 0.01 |
| Triglyceride   | 0.41      | 0.26      | -0.11 | 0.18 |
| HDL            | 0.25      | 0.05      | 0.31  | 0.04 |
| LDL            | 0.18      | 0.43      | 0.10  | 0.28 |
| Estradiol      | 0.21      | 0.04      | 0.46  | 0.02 |
| Progesterone   | 0.36      | 0.05      | 0.50  | 0.03 |
| FSH            | -0.12     | 0.42      | 0.43  | 0.14 |
| LH             | 0.23      | 0.51      | 0.09  | 0.21 |

r: Pearson’s correlation coefficient. P ≤ 0.05: Significant, P ≥ 0.05: Not significant.

| Indices                  | Birth type (LSM ± SE) | P-value |
|--------------------------|-----------------------|---------|
|                          | Single (114)          | Twin (86) |
| Cholesterol (mg/dl)      | 85.32 ± 1.42b         | 97.63 ± 1.54a | 0.04 |
| Triglyceride (mg/dl)     | 33.82 ± 0.89b         | 35.21 ± 0.74a | 0.34 |
| HDL (mg/dl)              | 42.52 ± 0.11b         | 44.63 ± 0.93a | 0.52 |
| LDL (mg/dl)              | 40.67 ± 0.21b         | 42.31 ± 0.50a | 0.81 |
| Estradiol (pg/ml)        | 35.62 ± 0.74b         | 49.44 ± 0.53b | 0.02 |
| Progesterone (ng/ml)     | 3.21 ± 0.06b          | 6.51 ± 0.02a  | 0.01 |
| FSH (ng/ml)              | 10.94 ± 1.24a         | 11.62 ± 1.03a | 0.42 |
| LH (ng/ml)               | 5.01 ± 0.31a          | 5.61 ± 0.42a  | 0.26 |

P ≤ 0.05: Significant, P ≥ 0.05: Not significant. HDL, high density lipoprotein, LDL, low density lipoprotein, FSH, Follicle stimulating hormone, LH, Luteinizing hormone.

CONCLUSION

Birth progeny type is associated with lipid profile and sex hormones levels in Awassi ewes. The ewes with twin lambs are associated with the highest cholesterol and sex hormones levels than ewes with a single lamb.

ACKNOWLEDGEMENTS

The authors are grateful to the staff of the stations for raising sheep (Babylon and Karbala) for their facilities that provided the Awassi ewes population.

REFERENCES

• Al-Thuwaini TM (2021). Novel single nucleotide polymorphism in the prolactin gene of Awassi ewes and its role in the reproductive traits. Iraqi J. Vet. Sci. 35(3):429-435.
• Arfuso F, Fazio F, Levanti M, Rizzo M, Pietro SD, Giudice E, Piccione G (2016). Lipid and lipoprotein profile changes in dairy cows in response to late pregnancy and the early postpartum period. Archiv. Anim. Breed. 59(4): 429-434. https://doi.org/10.5194/aab-59-429-2016
• Atoui A, Luengo MJC, Najari S (2018). Evaluation of a local goat population for fertility traits aiming at the improvement of its economic sustainability through genetic selection. Spanish J. Agric. Res. 16(2): 11. https://doi.org/10.5424/sjar/2018162-12604
• Ekiz B, Özcan M, Yilmaz A, Ceyhan A (2005). Estimates of phenotypic and genetic parameters for ewe productivity traits of Turkish Merino (Karacayceh Merino) sheep. Turkish J. Vet. Anim. Sci. 29(2): 557-564.
• El Tahawy AS, Sharkawy A (2014). The Influence of Different Hormonal Therapies on the Reproductive, Productive and Economic Efficiency of Early Postpartum Dairy Cows. J. Dairy.Vet. Anim. Res. 1(2):00011. https://doi.org/10.15406/jdvar.2014.01.00011
• Geraghty AA, Alberdi G, O’Sullivan EJ, O’Brien EC, Crosbie B, Twomey PJ, McAuliffe FM (2016). Maternal blood lipid profile during pregnancy and associations with child adiposity: findings from the ROLO study. PloS one. 11(8): e0161206. https://doi.org/10.1371/journal.pone.0161206
• Güzel S, Tanriverdi M (2014). Comparison of serum leptin, glucose, total cholesterol and total protein levels in fertile...
and repeat breeder cows. Rev. Brasil. de Zoot. 43(12): 643-647. https://doi.org/10.1590/S1516-35982014001200003

• Kaskous S, Gottschalk J, Hippel T, Grün E (2003). The behavior of growth-influencing and steroid hormones in the blood plasma during pregnancy of Awassi sheep in Syria. Berliner und Munchener Tierarztliche Wochenschrift. 116(3-4): 108-116.

• Luo HQ, Gu WW, Huang LW, Wu LH, Tian YG, Zheng CH, Yue M (2018). Effect of Prepregnancy Obesity on Litter Size in Primiparous Minipigs. J. American Assoc. Laborat. Anim. Sci. 57(2): 115-123.

• Meza-Villalvazo VM, Magaña-Sevilla H, Rojas-Marquez CA, Sandoval-Castro C, Trejo-Cordova A (2018). Corn oil enhances progesterone and estradiol plasma levels in tropical hair sheep. Ecosistemas y recursos agropecuarios. 5(15): 583-589. https://doi.org/10.19136/era.a5n15.1511

• Minuti A, Gallo A, Lopreiato V, Bruschi S, Piccioli-Cappelli F, Uboldi O, Trevisi E (2020). Effect of litter size on prepartum metabolic and amino acidic profile in rabbit does. Animal. 14(10): 2109-2115. https://doi.org/10.1017/S1751731120000981

• Nemeth M, Millesi E, Siutz C, Wagner KH, Quint R, Wallner B (2017). Reproductive performance and gestational effort in relation to dietary fatty acids in guinea pigs. J. Anim. Sci. Biotechnol. 8(1): 1-11. https://doi.org/10.1186/s40104-017-0158-4

• Nowak B, Mucha A, Moska M, Kruszyński W (2020). Reproduction Indicators Related to Litter Size and Reproduction Cycle Length Among Sows of Breeds Considered Maternal and Paternal Components Kept on Medium-Size Farms. Animals. 10(7): 1164. https://doi.org/10.3390/ani10071164

• Pesáñez-Pacheco JL, Heras-Molina A, Torres-Rovira L, Sanz-Fernández MV, García-Contreras C, Vázquez-Gómez M, Feyjoo P, Cáceres E, Frias-Mateo M, Hernández F, Martínez-Ros P, González-Martin JV, González-Bulnes A, Astiz S (2019). Influence of maternal factors (Weight, Body Condition, Parity, and Pregnancy Rank) on plasma metabolites of dairy ewes and their lambs. Animals. 9(4): 122. https://doi.org/10.3390/ani9040122

• Perkova M, Kitanov I, Girginov D (2008). Blood lipids profile in lactating cows fed with supplement of OVOCAP®. Biotechnol. Anim. Husband. 24(3-4): 19-28.

• Piccione G, Caola G, Giannetto C, Grasso F, Runzo SC, Zumbo A, Pennisi P (2009). Selected biochemical serum parameters in ewes during pregnancy, post-parturition, lactation and dry period. Anim. Sci. Papers Rep. 27(4): 321-330.

• Tesema Z, Deribe B, Kefale A, Lakew M, Tilahun M, Shibesh M, Belayneha N, Zegeye A, Worksu G, Yizengaw L (2020). Survival analysis and reproductive performance of Dorper x Tumele sheep. Heliyon. 6(4): e03840. https://doi.org/10.1016/j.heliyon.2020.e03840