Journal of Kerbala for Agricultural Sciences Issue (2),Volume (7), (2020)

Association of litter size with sex hormones and body measurements of Iraqi Awassi ewes

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Received:

March 25, 2020

Accepted:

April 27, 2020

Published:

June 01, 2020

Abstract

Birth type is the most important reproductive trait in sheep production, which is influenced by the ovulation rate, hormones, and fecundity genes. Ewe reproductive performance is known to be affected by body measurements. Therefore, this study aims to investigate the possibility of an association between the litter size with sex hormones and body measurements in Iraqi Awassi ewes. A total of 224 sexually mature ewes, non-pregnant, non-lactation and healthy (124 ewes with single birth and 100 ewes with twin birth), aged between 2.5 to 5 years were included in the present study. Blood samples were collected from the sheep, and then the serum was separated from blood to determine the concentrations of the estradiol and progesterone. Body measurements and Live body weight were determined for each ewe. The result of this study refers that the live body weight of Awassi ewes was significantly ($P<0.05$) influenced in the litter size. The association analysis of litter size with body measurements indicated that chest girth, the neck length and height at the hip were different for the type of birth of Awassi ewes. The highest positive correlation ($P < 0.01$) was recorded among litter size with live body weight ($r=0.698$, $P=0.001$), with height at shoulder ($r=0.242$, $P=0.031$) and height at hip ($r=0.309$, $P=0.005$).In conclusion, the litter size of Awassi ewes is influenced by the other phenotypic traits. The ewes with heavier live body weight and higher body measurements are more favourable to having more lambs than ewes with a single birth.

Keywords: Litter size, sex hormones, body measurements, sheep.

ارتباط نوع الولادة مع الهرمونات الجنسية وقياسات الجسم في النعاج العواسي العراقية

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المستخلص:

نوع الولادة هو أهم سمة تكاثرية في إنتاج الأغنام ، والتي تتأثر بمعدل الإباضة ، وبعض الهرمونات وجينات الخصوبة. من المعروف أن أداء تكاثر النعاج يتأثر بقياسات الجسم. لذلك تهدف هذه الدراسة إلى التحري عن إمكانية الارتباط بين نوع الولادة مع الهرمونات الجنسية وقياسات الجسم في النعاج العواسي العراقية. تم تضمين في هذه الدراسة ما مجموعه 224 من النعاج دات صحة جيدة وناضجة جنسياً وغير الحوامل وغير المرضعات (124 نعجة ذات ولادة مفردة و 100 نعجة ذات ولادة توائم) تتراوح أعمارهم بين 2.5 إلى 5 سنوات. تم جمع عينات الدم من الأغنام ، ثم تم فصل المصل عن الدم لتحديد تراكيز الاستراديول والبروجسترون . تم تحديد وزن الجسم الحي وقياسات الجسم لكل حيوان. تشير نتائج الدراسة الحالية إلى أن وزن أجسام النعاج العواسي الحي كان معنويا ($P<0.05$) متأثر بنوع الولادة . أوضح تحليل الارتباط لنوع الولادة مع قياسات الجسم الى أن طول الرقبة والارتفاع في الورك ومحيط الصدر كان مختلفاً بالنسبة لنوع الولادة في النعاج العواسي . تم تسجيل أعلى ارتباط موجب ($P < 0.01$) بين نوع الولادة مع وزن الجسم الحي($r = 0.698$ ، $P = 0.001$)، مع الارتفاع في الكتف($r = 0.242$ ، $P = 0.031$)والارتفاع في الورك ($r = 0.309$ ، $P = 0.005$) . مما تقدم نستنتج ، تتأثر نوع الولادة للنعاج العواسي بالصفات المظهرية الأخرى . تكون النعاج ذات الوزن الحي الثقيل وقياس الجسم الأعلى أكثر ملائمة لإمتلاك حملان أكثر من النعاج ذات الولادة المفردة.

الكلمات المفتاحية: نوع الولادة، الهرمونات الجنسية ، قياسات الجسم ، الاغنام

البحث مستل من رسالة ماجستير للباحث الثالث

Introduction.

Sheep is one of the most important livestock animals that have an impact on the economics of people (Farrag, 2019). The economic characterization of sheep is necessary for livestock development and breeding programs (Abd-Allah *et al*., 2019). Awassi sheep play a significant role in the economy because of high performance in lamb and milk production (Galal *et al*., 2008). in all sheep production systems and high economic value, reproductive traits are the most important traits (Yavarifard *et al*., 2015). Litter size (LS) is the most important economic trait in sheep production (Janssens *et al*., 2004; Notter, 2008), which is influenced by ovulation rate, a few hormones and the fecundity genes (Ekiz *et al*., 2005). Litter size is directly related to ovulation rate and on the number of the ooc00yte that was released from follicles during ovulation (Williams & Stanley, 2008). The oocyte is surrounded by granulosa cells and theca cells that are essential for ovulation by secreting the hormones estrogen and progesterone, and a non-cellular material layer called the zona pellucida (Kumer *et al*., 2017). Awassi breed is mono-ovulatory species (Iber & De Geyter, 2013) with a very low incidence of twinning (Al-Sa'aidi *et al*., 2018; Kridli *et al*.,

2018), compared to rodents and pigs which have high ovulation rates (Montgomery *et al*., 2001). Moreover, the litter size of sheep differs between breeds; it ranges from single birth in Texel and Suffolk to twin birth in the prolific Booroola Merino breed (Souza *et al*., 2001). Besides the variation in litter size between breeds, several factors like age, season, management, nutrition, genetic effect, body score, and environmental conditions affect on sheep litter size in sheep (Kumer *et al*., 2017). Youssef *et al*., (2014) refer to the relationship among body length, age, body weight and other body measurements with litter size for Damascus and Zaraibi goats. Based on the above consideration, no researches yet on the association of the litter size with the sex hormones and body measurements have been reported in Iraqi Awassi ewes. Thus, the current studies aimed to evaluate the association of litter size with sex hormones and body measurements in Iraqi Awassi ewes.

Materials and Methods.

Blood examination and Animals.

The present study was conducted according to regulations of the international recommendations for the care and use of animals under Al-Qasim Green University's approval (Agri, No. 015,3,12), at the College of Agriculture /Department of Animal Resources for the period from January 2019 to August 2019 on Awassi ewes. A total of 224 healthy and sexually mature ewes, non-pregnant, non-lactation and healthy (124 ewes with single birth and 100 ewes with twin birth), 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). They were fed *ad libitum* on seasonal grass, concentrate food about 2.5% of their live body weight daily, comprising a mixture of barely (59%), bran (40%), salt (1%) concentrates, and freshwater. From the sheep, blood samples were collected, using vacutainer tubes with EDTA. From blood samples, serum was separated by centrifugation at 3,000 rpm for 15 min at room temperature where it was kept frozen at –20°C to determine hormonal assay. Estradiol and progesterone were measured by using Bioassay Technology Laboratory company ELISA kit (sheep estradiol Elisa kit catalogue number E0047Sh and sheep progesterone Elisa kit catalogue number E0015Sh). The condensations of the estradiol and progesterone in the serum were determined by using the standard curve.

Body measurements and live body weight.

Live body weight (kg) of Awassi ewes was done in the morning before the animals were grazing using a suspended spring balance. Body measurements were obtained according to (Abd-Allah *et al*., 2019) by using the measuring tape calibrated in centimetres (cm) including body length (BL) was the distance from the point of shoulder to the base of the tail; head length (HL) was the distance measured from the upper lip of the animal to nodule of the horn; neck length (NL) was the distance from the lower jaw to the point of the shoulder; height at shoulder measured vertically from the thoracic vertebrae to the ground; height at the hip was measured in between hip to the

sole of the hoof; chest girth the circumference of the chest and chest width was measured as the width of the rib cage between the forelegs.

Statistical analyses.

The significant effect of litter size on the various parameters studied was construed using Statistical Package for the Social Sciences (SPSS) software version 23.0., with general linear model:

$$Y_{ijkl} = \mu + L_i + P_j + A_k + e_{ijkl}$$

where Y_{ijkl} = phenotypic traits, μ = overall mean, L_i = fixed effect of i^{th} litter size (*i* = single birth, twin birth), 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_{ijkl} = random error associated with Y_{ijkl} observation and assumed to be NID (0, $\sigma^2 e$). Means were compared using the Tukey-Krammer test with a significance level of ($P<0.05$). Preliminary statistical analysis indicated the effect of factor interaction, season and station did not have a significant effect on phenotypic traits, so they are not matched in the general linear model.

Results and Discussion.

Association analysis of litter size with live body weight and sex hormones of Awassi ewes.

Association analysis of birth type refers to the physiological changes occurs in this study. Table 1 shows the least-square means of sex hormones and live body weight in Awassi ewes. The live body weight of Awassi ewes was significant ($P<0.05$) influenced in the litter size, while no statistically significant difference was observed for the sex hormones ($P>0.05$) (Table 1).

Table 1: Least square Mean ± SE of live body weight and sex hormones assay for the litter size of Awassi ewes.

Indices		Live body weight (Kg)	Estradiol (pg/ml)	Progesterone(ng/ml)
Litter size	Single	32.940 ± 3.631^{b}	37.807 ± 3.791^{a}	4.780 ± 0.846^{a}
	Twin	40.633 ± 4.468^{a}	39.815 ± 3.950 ^{a}	7.285 ± 1.449^{a}
P-value		0.001	0.358	0.717

Different superscript in the same column indicates significant differences ($P<0.05$).

The result refers to the presence of significant differences ($P< 0.05$) in live body weight between Awassi ewes with single and twin births. Sheep live body weights have been reported to influence on reproductive performance and litter size (Akhtar et al., 2012). The ewe ovulation rate and litter size are affected by live body weight of the sheep, with heavier sheep be more favourable to having more lambs than ewes with single birth (Pettigrew et al., 2019). Accretion the pre-mating weight of ewes

could accretion the pregnancy rate and twins births (Aktas & Dogan, 2014). In agreement with Aktas et al., (2015), the twinning ratio was reported to increase with the live body weight of the ewes. While no statistically significant difference was observed for the sex hormones (P>0.05) (Table 1). This is consistent with studies of Pang *et al*., (2009) that referred to non-significant differences of plasma profiles of progesterone and estradiol in much prolific Huanghuai goats contrasted with nonprolific across the oestrous cycle and after ovariectomy.

Association analysis of litter size with body measurements of Awassi ewes

The result of the association analysis of litter size with body measurements indicated that the neck length, height at hip and chest girth were different for the type of birth of Awassi ewes (Table 2).

Table 2: Least square Mean ± SE of the body measurement for the litter size of Awassi ewes.

Indices		Body length	Head length	Neck length	Height at shoulder	Height at hip	Chest girth	Chest width
Litter size	Single	69.320 ± 3.481^{a}	24.860 ± 1.603^{a}	24.720 ± 2.119^{b}	70.260 ± 2.912^{a}	72.480 ± 3.038^{b}	87.000 ± 3.187^{b}	26.260 ± 2.202^{a}
	Twin	69.700 ± 4.178^{a}	24.766 ± 1.501^{a}	26.600 ± 2.283^{a}	70.313 ± 3.356^{a}	74.000 ± 2.912^{a}	89.433 ± 4.384^{a}	26.500 ± 2.713^{a}
P-value		0.659	0.797	0.045	0.918	0.031	0.005	0.667

Different superscript in the same column indicates significant differences (P<0.05).

Body dimensions supply information about the reproductive traits of the ewes. Through the most important body dimensions are chest girth, shoulder and hip length and widths, body length and hip heights (Abdullah & Tabbaa, 2011). Ewe reproductive performance is famous to be influenced by body measurement (Corner-Thomas *et al*., 2015). It is likely that ewes of higher body measurement may be more able to manage multiple births than ewes of poorer body measurement (Kenyon *et al*., 2012).

Correlation analysis of litter size with other variables of Awassi ewes

The correlation coefficient between litter size and phenotypic traits of the Awassi ewes are shown in Table 3. The highest and mightily positive connection (P < 0.01) was listed among litter size with live body weight (r=0.698, P=0.001), height at shoulder (r=0.242, P=0.031) and height at hip (r=0.309, P=0.005).

Table 3: Correlation between litter size and other variables in Awassi ewes .

Variables	Litter size	
	r	P-value
Live body weight	0.698	0.001
Estradiol	0.058	0.717
Progesterone	0.145	0.358
Body length	0.0.50	0.659
Head length	0.194	0.085
Neck length	0.012	0.918
Height at shoulder	0.242	0.031
Height at hip	0.309	0.005
Chest girth	0.049	0.667
Chest width	-0.029	0.797

P < 0.05: Significant, P >0.05: Not significant.

The result refers to the presence of positive and significant correlation (P< 0.05) among litter size with live body weight and body measurement. The present study coordinated with the study of Yavarifard *et al*., (2015) that reported the appositive correlation between birth type and body dimension in Mehraban sheep. Similarly, Moraes *et al*., (2016) refer that the maternal body provision score of Corriedale ewes, was positively correlated to reproductive traits during breeding (r = 0.37, p < 0.05). The phenotypic variations (heart girth, body weight, punch girth and other dimensions) were significantly higher (P< 0.05) in goats bearing multiplied births than the goats bearing a single birth. This variation may be used as a useful tool for the discrimination between the goats carrying multiple births and the goats carrying single birth and thus achieving more economic benefits by this discrimination (Pan *et al*., 2015).

The litter size of Awassi ewes is influenced by the other phenotypic traits. The ewes with heavier live body weight and higher body measurements are more favourable to having more lambs than ewes with a single birth.

Acknowledgements.

The present study was supported by the college of agriculture, Al-Qasim Green University [grant number Agri, No.015, 3, 12]. The authors are grateful to the staff of two stations for raising sheep (Babylon and Karbala) for their facilities that provided the Awassi ewes population.

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