REMARKABLE CORRELATION OF NON-GENETIC FACTORS WITH GROWTH TRAITS IN TWO BREEDS OF SHEEP

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ABSTRACT

This study was conducted at the college of agriculture – Al-Qasim Green University to investigate the effect of breed and age of dams on several growth traits of two sheep breeds, including 123 Iraqi Awassi and 78 Iranian Karakul breeds. Variables growth traits were examined in the present study, namely body weight (BW), body length (BL), wither height (WH), rump height (RH), and chest circumference (CC), and abdominal circumference (AC). Results indicated the absence of a significant effect between both breeds in all investigated growth traits in birth. Meanwhile, a significant (P<0.05) superiority of Karakul over Awassi was detected in month-3 in three growth traits (BW, WH, and RH), and in month-6, in four growth traits (BW, WH, RH, and BL). The age of dams exhibited a significant (P<0.05) effect on the majority of lambs' growth traits since lambs born from dams aged over 4 years gave more values than those born from dams aged less than 4 years. Sex of lambs had also contributed to growth traits measurements since higher values were collected from several growth males over females in month-3 (BW, BH, and RH), and month-6 (BW, BL, WH, and RH). Time of birth had also yielded significantly (P<0.05) better values for lambs born in January over those born in other months. However, lambs born in December gave better traits than other lambs. In conclusion, this study demonstrated the obvious superiority of Karakul over Awassi breed in the majority of growth traits measured.

Keywords; association, growth traits, non-genetic factors, Sheep

مجلة العلوم الزراعية العراقية -2021 :52 (2):309-314 علي وآخرون

وجود علاقة بارزة بين العوامل الغير وراثية مع صفات النمو في سلالتين من الأغنام

ثامر راضي الجبوري عماد فاضل حسن محمد باقر صاحب الشهيب
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المستخلص

قامت الدراسة في كلية الزراعة – جامعة القاسم الخضراء لتحري تأثير نسل وعمر أمهات الأغنام على مواصفات النمو والتي تم قياسها لنسلين من الأغنام, بعدد 123 للعواسي العراقية و78 للكاراغول الإيرانية. تم فحص العديد من صفات النمو في هذه الدراسة, وهي وزن الجسم, وطول الجسم, وارتفاع الصدر, وارتفاع الارداف, ومحيط الصدر, ومحيط البطن. اشارت الدراسات الى عدم وجود تأثير ملحوظ بين كلا السلالتين في كل مواصفات النمو المدروسة عند الولادة. بينما, تم اكتشاف تفوقاً ملحوظا (P<0.05) لسلالة الكراغول على سلالة العواسي في الشهر الثالث من الولادة في ثلاث من صفات النمو, وهي وزن الجسم وارتفاع الصدر والارداف, وفي اربع من الصفات في الشهر السادس وهي وزن الجسم وارتفاع الجسم وارتفاع الصدر والارداف. أبدت اعمار الأمهات تأثيرا معنوياً (P<0.05) على معظم صفات النمو في الحملان, كون ان تلك الحملان التي ولدت من أمهات بأعمار أكثر من الاربع سنوات قد أعطت قيم اكثر من تلك الحملان التي ولدت من أمهات باعمار أقل من 4 سنوات. وقد اثّر جنس الحملان أيضاً في قياسات صفات النمو لانه قد تم جمع قيم اعلى من عدة اناث بعمر ثلاثة أشهر (وزن وطول الجسم وطول الصدر والارداف) وبعمر ستة أشهر (وزن وطول الجسم وارتفاع الصدر والارداف). وقد اعطى توقيت الولادة كذلك قيم أعلا معنوياً (P<0.05) بالنسبة للحملان المولودة في شهر يناير على تلك المولودة في الأشهر الأخرى. اثبتت نتائج الدراسة الحالية تفوق واضح لسلالة الكراغول على سلالة العواسي في معظم صفات النمو المدروسة.

كلمات مفتاحية: ترابط, صفات النمو, عوامل غير وراثية, اغنام

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INTRODUCTION

The growth traits in sheep can largely be improved via increasing the rate of reproduction to get higher marketing standards. Sheep exhibit a seasonally polyestrous mode of reproduction to ensure the optimal birth of lambs (10). However, reproductive measurements fluctuate among different breeds in different regions worldwide. These differences have been attributed to many genetic factors (20). But, the growth performance of sheep is highly exposed to a variety of non-genetic factors, which have largely been implicated in the development and growth of many sheep populations (21). Among these non-genetic factors are, age of dams (22, 23), breed of sheep (19), and season of birth (26), which are considered the most important challenges toward the progression of proliferative sheep around the world. However, most of the sheep in the Middle East can be reproduced all over the year, but its reproduction reaches its optimal level in April, May, and June. Awassi sheep is one of the most predominant fat-tailed sheep in the Middle East (7). This breed is highly known for its higher distribution in Iraq which constitutes about 58% of the national welfare in this country (6). Although this breed is characterized by reduced growth, low fertility, and low milk production (3), it has a noticeable ability to keep up the extreme climate fluctuations (13). As well, it has been reported that this breed can be reproduced under drought conditions (5). Meanwhile, Karakul sheep represents one of the main ovine breeds in central Asian regions, which is categorized by a large ratio of fat deposited in a broad tail (17). Whereas Karakul breed is a highly predominant proliferative sheep with high distribution in many Asian and African regions. However, both breeds are proliferative and can be used for meat, milk, and wool production (13, 25, 16). It is well known that lambs are highly affected by several kinds of non-genetic factors that are largely involved in altering several growth parameters and body performance (29). Accumulated data of recent literature have been reported to describe the remarkable effect of dams age, breed, the timing of birth on the early growth and weight of lambs (8, 31). Though both Awassi and Karakul breeds have widely been studied, no direct comparison has been provided to describe growth trait differences between them. For this reason, this study aims to provide a direct comparative analysis for the lambs of both breeds taking into account the raising of both breeds in the same management conditions. In addition to the breed effect, this study was also designed to evaluate the potential of the other non-genetic factors in the analyzed traits of the newborn lambs in Awassi and Karakul populations.

MATERIALS AND METHODS

Animals: A total of 201 dams, (123) Awassi, and (78) Karakul, were included in this study. The analyzed sheep populations were raised at the animal field of the general investment company of Al-Abbas Station for raising sheep (Al-Khafeel co., Karbala, Iraq) from 1 - October 2018 to 30 - November 2019. This station was situated at a longitude of 32.6027° N, the latitude of 44.0197° E, and 32 m above mean sea level. Dams were fed *ad libitum* with seasonal grass, concentrate food about 2.5% of their live body weight daily, comprising a mixture of barley (59%), bran (40%), salt (1%) concentrates, and freshwater. Lambs were fed according to guidelines mentioned by Urbano et al. (34). Experiments involved with animals were performed in compliance with proper animal welfare guidelines for the care and use of livestock animals (36). All experiments conducted on animals were approved by the scientific committee of the College of Agriculture, Al-Qasim Green University. Analyzed animals from both breeds were kept in the same conditions of daily regimen and feeding and serviced by the same personnel in the stated breeding station.

Data collection: In the three screened births months (November / 2018, December / 2018, and January / 2019), the ears for all newborn lambs were tagged with distinct identification numbers. The age of their dams was documented and kept under continuous monitoring according to the recommended guidelines (12). From the birthday to the age of six months, several growth traits were considered in the analyzed lambs in both Karakul and Awassi breeds. To provide accurate records, all growth traits were

collected by the same person using the same standards of measurements (37). The analyzed traits of body weight (BW), body length (BL), wither height (WH), rump height (RH), chest circumference (CC), abdominal circumference (AC), and average daily gains (ADG). The ADG was measured using the following formula; DWG (gm/day) = (previous weight – next weight)/time. All growth traits were investigated in three successive time intervals, beginning from the birthday until getting 6 months of age (birthday, 3 months, 6 months) (19).

Statistical analysis

The effects of breed, age of dams, birth date, and sex of lambs on growth traits measurements were analyzed using SAS software (30). The following General Linear Model (GLM) procedure was fitted to the following data;

$$\mathbf{Y}_{ijklm} = \boldsymbol{\mu} + \boldsymbol{B}_i + \boldsymbol{S}_j + \mathbf{D}_k + \mathbf{Q}_l + \boldsymbol{E}_{ijklm}$$

Where; Y_{ijklm} is the phenotypic value of the traits, μ is the overall mean, B_i is the fixed effect of the breed ($i = 1, 2$), S_j is the fixed effect of the sex of lamb (j= 1, 2), D_k is the fixed effect of the age of dams (k= 1, 2, 3), Q_l is the fixed effect of the birth month of lambs ($l = 1, 2, 3$), and E_{ijklm} is the random residual effect of each observation. Phenotypic correlations between the traits analyzed were investigated through the use of Pearson correlation coefficients. *P*-values of less than 0.05 were considered statistically significant for all comparisons. Interactions between variables were computed using univariate analysis in the general linear model procedure of SAS statistical package ver. 9.

RESULTS AND DISCUSSION

Growth traits recording is essential in sheep breeding because these traits comprise crucial selection standards for improving breeding programs of livestock animals. These criteria are important to expand economic prognostics and to provide more insights on reproduction, feeding, and other biological activities. In the present study, the main growth traits of the Awassi and Karakul breeds have been compared with each other to develop a deep study of the effect of non-genetic factors on the physiological growing performance of both breeds.

Breed of dams: No significant differences were observed in the newborn lambs between both analyzed breeds in birth. In month-3, significantly (P<0.05) higher values of BW (23.08± 0.47kg), WH (62.25± 0.36cm), and RH (62.87± 0.35cm) were detected in Karakul over Awassi lambs. Furthermore, more advent superiority of Karakul was detected in month-6 in more growth traits measurements, including BW (31.54± 0.78kg), WH (69.20± 0.41cm), RH (69.91± 0.41cm), and BL (69.31± 0.61cm). Moreover, Karakul lambs showed significant (P<0.01) values of ADG over Awassi lambs. These values were observed from all measurements taken from animals, both in the weaning (205.33±9.22 g for Karakul and 180.53±9.22 g for Awassi) and at 6 months (105.32±8.54 g for Karakul and 80.11±6.54 g for Awassi) respectively (Table 1).

Age of dams

A highly significant (P<0.01) effect of age observed in the majority of growth traits measured. At the birth of lambs, dams aged more than 4 years showed more BW (4.45±0.08 kg), WH (40.46±0.23 cm), RH (40.83±0.24 cm), CC (41.53±0.33 cm) than other younger dams. These differences were extended all over the analyzed period with slight fluctuations in month-3 and month-6 intervals. However, results showed no significant differences between lambs born from younger dams.

Table 1. Effect of breed and age of dams on lambs' weights and their body measurements from birth until 6 months. Data in the table are means ± standard errors

Time interval	Measured trait	Breed			Age of dam (year)			
		Karakul (n=78)	Awassi (n=123)	P value	>2 to <3 (n=68)	3> to <4 (n=63)	> 4 (n=70)	P value
Birth	BW (kg)	4.38±0.07	4.36±0.05	N.S	4.30±0.06[b]	4.36±0.08[ab]	4.45±0.08 [a]	P<0.01
	BL (cm)	30.60±0.21	30.35±0.20	N.S	30.00±0.21	30.70±0.32	30.60±0.23	N.S
	WH (cm)	40.45±0.22	39.84±0.15	N.S	39.72±0.18 [b]	40.03±0.24 [b]	40.46±0.23 [a]	P<0.01
	RH (cm)	40.74±0.23	40.20±0.15	N.S	40.04±0.18 [b]	40.35±0.25 [b]	40.83±0.24 [a]	P<0.01
	CC (cm)	41.41±0.29	41.41±0.20	N.S	41.31±0.25 [b]	41.29±0.29 [b]	41.53±0.33[a]	P<0.01
	AC (cm)	43.41±0.29	42.77±0.21	N.S	43.16±0.26	42.95±0.30	42.94±0.35	N.S
3 months	BW (kg)	23.08±0.47 [a]	20.76±0.32 [b]	P<0.01	20.26±0.38 [c]	22.23±0.51 [a]	22.38±0.54 [a]	P<0.05
	BL (cm)	57.72±0.51	56.30±0.35	N.S	55.87±0.44 [b]	57.72±0.48 [a]	57.04±0.57 [a]	P<0.01
	WH (cm)	62.25±0.36[a]	60.45±0.33 [b]	P<0.01	60.72±0.41	61.36±0.47	61.37±0.42	N.S
	RH (cm)	62.87±0.35 [a]	61.17±0.31 [b]	P<0.01	61.32±0.38	62.11±0.45	62.07±0.40	N.S
	CC (cm)	77.58±0.65	75.69±0.47	N.S	74.91±0.65	76.97±0.66	77.43±0.64	N.S
	AC (cm)	85.74±0.72 [a]	83.19±0.46 [b]	P<0.05	82.25±0.62	84.75±0.69	85.57±0.70	N.S
	ADG (g)	205.33± 9.22[a]	180.53±6.97 [b]	P<0.05	185.51±7.69	190.42±7.58	202.87± 7.39	N.S
6 months	BW (kg)	31.54±0.78 [a]	28.34±0.49 [b]	P<0.01	27.37±0.61 [b]	30.05±0.79 [a]	31.30±0.79 [a]	P<0.05
	BL (cm)	69.31±0.61 [a]	66.27±0.48 [b]	P<0.01	65.74±0.66 [b]	67.60±0.61 [a]	68.97±0.68 [a]	P<0.01
	WH (cm)	69.20±0.41 [a]	67.61±0.35 [b]	P<0.01	67.21±0.46	68.69±0.47	68.81±0.45	N.S
	RH (cm)	69.91±0.41 [a]	68.19±0.34 [b]	P<0.05	67.74±0.45 [b]	69.40±0.46 [a]	69.45±0.45 [a]	P<0.05
	CC (cm)	90.57±1.03	88.46±0.71	N.S	86.34±0.91 [b]	89.93±1.06 [a]	91.48±1.01 [a]	P<0.01
	AC (cm)	100.97±0.99	99.04±0.69	N.S	97.29±0.83	99.57±1.03	102.33±0.98	N.S
	ADG (g)	105.32± 8.54[a]	80.11±6.54 [b]	P<0.01	93.19±7.15	90.68±6.97	94.28±7.06	N.S

Abbreviations: BW; body weight, BL; body length, WH; wither height, RH; rump height, CC; chest circumference, AC; abdominal circumference, ADG; average daily gain. Values with different superscript letters within the same line differ significantly at P<0.05 for "a" and "b" and P<0.01 for "a" and "c".

This observation signifies a positive influence of this age on the growth traits performance in both investigated breeds. In compliance with our findings, a proportional correlation has been reported between the age of dams and growth traits performance in several breeds worldwide, such as the Nigerian Yankasa breed (2), the Iranian Afshari breeds (14), the Indian Nellore Jodipi breed (29), and the Mexican Dorper breed (24). This superiority of larger age dams could be attributed to the extended diameters of these dams, which provide more supply of nutrients (28).

Sex of lambs

No significant (P<0.05) effect of sex was observed in all recorded growth traits of the newborn lambs at birth. Meanwhile, high significant (P<0.01) values were observed in the weaning month for males (22.65±0.46 kg for significant (P<0.05) BW, 61.80± 0.42cm for WH, 62.50± 0.39cm for RH, and 203.71±6.76 g for ADG) over females (20.76± 0.34kg for BW, 60.61± 0.30cm for BL, 61.28± 0.28cm for RH, and 182.154±6.77 g for ADG) (Table 2). Additional confirmation for these measurements was obtained in month-6, in which a more significant (P<0.01) effect of sex was perceived between both sexes. In this month, males exhibited greater measurements in more traits (31.23±0.69 kg for BW, 68.64± 0.58cm for BL, 68.88± 0.40cm for WH, 69.56± 0.40cm for RH, and 101.16± 0.86cm for AC) than females (28.26± 0.50kg for BW, 66.51± 0.48cm for BL, 67.71± 0.34cm for WH, 68.28± 0.33cm for RH, and 98.67± 0.71cm for AC). Our results came in agreement with several studies that reported a remarkable contribution of sex on growth and development. These studies have indicated considerable involvement of sex and several reproductive measurements of weaning in several breeds, such as the Indian Sonadi breed (32), the Iranian Afshar breed (14), the Egyptian Chio, and Rahmani breeds (1), and the Iraqi Awassi breed (35). Meanwhile, no significant effect was reported for sex in both the Indian Harnali breed (19, 29) in the Syrian Awassi breed (15), and in the Serbian local breed (27). However, the sexual intervention in inducing these referred differences could be associated with the differences in the endocrine systems in both sexes (18). Furthermore, the selection of males over females in artificial insemination purposes may also be correlated with the proportional differences between sexes (11).

Season of birth

The results of this study showed highly significant (P<0.01) effects of birth month on the majority of growth performance. Lambs born in January showed significantly higher values (4.65± 0.04kg for BW, 40.60± 0.13cm

for WH, 40.74± 0.12cm for RH, 42.62± 0.15 cm for CC, and 44.29± 0.17cm for AC) of growth traits over other lambs born in November (3.95±0. 08kg for BW, 39.38± 0.27 cm for WH, 39.93± 0.30cm for RH, 39.53± 0.28cm for CC, and 41.28±0.32 cm for AC) and December (4.34±0. 11kg for BW, 39.83± 0.27cm for WH, 40.38±0.30 cm for RH, 41.52± 0.35cm for CC, and 42.55± 0.33cm for AC). Some of these differences did not reach significant levels in the weaning. However, lambs born in January showed significantly (P<0.05) superiority in terms of BL (57.68±0.38), WH (61.95±0.30), and RH (62.53±0.29) over lambs born in December (56.00± 0.72cm for BL, 59.89± 0.63cm for WH, and 60.57± 0.56for RH) and November (55.96± 0.55cm for BL, 60.46± 0.48cm for WH, and 61.29± 0.46for RH). However, the reason for these differences could be attributed to the sufficient amounts of milk synthesis and to the presence of more favorable conditions for growth in January (9, 33).

Table 2. Effect of birth date and sex in lambs' weights and body measurements from birth to 6 months. Data in the table are means ± standard errors.

Time interval	Measured trait	Sex of lamb			Season of birth (month)			
		Female (n=111)	Male (n=90)	P value	November (n=68)	December (n=30)	January (n=101)	P value
Birth	BW (kg)	4.34±0.05	4.41±0.07	N.S	3.95±0.08 ^{c}	4.34±0.11 ^{b}	4.65±0.04 ^{a}	P<0.01
	BL (cm)	30.49±0.17	30.40±0.25	N.S	30.68±0.35	29.90±0.36	30.45±0.13	N.S
	WH (cm)	40.09±0.16	40.06±0.20	N.S	39.38±0.27 ^{b}	39.83±0.27 ^{b}	40.60±0.13 ^{a}	P<0.01
	RH (cm)	40.41±0.17	40.41±0.19	N.S	39.93±0.30 ^{b}	40.38±0.30 ^{b}	40.74±0.12 ^{a}	P<0.01
	CC (cm)	41.39±0.21	41.44±0.26	N.S	39.53±0.28 ^{b}	41.52±0.35^{b}	42.62±0.15 ^{a}	P<0.01
	AC (cm)	42.84±0.22	43.24±0.28	N.S	41.28±0.32 ^{b}	42.55±0.33 ^{b}	44.29±0.17 ^{a}	P<0.01
3 months	BW (kg)	20.76±0.34 ^{b}	22.65±0.46 ^{a}	P<0.01	22.18±0.61	20.14±0.58	21.62±0.34	N.S
	BL (cm)	56.51±0.35	57.26±0.50	N.S	55.96±0.55 ^{b}	56.00±0.72 ^{b}	57.68±0.38 ^{a}	P<0.01
	WH (cm)	60.61±0.30 ^{b}	61.80±0.42 ^{a}	P<0.05	60.46±0.48 ^{b}	59.89±0.63 ^{b}	61.95±0.30 ^{a}	P<0.01
	RH (cm)	61.28±0.28 ^{b}	62.50±0.39 ^{a}	P<0.05	61.29±0.46 ^{b}	60.57±0.56 ^{b}	62.53±0.29 ^{a}	P<0.05
	CC (cm)	76.20±0.51	76.68±0.60	N.S	78.04±0.75	74.61±1.01	75.82±0.45	N.S
	AC (cm)	83.65±0.55	84.82±0.59	N.S	86.00±0.79	82.07±0.94	83.52±0.49	N.S
	ADG (g)	182.154±6.77 ^{b}	203.71±6.76 ^{a}	P<0.01	203.95±7.30	185.91±10.78	188.93± 6.32	N.S
6 months	BW (kg)	28.260±0.50 ^{b}	31.23±0.69 ^{a}	P<0.05	32.87±0.88 ^{a}	28.55±0.75 ^{b}	27.73±0.46 ^{b}	P<0.01
	BL (cm)	66.51±0.48 ^{b}	68.64±0.58 ^{a}	P<0.01	70.11±0.61 ^{a}	66.67±0.81 ^{b}	65.95±0.51 ^{b}	P<0.05
	WH (cm)	67.71±0.34 ^{b}	68.88±0.40 ^{a}	P<0.05	69.34±0.44 ^{a}	68.48±0.59 ^{ab}	67.44±0.37 ^{b}	P<0.05
	RH (cm)	68.28±0.33 ^{b}	69.56±0.40 ^{a}	P<0.05	70.08±0.43 ^{a}	69.04±0.57 ^{ab}	68.01±0.38 ^{b}	P<0.05
	CC (cm)	88.46±0.44	90.29±0.86	N.S	93.34±0.96 ^{a}	87.70±1.19 ^{b}	87.04±0.77 ^{b}	P<0.05
	AC (cm)	98.67±0.71 ^{b}	101.16±0.86 ^{a}	P<0.05	104.11±0.95 ^{a}	98.44±1.10 ^{b}	97.31±0.71 ^{b}	P<0.01
	ADG (g)	88.29±6.28	97.14±6.35	N.S	112.51±6.80 ^{a}	99.03± 10.07^{b}	66.60±5.90 ^{c}	P<0.01

Abbreviations: BW; body weight, BL; body length, WH; wither height, RH; rump height, CC; chest circumference, AC; abdominal circumference, ADG; average daily gain. Values with different superscript letters within the same line differ significantly at P<0.05 for "a" and "b" and P<0.01 for "a" and "c".

In contrast pre-weaning, the observed values in post-weaning periods were directed toward the superiority of lambs born in December over other lambs in terms of all recorded growth traits. The reason behind this evident alteration is may be correlated to the presence of compensatory growth for these lambs that suffered from an insufficient supply of milk in pre-weaning months. This insufficiency seems to increase the survival adaptability of these lambs to withstand such conditions, which triggered the early development of rumen (4). This study has demonstrated the advent superiority of Karakul over Awassi which was found to be associated with the majority growth traits (42). However, the involvement of sex of lambs, age of dams, and season of birth could not be excluded from this explanation since all these non-genetic factors have exhibited a profound effect on the early growth of lambs (38 – 41). Therefore, it can be stated that all these factors need to be considered in the improvement plan of both sheep breeds. The currently investigated analyses could be considered as a useful guide for the comparative analysis between Awassi and Karakul breeds for developing better performance in the management systems in both populations.

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