THE USE OF TEST-DAY MILK YIELD AND LAMBS WEIGHT FOR PREDICTION OF SOME PRODUCTIVE TRAITS IN AWASSI SHEEP

Muthanna F. A. Al-Juwari
Lecturer
Dept. Anim. Prod. Coll. Agric. and Forestry, University of Mosul, Iraq.
muthanna.f.a@uomosul.edu.iq

ABSTRACT

This study was included 155 records of Awassi ewes and 199 records of lambs born during two seasons (2011-2012), belonging to the College of Agriculture and Forestry, Mosul University. The effect of year was highly significant on all traits except for weight gain from weaning to 180 days (GW180d). Age of dam was significantly affected daily milk yield (DMY), birth weight (BW), weaning weight (WW) and gain from birth to weaning (GBW). Type of birth had significant effect on DMY, BW,WW and weight at 180 days. The effect of lamb sex on WW, GBW was significant. Significant correlations coefficient were observed between DMY and total milk yield (TMY), months weight of lambs, GBW and GB180d being ranged from 0.46 to 0.99 and -0.44 to 0.99 respectively. The R^2 values of prediction equations were high and ranged between 0.81 to 0.99 to predict TMY, and 0.97 to predict lamb weight at 180 days.

keywords: environmental factors, growth, milk production, predictive equations.

استعمال الفحوصات الدورية لإنتاج الحليب وأوزان الحملان للتنبؤ ببعض الصفات الإنتاجية في الأغنام العواسية

مثنى فتحي عبدالله الجواري

مدرس

قسم الإنتاج الحيواني / كلية الزراعة والغابات / جامعة الموصل / العراق

المستخلص

اشتملت الدراسة على تحليل 155 سجلاً للنعاج العواسية إضافة إلى 199 سجلاً لمواليدها في قطيع أغنام كلية الزراعة والغابات/جامعة الموصل خلال الموسمين 2011−2012 . ظهر أن للسنة تأثير عالي المعنوية في كافة الصفات المدروسة باستثناء الزيادة الوزنية من الفطام إلى عمر 180 يوماً. وكان لعمر الأم تأثير معنوياً في إنتاج الحليب اليومي والوزن عند الميلاد و الفطام والزيادة الوزنية من الميلاد لغاية عمر الفطام. لوحظ تأثير معنوي لنوع الولادة في إنتاج الحليب اليومي والوزن عند الميلاد والفطام وعند عمر 180 يوماً. كما أثر الجنس معنوياً في وزن الفطام والزيادة الوزنية (ميلاد− فطام). لوحظ معامل ارتباط معنوي بين الفحوصات الدورية للحليب وإنتاج الحليب الكلي وتراوح ما بين 0.46 و0.99 كما تراوح معامل الارتباط بين الأوزان الشهرية للحملان والزيادات الوزنية ما بين −0.44 و 0.99. تراوحت قيم معامل التحديد(R^2) للمعادلات التنبؤية ما بين 0.81 و 0.99للتنبؤ بإنتاج الحليب الكلي في حين بلغت قيمة 0.97 R^2 للتنبؤ بوزن الحملان عند عمر 180 يوماً.

الكلمات المفتاحية: العوامل البيئية، نمو ،إنتاج حليب ،معادلات تنبؤية.

Received:11/9/2021, Accepted:19/12/2021

INTRODUCTION

Awassi sheep are characterized by multiple productive capacities and they have been adapted in the region for decades, which gave them high resistance against diseases and great tolerance to harsh environment and food conditions, and this helped their spread in some Arab, Asian, European and African countries, all the way to New Zealand and Australia (Kaskous (28). Awassi sheep constitute 60% of the Iraqi sheep, which are raised mainly for the production of meat, milk and wool (Al-Dabbagh and Abbo (9). The milk yield in sheep is one of the basic indicators of the lambs growth, especially during the period of suckling, as it has an important role in its subsequent productive performance (Al-khalisi (15). Many countries have adopted the method of periodic registration of milk tests over specific periods (every two weeks or every month) and adopted them as an indicator in determining the productive capacity of ewes and improving their productive performance, which facilitated the process of measuring milk production and reducing production costs (Al-Dabbagh and Ahmed (8), Oramari and Hermiz (36) and Abdul- Rahman et al.(3). Some studies explained the possibility of predicting TMY using a specific number of test-day milk yield (Maarof et al.(31) and Abdul- Rahman and Al-Juwari (2). Kominakis et al. (29) indicated that there is a positive correlation between test-day milk yield and TMY. Other studies observed a positive relationship between lamb weights at different ages (Baneh et al. (21) and Adhab and Ahmed (4). The variation in milk production and body weights is the result of the influence of several factors, including age of dam, type of birth, sex of lambs and year of birth, as well as other environmental effects that play an important role in influencing the economic characteristics of animals (Al-Samray (18) and Ayadi et al. (19) and Hermiz and Baper (28) and Jawasreh and Al-Kass (30). The objective of the current study was to investigate the effect of birth year, age of dam, type of birth, and sex of lamb on the characteristics of milk yield, some growth traits of lambs, and the relationship of these characteristics with each other. Different predictive equations to predict TMY and weights of lambs in Awassi sheep were also investigated.

MATERIALS AND METHODS

Animals: This study was conducted on a flock of Awassi sheep raised in the farm of the College of Agriculture and Forestry /University of Mosul, including the data of 155 Awassi sheep and 199 lambs born for the two productive seasons (2011-2012). The DMY was measured using periodic monthly tests that started after a month from the birth using hand-milking and continued till the drying period (100 g/day) lambs were separated from their dams at 7:00 p.m. and ewes were milked in the next morning at 7:00 a.m. that is 12 hours after separated, and by multiplying milk produced by 2 to obtained daily milk yield DMY (ICAR (27). lambs weight were recorded monthly from birth to 180 days of age. The age of dam, type of birth and sex of lamb were taken immediately after birth. The ewes were fed on natural pastures close to the field site for 4 hours daily, in addition to concentrate fodder at a rate of 500 gm/head/day at the morning and evening, with 500 gm/head/day of hay. Blocks of mineral salts and drinking water were introduced ad libitum during the study period. lambs were gradually allocated on concentrated diet at a rate of 250 gm/head/day during the second month of birth, to adapted them for concentrate diet to weaned them at 120 days of age.

Statistical analyses: The data were statistically analyzed using the General Linear Model (GLM) method within the ready-made statistical program SAS (39) to study the effect of year of birth, age of dam, type of birth and sex lamb on the characteristics of DMY, weights of lambs at birth and weaning (120 days) and at the age of (180 days) and weight gain(WG) (birth- weaning, weaning-180 and birth-180 days) according to the following equation:

$$Yijklm = \mu + Ri + Aj + Tk + Sl + E\,ijklm$$

Yijklm : The value of any observation in the experiment

μ : Overall mean

Ri : Effect of year, where i =1 and 2 for the years 2011 and 2012, respectively

Aj : Effect of age of dam, where $_j$ = (2, 3, 4, 5 and 6) years

Tk :Effect of type of birth, where $_k$ = 1 and 2 for single and twin births, respectively
Sl:Effect of sex of lamb, where $_l$ =1 and 2 for males and females, respectively
E ijklm = Random error associated with each observation
The same program was relied upon to find the correlation coefficient among the studied traits. Stepwise multiple regression analysis was also used in order to reach predictive equations to predict the TMY and weights of lambs at 180 days of age using periodic test-day for milk yield and monthly weights of lambs.

RESULTS AND DISCUSSION

Milk yield: The overall mean of DMY was 487.88 ± 14.25 g. Table (1), Merkhan et al. (36) obtained a lower value for milk yield and amounted to 359.09 ml/day, while Tayeb et al. (44) found a higher value reached 571 g/day in their study on the same breed. The year had a significant effect ($p \leq 0.01$) on the rate of DMY, ewes in the first year gave better yield compared to the second year, with a difference of 221.79 g. This may be attributed to the influence of managemental and nutritional factors, in addition to the environmental influences represented by climate and the amount of rain, and its implications on the availability of green fodder and the variation of pasture in quantity and quality. This result was in agreement with the findings of Al-Samarai and Al-Anbari (17), Al-Dabbagh and Abbo (9), who confirmed that milk yield is significantly affected by different years. The results also indicate that there are highly significant differences in milk yield between ewes of different ages, the lowest yield of two-year-old ewes was 360.29 g. It was significantly higher for ewes of 3, 4 and 5 years of age, reaching a maximum of 584.16g for ewes of 3 years of age Table (1). This may be due to the fact that the mammary gland of these ewes is more matured compared to young ewes, and no significant differences were observed among ewes within the age groups of 3-5 years. These ewes have reached their mature weight and were able to utilize feed nutrients in addition to the integration of the growth and development of the udder. This result was in line with what was found by Al-Juwari (12), Al-Azzawi and Mohammed (6) and in contrast with those reported by Abdul-Rahman et al. (3) and Al-Qasimi et al. (16) who did not find significant differences in milk yield according to the ages of the ewes. Type of birth was highly significant affect on the DMY, the ewes nursing twin lambs were significantly superior to their counterparts that suckled individual lambs by 102.77 g Table (1). This may be due to the repeated suckling leads to stimulating the secretion of the prolactin hormone, which increases milk production, and twin lambs empty a greater amount of milk from the udder during the suckling period, which leads to increased stimulation and activation of lactating cells to secrete a greater amount of milk compared to single-bred ewes (Al-Kass et al. (14). Similar results noticed by Abd Allah et al. (1) and Al-Dabbagh and Ahmed (8). Results showed non-significance effect of sex of lamb on the DMY Table (1), and this was completely agreed with the findings of Al-Dabbagh (7), Al-Azzawi and Mohammed (6) and Al-Juwari (13), who observed that the variation in DMY according to the sex of lamb was not significant.

Table 1. Least square means ± standard error of factors affecting daily milk yield (DMY) of Awassi ewes.

Factors affects	Number of animals	DMY (g).
Overall mean	**155**	**487.88±14.25**
Year		**
2011	**69**	**617.72±17.12 a**
2012	**86**	**395.93±22.13 b**
Age of dam		**
2	**14**	**360.29±39.54 c**
3	**26**	**584.16±28.56 a**
4	**48**	**551.19±22.45 ab**
5	**42**	**553.58±22.78 ab**
6	**25**	**484.89±29.84 b**
Type of birth		**
Single	**121**	**455.44±14.02 b**
Twin	**34**	**558.21±26.48 a**
Sex of lamb		**N.S**
Male	**83**	**499.06±18.12 a**
Female	**72**	**514.58±18.30 a**

: P> 0.01 . N.S. Non-Significant

Lambs weight: The overall mean weight of lambs at birth, weaning and at 180 days of age were 4.17 ± 0.06, 20.19 ± 0.44 and 24.41 ± 0.51 kg, respectively Table (2). The births of the second year was significantly superior those of the first year at birth Table (2). While lambs in the first year were significantly superior to their counterparts in the second year at weaning and at the age of 180 days Table (2). These differences may be attributed to the fluctuation in the amount of rain, which in turn affects the quality of pastures and the abundance of green fodder necessary for pregnant ewes. As well as the discrepancy in administrative conditions and health care among the years of birth (Mohammadi et al. (33). This result is in agreement with the findings of several studies including Aktas et al. (5), Kramarenko et al. (30) and Torres et al. (40). The results also showed that the age of dam had a significant effect on the weights of her lambs at birth and weaning Table (2). It was observed that the birth weights of lambs born from dams aged 2 and 3 years was 3.65±0.17 and 3.34±0.11 kg, respectively, and then gradually increased to reach its maximum at the age of 5 years (4.06±0.09 kg). The reason behind this difference may be attributed to the increase in the size of the uterus with advancing the age of the ewes, which provides a wider space for the growth of the fetus and its supply with larger quantities of nutrient during pregnancy, which is positively reflected the weights of their lambs at birth (Babar et al. (20). Also, young ewes are still in the growth stage. The feed intake by these dams goes as part of the dams growth herself (Bermejo et al. (22). Moreover it was found that lambs produced from dams at age of 2 years had the lowest weight at weaning (16.62±1.23 kg). This result agreed with what was obtained by Raoof (38), Kramarenko et al. (30) and Mohammed et al. (34) who observed a significant effect of dam age on lambs weights at birth and weaning. No significant differences were observed in the weights of lambs at the age of 180 days due to the ages of their dams. Growth of lambs before weaning is affected by dams' maternal ability, as well as the variation in the quantity of milk produced and its impact on the speed of growth of lambs and this effect disappears after weaning (Mavrogenis (32).

Table 2. Least square means ± standard error of factors affecting weights of lambs and total weights gains (kg).

	Factors affects	Number of animals	Birth weight	Weaning weight	Weight at 180-day	Gain from Birth-Weaning	Gain from Weaning-180day	Gain from Birth-180 day
Overall mean	199	4.17±0.06	20.19±0.44	24.41±0.51		16.05±0.46	4.00±0.14	20.25±0.54
Year		**	**	**		**	N.S	**
2011	132	3.26±0.08 b	23.51±0.53 a	27.93±0.66 a		20.25±0.53 a	4.00±0.24 a	24.70±0.66 a
2012	67	4.17±0.09 a	15.88±0.71 b	20.74±0.85 b		11.60±0.71 b	4.08±0.31 a	16.44±0.85 b
Age of dam		**	*	N.S		*	N.S	N.S
2	14	3.65±0.17 bc	16.62±1.23 b	22.72±1.47 a		12.80±1.22 b	4.40±0.54 a	18.78±1.46 a
3	32	3.34±0.11 c	20.14±0.96 a	24.11±1.30 a		16.71±0.95 a	3.57±0.47 a	20.86±1.29 a
4	73	3.67±0.09 b	19.86±0.66 a	23.91±0.77 a		16.11±0.66 a	3.75±0.28 a	20.19±0.77 a
5	54	4.06±0.09 a	20.35±0.65 a	24.58±0.82 a		16.23±0.65a	4.16±0.30 a	20.51±0.81 a
6	26	3.84±0.13 ab	21.48±1.04 a	26.36±1.31 a		17.76±1.03 a	4.32±0.48 a	22.49±1.30 a
Type of birth		**	*	*		N.S	N.S	N.S
Single	164	4.13±0.06 a	20.87±0.43 a	25.60±0.56 a		16.72±0.43 a	4.09±0.20 a	21.42±0.56 a
Twin	35	3.29±0.11 b	18.52±0.87 b	23.07±1.01 b		15.13±0.86 a	4.00±0.37 a	19.72±1.00 a
Sex of lamb		N.S	*	N.S		*	N.S	N.S
Male	100	3.77±0.07 a	20.48±0.58 a	24.89±0.66 a		16.65±0.57 a	4.00±0.24 a	21.10±0.66 a
Female	99	3.66±0.07 a	18.90±0.58 b	23.78±0.71 a		15.20±0.58 b	4.09±0.26 a	20.04±0.71 a

: P≤0.01 , *: P<0.05 , N.S Non-Significant.**

It is clear from Table (2) that there are significant differences in the weights of lambs resulting from the effect of birth type, single births was superior to their twins births at birth, weaning and at the age of 180 days. The superiority of single births over their counterparts twin births at birth may be due to the large space occupied by a single lamb from the dam's womb compared to the space occupied by twin lambs (Babar et al. (20). The superiority of individual lambs in weight at weaning reflects the competition between twin births over the amount of milk produced and the amount of care provided by dams compared to individual lambs (Al-Jalili et al. (11). Similar findings were found by other studies Elia (25) and Kramarenko et al (30). The results also indicated that sex had a significant effect on weaning weight, the weights of males and females reached 20.48±0.58 and 18.90±0.58 kg respectively Table (2). This difference may be attributed to the activity of males and their ability to withdraw larger amounts of milk from the dam's udder during the period of suckling than females which helped them to grow, which was reflected in the weaning weight (Al-Hadithi (10). These results are in agreement with the findings of Obeidat et al. (36), Al-Juwari (12) and Mohammed et al. (34) who observed that males superior females in weight at weaning.

Total weight gain (TWG): The overall mean of TWG from birth to weaning was 16.05 ± 0.46 kg, from weaning to 180 days of age was 4.00 ± 0.14 kg, and from birth to the age of 180 days was 20.25 ± 0.54 kg Table (2). The results of the study showed that the year of birth had a highly significant effect on weight gain of lambs from birth to weaning and from birth to 180 days of age Table (2). These differences may be attributed to the influence of environmental conditions and the variation in the level of management and nutrition represented in the quantity and quality of feed provided to animals (Torres et al. (40). These results agreed with the findings of Aktas et al. (5) and Mohammed et al. (34) who found a significant effect of year of birth in the weight gain of lambs from birth to weaning. It is evident that there is a significant effect of the age of the dam on the weight gain of lambs from birth to weaning, the lowest and highest increase reached 12.80±1.22 and 17.76±1.03 kg for births from dams aged 2 and 6 years, respectively, This is probably due to the fact that the 2-year-old ewes are in their first productive season, which is reflected the level of care, motherhood, and the amount of milk they provide to their lambs, compared to the mature ewes (Torres et al. (40). These results are in agreement with the findings Ceyhan et al. (23) and Elia (25) in terms of the significant effect of maternal age on weight gain from birth to weaning. The age of the dam did not have a significant effect on the weight gain of lambs at the rest of the ages, and this may be due to the low effect of the dam's age at this stage of the animal's life. The results of Table (2) show that there is non-significant effect of the type of birth on the weight gain of lambs at different ages. Similar results were obtained by Qureshi et al. (37) who confirmed that there was non-significant effect of birth type on these traits. The average weight gain of lambs from birth to weaning was 16.65±0.57 and 15.20±0.58 kg for males and females, respectively Table (2). This difference may return to the ability of males to grow and develop compared to females, due to the different functions of sex hormones, which play an important role in accelerating the growth of animals and depositing fat and muscle and bone tissues (Hassan (26) and Djaout et al. (24). This result was in agreement with the findings of several studies who recorded significant differences in favor of male lambs in weight gain up to the weaning age (Obeidat et al. (35), Torres et al. (40) and Al-Juwari(13).Non-significant differences were noticed between sexes with the advanced age stages.

Correlation coefficient between test-day milk yield and TMY

Table (3) showed that all correlation values between test-day milk yield and the average DMY and TMY appeared positive and significant except for the relationship between the first test (30 days) and the third test (120) days, which was non-significant, and the values ranged between 0.24 and 0.99. It was showed that the high values of the correlation between the TMY and the periodic test-day milk yield measured at days 30 and 150, being

0.84 and 0.90, respectively. This showed the possibility of investing these values in the formation of different predictive equations to predict TMY using a specific number of tests. These results agreed with the findings of Kominakis et al. (29), who obtained a positive and significant phenotypic correlation being 0.20 and 0.80 between the monthly periodic of milk yield and TMY.

Correlation coefficient between monthly weights and total weight gain TWG of lambs: The current results showed that all the values of the correlation coefficient between birth weight and the remaining traits appeared negative and significant and ranged namely -0.04 and -0.44 Table (4). All the values of the correlation between the monthly weights of lambs were positive and significant, and most of the correlation values appeared between weight gain (weaning -180 days) and other growth traits are non-significant. On the other hand, all the correlation values between the monthly periodic examinations as well as the weight gain (birth - weaning) and (birth-180 days) were positive and highly significant being 0.79 and 0.99 and this showed that most of the factors affecting the weight gain (birth - weaning) and birth - 180 days is the result of the accumulation of factors affecting the monthly weights of lambs. These results confirmed the possibility of using a specific number of monthly weights to predict the subsequent weights and the amount of weight gain of lambs at weaning and at 180 days of age. These results were in agreement with the findings of Adhab and Ahmed (4), who observed positive and highly significant correlations between the monthly weights of lambs up to the fourth month of life.

Table 3. Correlation coefficient between test-day milk and total milk of Awassi ewes.

Traits	60 day	90 day	120 day	150 day	Average (DMY)	(TMY)
30 day	0.33 **	0.56 **	0.12 N.S	0.55 **	0.87 **	0.84 **
60 day		0.42 **	0.49 **	0.69 **	0.61 **	0.59 **
90 day			0.24 *	0.54 **	0.61 **	0.68 **
120 day				0.65 **	0.49 **	0.46 **
150 day					0.90 **	0.90 **
Average (DMY)						0.99 **

:P≤0.01 , *: P<0.05 , N.S Non-Significant**

Predicting the TMY and weights of lambs at 180 days of age: In this study different predictive equations were reached which showed the possibility of adopting a specific number of tests to predict TMY Table (5). It is noted from equation (1) that the strongest relationships were with milk yield measured at the fifth test (150 days), where the value of R^2 reached 0.81 and this is due to the high correlation coefficient between the fifth test and TMY, which amounted to (0.90) Table (3). Adding other tests such as tests measured at days (30 and 150) or (30, 60 and 150), the value of R^2 for equations (2 and 3) was 0.98, and this shows the possibility of predicting TMY with high accuracy, but the use of four monthly tests and measured regularly on days (30, 60, 120, and 150) the estimation accuracy for R^2 was 0.99. Equation (2) is suitable to be a clear indicator for predicting TMY and reducing the effort that is exerted when the number of measurements increases more than that, especially in large herds (Abdul-Rahman and Al- Juwari (2). A number of lambs' monthly weights were also used to predict body weight at 180 days of age, and Table (6) shows that the strongest relationship was between the sixth test at 150 days of age and body weight at 180 days of age, which is represented by equation (1), as the value of R^2 reached It has to be 0.97, and adding other weights to this equation, such as using body weight at the age of 90 days, it was noted that the prediction accuracy was as it is 0.97 equation (2) and this shows the possibility of adopting equation (1) to predict the weights of lambs at the age of 180 days with high accuracy.

Table 4. Correlation coefficient between month weights and total gain of weights for lambs (kg) of Awassi ewes.

traits	Weight at 30 day	Weight at 60 day	Weight at 90 day	Weight at 120 day	Weight at 150 day	Weight at 180 day	Birth-weaning	Weaning-180 day	Birth- 180 day
Birth weight	-0.16 *	-0.19 **	-0.26 **	-0.29 **	-0.27 **	-0.30 **	-0.43 **	-0.04 N.S	-0.44 **
weight at 30 day		0.90 **	0.85 **	0.82 **	0.81 **	0.81 **	0.80 **	0.11 N.S	0.79 **
weight at 60 day			0.95 **	0.91 **	0.89 **	0.85 **	0.89 **	0.09 N.S	0.83 **
weight at 90 day				0.96 **	0.94 **	0.90 **	0.95 **	0.04 N.S	0.89 **
weight at 120 day					0.98 **	0.96 **	0.99 **	0.11 N.S	0.96 **
weight at 150 day						0.98 **	0.97 **	0.26 **	0.98 **
weight at 180 day							0.94 **	0.38 **	0.99 **
birth-weaning								0.10 N.S	0.97 **
weaning-180 day									0.35 **

** : P≤0.01 , * : P<0.05 , N.S Non-Significant

Draper and Smith (24) have previously stated that there are two contradictory limits in choosing the best predictive equation:1-In order for the equation to be more useful for prediction, it is necessary that the mathematical model of the multiple regression equation include as many values (X's) as possible of the traits on which the studied trait (Y) depends, which can be considered more indication and logical. 2- Because of the high cost of test to obtain data on the influential traits (X's), it is preferable that the multiple regression equation include the least number of them. To compare between the above two limits, it is possible to rely on a method called choosing the best predictive equation based on the value of the coefficient of determination (R^2), for which several values have been reached in this study.

Table 5. The prediction equations for total milk yield used (DMY) for Awassi ewes

Equations	% R^2
TMY = 54101+ 83.036 X5 ……. 1	**0.81
TMY = 30769 + 27.066 X1+ 57.883 X5 ……. 2	**0.98
TMY = 19889 + 28.735 X1+ 28.069 X2 + 48.653 X5 ……. 3	**0.98
TMY = 12415 + 31.753 X1+ 27.446 X2 + 20.182 X4 + 39.293 X5 …4	**0.99

TMY = Total milk yield X1,X2,X3,X4,X5= Test-day milk yield measured in day 30,60,90,120 and 150 after birth respectively. **: (P> 0.01).

Table 6. The prediction equations for weight at age 180 days from used some month weights for lambs

Equations	% R^2
WT180D = 1.01925 + 1.040 X6 ……. 1	**0.97
WT180D = 1.049 + (-0.156) X4 + 1.157 X6 ……. 2	0.97**

WT180D =weight at age 180 days. **: (P> 0.01) . X4,X6 = lamb weight at Age 90,150 days after birth respectively

CONCLUSION: The results showed that The best prediction equation of TMY and W180d were used DMY at (30,150) days and lamb weight at 150 day after lambing.

ACKNOWLEGEMENT: The author is very grateful to the College of Agriculture and Forestry at the University of Mosul for the facilities they provided, with helped to improve the quality of this work

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