Prediction of Lambs Growth From Milk Production and Its Composition in Awassi Sheep and Description of Growth Curve of Non-Linear Function

Ahmed Burair Abd-Alameer¹ and Nasr Noori Al-Anbari²

¹,²College of Agricultural Engineering Sciences, University of Baghdad, Iraq.

¹Email: ahmedburaer6@gmail.com

Abstract

This study was undertaken at the Ruminant's Research Station, Office of Agricultural Research / Ministry of Agriculture (20 km west of Baghdad). 102 ewes were used in this study from 1/1/2020- 1/10/2021 to study prediction of lambs growth from milk production and its composition in Awassi sheep and description of growth cure of non–linear function. Simple regression was used to examine relationship between growth traits such as gain, weaning weight, weight at 6 months of age and milk production and its composition. Regression of weaning weight was positive and highly significant (P≤ 0.01) with daily milk yield (DMY) and significant (P≤0.05) with dam's milk protein percentage (MPP). Analysis of regression also showed significant positive increasing (p≤ 0.05) in lambs' weight at six months of age with increasing of DMY and MPP, where coefficient of regression (CR) amount to 5.006 kg/kg and 0.663 kg/ % respectively. Results showed that CR of gain from birth to weaning was highly significant with dam's DMY, whereas was significant with MPP. Both DMY and MPP had significant and positive relationship with gain between birth weight and weight at six months, where amount of CR was 4.859 kg/kg and 0.619 kg/% with determination coefficient (R²) amount to 0.31 and 0.19 sequentially. Also, positive and significant regression was noticed for gain from birth to 6 months with MPP and milk Solids Not-Fat(SNF) percentages. Exponential functions also were used according to analysis of non-linear regression with calculated R² for growth in Awassi lambs. Results showed that relationship which derives from regression weight at 6 months on weight at weaning according to equation WT6^= a+b WWT2 is considered the best because increasing value of R² which was 0.69. we conclude, possibility prediction in lamb's growth from birth to six months depend on DMY and MPP, also dependence non-linear functions gave an important results to describe growth curves between weaning to 6 months.

Keywords: Awassi sheep, Prediction of growth, Milk production, Non-linear function.

1. Introduction

Awassi is the most common breed of sheep in the east of Mediterranean. It is the main sheep breed in Iraq and Syria, the only native breed in Israel, Jordan and Palestine and represent an important contribution to sheep breeds in Turkey, also Awassi possesses very desirable characteristics as far as endurance to nutritional fluctuation, resistance to disease and parasites, tolerance to extreme temperature[1]. Body weight and body measurements (heart girth and body length) are primarily and routinely used as conventional methods to collect relevant data of the herd [2]. These traits are controlled by polygene as random effect, including direct and maternal additive genetic effects, and are affected by feeding and management as well as environmental factors concerning farm conditions, which can affect both lamb and its dam. Knowledge of genetic variations and correlations among traits are required for both the design of effective sheep breeding programs and the accurate prediction of genetic progress [3 , 4]. Sheep farming, a large part of the economic income is based on meat production, consequently, it is observed that studies aimed to increase lambs productivity and growth performance in lambs, which are the main source of meat production, have intensified [5, 6]. Sheep husbandry in Iraq has been a historically important component of rural development and still fulfills a sustainable role in the livelihood of farmers. The country has a tradition of the consumption of sheep products, especially lamb and mutton [7, 8, 9]. Growth, defined as changes of body weight over time is an economically important trait in sheep that directly determines meat production. Knowing the growth traits of a sheep is important for number of reasons such as relating to breeding, feeding, healthcare and monitoring growth pattern. Changes in live weight or dimension for a period of time are explained by the growth curves; this is often sigmoid in shape and sigmoid curve has three phases, preparing, increasing and quietness, therefore different mathematica...
express the life time growth curve [10, 11]. The objective of this work was prediction of lambs growth from milk production and its composition in Awassi sheep and evaluate the growth curves in lambs from description of growth curve of non-linear function.

2. Materials and Methods

Experimental animals: This study was carried out in the Ruminant Research Station/ Office of Agricultural Researches from 1/10/2020- 1/1/2021. 102 Awassi ewes and it's offspring were used as experimental animals. Aim to study prediction of lambs growth from milk production and its composition in Awassi sheep and description of growth curve of non-linear function..

2.1 Traits and studying indexe

Common scale 30kg capacity was used to weigh lambs (birth weight, weaning weight and weight at 6 month of age). Milk production was calculated from date at birth to 90 days twice monthly. Daily milk production was calculated according to equation under below.

\[ \text{DMY} = \text{once daily milk} \times 2 \]

Ultrasound device was used to analyze milk composition (Fat\%, Lactose\%, Protein\% and Solids Not-Fat\%).

2.2 Statistical analysis

The data was analyzed by used Statistical Analysis System [12] to study regression of growth traits each one severally on milk production and it’s composition to calculate prediction function, also Exponential functions were used to describe growth curve and were used according to analysis of non-linear regression with calculated R^2. Equations under below to calculate regression:

- Weaning weight (WWT) on birth weight (BWT)
  \[ \text{WWT}^2 = a + b \text{BWT}^2 \]

- Weight at 6 months on birth weight (BWT)
  \[ \text{WT6}^2 = a + b \text{BWT}^2 \]

- Weight at 6 months on Weaning weight (WWT)
  \[ \text{WT6}^2 = a + b \text{WWT}^2 \]

3. Results

3.1 Prediction of weaning weight

Relationship between lambs’ growth and milk production and it’s composition: Weight at weaning results showed in (Table 1), there was positive and highly significant regression (P≤0.01) for weaning weight on milk production of their dams 6.187kg/kg, that means weaning weight increases 6.187kg when increase milk production 1kg daily with R^2 0.16 which explain daily milk production affect in weaning weight. Also regression was positive and significant (p≤0.05) with protein and SNF percentages 0.526 and 0.331 kg/\% sequentially, and R^2 was 0.23 and 0.17 respectively.

| Traits on Dams   | Regression coefficient-b | Prediction equation         | Level of Sig. | Determination coefficient-R^2 |
|------------------|--------------------------|-----------------------------|---------------|------------------------------|
| DMY (kg)         | 6.187                    | Y^2 = 14.67 +6.187X         | **            | 0.16                         |
| Fat (%)          | 0.0349                   | Y^2 = 18.32 +0.0349X        | NS            | 0.07                         |
| Lactose (%)      | -1.596                   | Y^2 = 25.53 -1.596X         | NS            | 0.07                         |
| Protein (%)      | 0.526                    | Y^2 = 21.35 +0.526X         | *             | 0.23                         |
| Solids Not-Fat   | 0.331                    | Y^2 = 22.01 +0.331          | *             | 0.17                         |

*(P≤0.05), **(P≤0.01), NS: Non-Significant.
3.2 Weight 6 months

The results of the current study showed there is a positive and moral decline (P≤0.05) the weight of the lambs at the age of 6 months on the daily milk production reached its coefficient 5.006 kg/kg (Table 2). This may be due to the proceedings of the primer between the weights with an early return with subsequent weights and including the weight of the flexible which is morally affected by the mother’s milk in these studies with weight 6 months. Table (2) shows that the wedding of weight loss 6 months on the protein rabbit in milk a positive and moral (P≤0.05) the total 0.663 kg/% and an identification that has reached an 0.21 whereas weight regression at 6 months of age on the proportion of fat lactose and nonfat solids was not significant in this study.

Table 2. Prediction of weight at 6 month (kg) in Awassi lambs from daily milk yield-DMY and milk components.

| Traits on Dams | Regression coefficient-b | Prediction equation | Level of Sig. | Determination coefficient-R² |
|----------------|--------------------------|---------------------|----------------|-----------------------------|
| DMY (kg)       | 5.006                    | Y= 26.50 +5.006X    | *              | 0.13                        |
| Fat (%)        | -0.012                   | Y= 29.67 -0.012X    | NS             | 0.06                        |
| Lactose (%)    | -2.78                    | Y= 42.02 -2.78X     | NS             | 0.08                        |
| Protein (%)    | 0.663                    | Y= 33.35 +0.663X    | *              | 0.21                        |
| Solids Not-Fat | 0.404                    | Y= 34.05 +0.404X    | NS             | 0.12                        |

* (P≤0.05), NS: Non-Significant.

3.3 Weight gain between birth and weaning

It is noteworthy of table (3) that the enhanced revolution of the biennium between birth and the beam in the banners on the production of daily milk for their mothers and possession of mothers (P≤0.01) he reached a transaction 6.041 kg/kg the early weight gain reflects the health and vitality of the lambs especially through their obtaining adequate quantities of milk and thus the rate of weight gain will achieve important weights later the decline in weight gain between birth and weaning on the percentage of protein in milk was positive and significant (P≤0.05) he reached a transaction 0.482 kg/% while the industrial increase was not reliable on the proportion of both fat lactose and autocators and non fatty (Table 3).

3.4 Weight gain between birth and the age of 6 months

Table (4) shows that there is a positive and moral record (P≥0.05) for weight gain between birth and age of 6 months on both the daily milk production and the percentage of protein in the milk and the regression coefficient was reached 4.859 kg/kg and 0.619 kg/% and an identifier 0.31 and 0.19 and the formula for the expectation equations for these two relationships is Y=21.96+4.859x and Y=28.47+0.619x respectively while the growth regression between these two ages was not significant for the proportions of the other studied milk components.

Table 3. Prediction of gain weight between birth to weaning (kg) in Awassi lambs from daily milk yield-DMY and milk components.

| Traits on Dams | Regression coefficient-b | Prediction equation | Level of Sig. | Determination coefficient-R² |
|----------------|--------------------------|---------------------|----------------|-----------------------------|
| DMY (kg)       | 6.041                    | Y= 10.14 +6.04X     | **             | 0.16                        |
| Fat (%)        | -0.0097                  | Y= 113.88 -0.0097X  | NS             | 0.04                        |
| Lactose (%)    | -1.142                   | Y= 18.89 -1.142X    | NS             | 0.09                        |
| Protein (%)    | 0.482                    | Y= 16.48 +0.482X    | *              | 0.18                        |
| Solids Not-Fat | 0.283                    | Y= 16.87 -0.283X    | NS             | 0.08                        |

* (P≤0.05), ** (P≤0.01), NS: Non-Significant.
Table 4. Prediction of gain weight between birth to 6 month of age (kg) in wassi lambs from daily milk yield-DMY and milk components.

| Traits on Dams | Regression coefficient-b | Prediction equation | Level of Sig. | Determination coefficient-R² |
|----------------|--------------------------|---------------------|---------------|-------------------------------|
| DMY (kg)       | 4.859                    | \(Y^*= 21.96 +4.859X\) | *             | 0.31                          |
| Fat (%)        | -0.0319                  | \(Y^*= 25.22 -0.0319X\) | NS            | 0.03                          |
| Lactose (%)    | -2.328                   | \(Y^*= 35.37 -2.328X\) | NS            | 0.02                          |
| Protein (%)    | 0.619                    | \(Y^*= 28.47 +0.619X\) | *             | 0.19                          |
| Solids Not-Fat | 0.356                    | \(Y^*= 28.90 +0.356X\) | NS            | 0.09                          |

* (P≤0.05), NS: Non-Significant.

3.5 Weight gain between weaning and 6 months of age

It is evident from table 5 that there is a positive and significant regression (P≤0.05) of the weight increase between birth and the age of six months in lambs on the percentage of protein and the percentage of non-fat solids in the milk and its coefficient 0.137 and 0.173kg%/ and determination factor 0.13 and 0.11 were respectively, while the regression of the weaning weight of the lambs was not significant on the daily milk production and on the ratios of fat and lactose table 5. Morgan and colleagues reported 2007 that milk production in ewes is one of the main factors in the growth of lambs after birth, especially from birth to weaning, because they depend on it during this critical stage. It was observed that the growth and survival of the lambs occurred during the first 3-4 weeks, and that the differences between the weights of the lambs began to appear at the age of 8 weeks and affect the subsequent weight, while it was noted that 70% of the variations in the weight increases of the lambs are between 3-12 weeks and depend mainly on the amount of milk consumed by the mothers.

Table 5. Prediction of gain weight between weaning to 6 month of age (kg) in Awassi lambs from daily milk yield-DMY and milk components.

| Traits on Dams | Regression coefficient-b | Prediction equation | Level of Sig. | Determination coefficient-R² |
|----------------|--------------------------|---------------------|---------------|-------------------------------|
| DMY (kg)       | 1.182                    | \(Y^*= 11.82 +1.182X\) | NS            | 0.07                          |
| Fat (%)        | -0.022                   | \(Y^*= 11.34 -0.022X\) | NS            | 0.08                          |
| Lactose (%)    | 1.186                    | \(Y^*= 16.48 +1.86X\) | NS            | 0.03                          |
| Protein (%)    | 0.137                    | \(Y^*= 11.98 +0.137X\) | *             | 0.13                          |
| Solids Not-Fat | 0.173                    | \(Y^*= 12.03 +0.173X\) | *             | 0.11                          |

* (P≤0.05), NS: Non-Significant.

3.6 Characterization of growth curves

Some exponential equations were applied according to simple non-linear regression analysis with calculating and recording the determination coefficient (R²) of growth in Awassi lambs. The regression of weaning weight was shown according to the formula \(WWT^=a+bBWT^2\) a positive parameter reached 0.141kg and determination coefficient 0.17. The regression of the weight at the age of 6 months is on the birth weight of the formula \(WT6^=a+bBWT\) it has reached its coefficient 0.196kg and the determination coefficient 0.22 while regression analysis of weight at 6 months of age on weight at weaning according to the formula \(WTT6^=a+bBWT\) was his treatment 0.249kg and with a determination factor 0.69. Through these results, it is clear that the relationship of weight regression at the age of 6 months is related to the weight at weaning according to the formula \(WTT6^=a+bBWT\).

It is considered the best according to the determination coefficient, and it is balanced with the other two equations, table 6. Jannoune and his colleagues Lupi and colleagues explained that growth curves are mathematical models and functions that determine the relationship between age and live weight and cover all or part of an animal's life. An increased in body size is faster than it is in the post-puberty stage and the rate of increase slows scale until it follows the asymptote of the curve or the horizontal line [6, 13].
Table 6. Description of growth curve of non-linear function in Awassi lambs.

| Traits                                | Regression coefficient-b | Prediction equation | Level of Sig. | Determination coefficient-R² |
|----------------------------------------|--------------------------|---------------------|---------------|------------------------------|
| weaning weight on birth weight         | 0.141                    | $Y^2 = 18.09 + 0.141$ BWT² | *             | 0.17                         |
| Weight at 6 month on birth weight     | 0.196                    | $Y^2 = 27.82 + 0.196$ BWT² | *             | 0.22                         |
| Weight at 6 month on weaning weight   | 0.249                    | $Y^2 = 22.93 + 0.249$ WWT² | **            | 0.69                         |

*(P<0.05), **(P<0.01).

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