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Describe the growth curve in Shami goats and provide a non-linear function based on the composition and production of milk to estimate the performance of the kids.

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ABSTRACT

An investigation into the coefficient of determination (R2) was carried out at the Ruminant Research Station of the Agricultural Research Department/Ministry of Agriculture in Abu Ghraib (20 km west of Baghdad), during the production season, on a sample of (50) kids and their mothers (does). The suitability of five asymptotic nonlinear models to describe milk production and composition of shami goats and kidding body weight growth from weaning to 6 months of age has been examined. The results of this study showed there was a positive and significant (P≤0.05) coefficient of regression (b)for kids weaning weight on daily milk production (kg) were (3.419) kg/kg, that is, the weaning weight increases (3.419) kg, and there was a positive and significant (P≤0.05) regression coefficient (b)for kids age of 6 months (kg) on daily milk production (kg) were (3.763) kg/kg. The coefficient of regression (b) of weight increase during weaning and age six months (kg) was found to be significant and positive (P≤0.05) for children in daily production of milk (kg). Protein content and non-fat solids percentage reached 2.264,0.216, and 0.238 and the determination coefficient (R2) 0.13,0.22 and 0.09, respectively. the coefficient of regression of the 6th month's weight on birth weight according to the formula Y^= 12.95+0.162 BWT2 positive and ranged from 0.176 with a determination coefficient was (0.41). The expected birth weights, weaning weight, and 6th months approach to real weights of shami goat kids by applying Logistic Equation and Brody Equation.

1. Introduction

Determining the body weight of lambs throughout their life span is made easier by modeling the growth curve of sheep, which offers the chance to mathematically describe growth [9]. Usually used for both meat and milk, the Shami goat, sometimes called the Damascus goat, is milked mostly after weaning and during the nursing phase because a significant amount of milk stays in the udder without being consumed by the nursing kids [14]. Establishing the mathematical behavior of the Segureña sheep breed's body growth across its lifespan may be possible with non-linear models. Comparatively speaking, these models use less computing power and have a faster convergence rate. Furthermore, for genetic evaluation programmers with huge data sets, non-linear models are more beneficial [12]. The amount that any dependent variable changes when the independent variable changes by one unit is known as the regression coefficient. This definition makes it useful for figuring out the actual relationship between two variables so that it can be expressed in an equation with various functions (simple, multi-linear, or non-linear) while adhering to the values of the coefficient of determination (R^2). Nonlinear functions are applied in accordance with various models for prediction, application in selection processes, and suitable decision-making. Using an equation that makes it possible to predict birth weight in later life stages because this model makes data interpretation the simplest, followed by the option to plan and choose animals by analyzing their growth curves, which aids in identifying the ideal time to sell males, and several studies that used various models to estimate body weight [11 and13]. A common estimating technique used by practitioners to fit different growth curves is nonlinear regression [8].

The purpose of the current study was to forecast the postpartum development of the kids of shami goats by analyzing the composition and production of milk, and to identify the postpartum growth curve with nonlinear functions in the kids of shami goats using a variety of formulae.

2. Material and Methods:

The study was carried out at the Ruminant Research Station/Department of Agricultural Research /Ministry of Agriculture. The Research Station is at Abu-Ghraib (20 km west of Baghdad. Fifty animals were used in the study Kids and their mothers. The goat records were collected between 2022 and 2023 with measurements taken at birth weight, weaning weight, and 6th months of age. Goats are raised in semi-open pens (35% covered and 65% open) dedicated to housing goats. The area of the pen is (75 m x 25 m) and there are manholes of 25 m in length and feeders of 50 m in length for concentrated feeding. The birthing goats are placed in special pens for births, the area of which is (75 m x 25 m), containing inside it a birthing room distributed around its perimeter with 28 birthing boxes of an area of (2 x 2 m), as the newborns are weighed and numbered 24 hours after their birth. Colostrum is provided to the kid from the day of birth and is continued until the kid is weaned (120). days. Programmed that include this are used to manage the herd. Feeding,

health and veterinary care, as well as preparations for the sheening season and during the delivery process and pregnancy. Goats receive food based on many factors such as season, availability of fodder, and production status. Alfalfa, which stands for either coarse or green fodder, is supplied. Concentrated fodder is also provided, and this quantity increases according to the stages of the reproductive season and pregnancy and its duration for females and males, coarse fodder is provided either in the form of hay or green fodder and is free for adult animals with grazing.

2.1Measurement of daily milk production.

In the first three months, a cylinder was used twice a month for measuring each certified goat's daily milk production (three months with six samples), of the reproductive season, when kids are milked first thing in the morning after being separated from their mothers throughout the evening.

2.2. Analysis of milk components

For every goat, a milk component analysis was performed twice over the allotted three months. in measuring milk production, as after the milk had been weighed and well mixed, it was placed in clean, 50 ml plastic containers with tight lids which were closed after the sample was collected. and refrigerated to a laboratory affiliated to a laboratory dairy Abu Ghraib. To evaluate samples in the milk component analyzer which is called Julie-Z7 Figure (1). The device has a digital screen showing the components of the milk. Each form is emptied into a special container for the device.

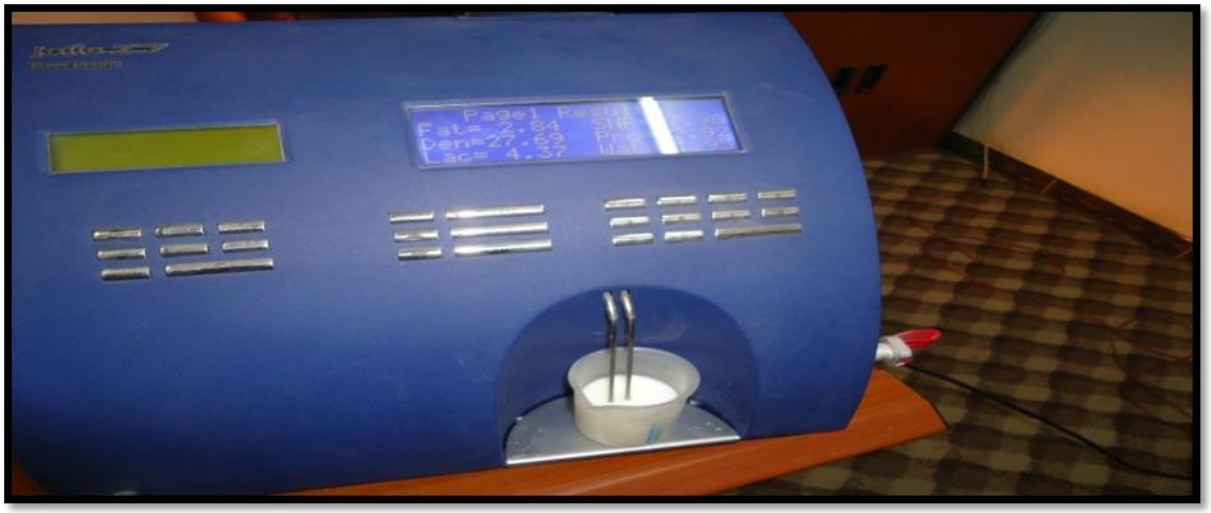

FIGURE 1. A device for measuring the components of milk.

The milk flows into the device through two tubes that come from the center of the container. The milk exits the device on the other side into a different container in the amounts that each of the components of milk indicate. On the screen and recorded, the measured components included the percentages of non-fat solids, fat, protein, and lactose.

2.3 Analytical statistics

The Statistical Analysis System programmed was followed while doing the statistical assessment of the data.[8] to calculate the regression of every growth, include on the components that make up milk production. To find the growth curves, prediction equation calculates using exponential equations was used. Using the following non-linear models, growth curves have been calculated [5]. Weaning weight (WWT) against birth weight (BWT) regression.

WWT^=a +bBWT2

Regression of weight at 6 months (WT6) on birth weight (BWT).

WT6^ =a +bBWT^2

Regression of weight at 6 months of age (WT6) on weight at weaning (WWT).

WT6^ =a +bWWT^2

Regression of weight at weaning (WWT) on does weight at birth (DWT).

WWT6^ =a +bDWT^2

Regression of weight at 6 months (WT6) on does birth weight (DWT).

WT6^ =a +bDWT^2.

3-Results and Discussion.

The regression coefficient is performed to find out the amount by which a change in x(the independent variable) should be multiplied to find out the average change in y(the dependent variable).Accordingly, regression coefficient is performed to estimate the exact relationship between variables, Establishing such The regression coefficient is a statistical tool that is used to measure the amount by which a change in x(the independent variable must be multiplied to find out the average relationship with different functions(simple linear-multiple -linear - and non-linear)would be an equivalent form with the coefficient of determination(R2).(for the purpose of investigation prediction and application in election programs and appropriate decision making and apply nonlinear functions are based on several important models Brody, von Bertalanffy, Logistic, and Gompertz.The main objectives are to characterization of growth curves at different ages of kids. The application of the pattern of evolution through non-linear regression models on growth in

different animal goats and sheep [7,15,16 and19].

3.1. Predicting weaning weight (kg).

The findings of our study are presented in table (1). It's evident that a highly significant positive regression coefficient ($p \leq 0.01$) for kids weaning weight on daily milk yield was observed (3.419 kg /kg). This indicates that for each unit increase in milk yield (1 kg of the independent variable), an increase of 3.419 kg in weaning weight (the dependent variable) would be resulted. The determination coefficient (R^2) for this relationship (0.24), which means that the daily milk production for goats can explain(0.24) the kids' weight at weaning, this may be due to the weight at this age reflects positively on later weights, the kids, and they attributed the reason for this to the fact that the goats that are larger in weight contain an appropriate amount of fat which provides the fetus with energy during pregnancy, and these ewes produce a larger amount of energy milk reflects positively on the weights of her newborns at different ages after birth, including weight at weaning, while the regression of the weight of the weaning was not significant for the percentage of fat. [3] in the study on Cyprus, local goats and their cross was found the regression coefficient(b) of %fat on goat weight at birth was highly significant ($p < 0.01$) and non- significant of %protein and %lactose. the regression coefficient(b) for the % fat, % protein, and % lactose on daily milk production were 0.406, - 0.051 and 0.016 percentage/kg respectively, meaning that an increase of 1 kg of daily milk production will lead to an increase in the percentage of fat and the percentage of lactose amounted to% 0.406 and% 0.016, while an increase of 1 kg of daily milk results in a decrease in protein percentage of - 0.051 percentage. The best prediction equations have been determined of the daily milk production through and births weights during lactation, as well as weaning weight [1]. [2] on Awassi, and Karakul sheep obtained regression coefficient (b) was positive and highly significant ranged (6.041).

TABLE 1. Predicting weaning weight (kg) for the Shami goats' kiddies according to the daily milk production and the main milk components

Traits recorded on the mothers	Significant level	Prediction equation	Regression coefficient (b)	Determination coefficient (R2)
Daily milk production (kg)	**	Y^= 9.96 +3.419X	3.419	0.24
(%) Fat percentage	NS	Y^= 11.95+0.0203X	0.0203	0.08
(%) Lactose content	**	Y^= 20.84 -1.265X	1.265-	0.16
(%) Protein content	*	Y^= 16.42 +0.374X	0.374	0.14
Non-fat solids percentage	*	Y^= 19.86 +0.277	0.277	0.17
Non-Significant :N.S ،(P≤0.01) **،(P≤0.05) *				

3.2. Weight at the age of 6 months (kg).

According to Table 2's findings, children ages 6 months and older had a significant and positive (p≤0.01) coefficient of regression (b) on their daily milk output (kg), which was (3.763) kg/kg. This may be due to the positive relationship between weight at an early age with later weights, including weaning weight, which was significantly affected by milk. production in this study with weight at the age of 6 months. The result of this study showed that there was a positive and significant (P≤0.05) regression coefficient (b) for kids aged 6 months (kg) on the protein content of daily milk production reached (0.702), and determination coefficient (R^2) was (0.28). While there was no significant regression weight at the age of 6 months for Lactose content and non-fat solids percentage, for the non-fat solids % and lactose content, there was not an apparent regression weight at six months of age. despite regression coefficient (b) for kids aged 6 months (kg) on fat percentage were negative and significant (*P*≤0.05) estimated (-0.0287). [14] on Awassi, and Karakul sheep obtained regression coefficient (b) was positive and significant ranged (4.859) [6,10 and 17] agreed with significant effect of milk production depending on the age of the goats, increases with age.

3.3 Weight increase from six months until weaning

The results of this study show in (table3). The weight increase (kg) of kids in daily milk production between weaning and six months of age was positively and significantly correlated (p≤0.01) with the regression coefficient (b). protein content and non-fat solids

TABLE 2. Prediction of weight at the age of 6 months (kg) in the Shami goats' kiddies according to daily milk production and the main milk components.

Traits recorded on the mothers	Significant level	Prediction equation	Regression coefficient (b)	Determination coefficient (R2)
Daily milk production (kg)	*	Y^= 21.69+3.763X	3.763	0.15
(%) Fat percentage	*	Y^= 24.59 -0.0287X	0.0287-	0.14
(%) Lactose content	NS	Y^= 33.79 -1.329X	1.329-	0.07
(%) Protein content	*	Y^= 27.78 +0.702X	0.702	0.28
Non-fat solids percentage	NS	Y^= 30.52 +0.306X	0.306	0.11
Non-Significant :N.S ،(P≤0.01) **،(P≤0.05) *				

TABLE 3. Weight growth in kg that Shami goat kids would experience between weaning and six months of age according to daily milk supply and the main components of milk.

Traits recorded on the mothers	Significant level	Prediction equation	Regression coefficient (b)	Determination coefficient (R2)
Daily milk production (kg)	*	Y^= 14.62 +2.264X	2.264	0.13
(%) Fat percentage	NS	Y^= 9.78 -0.0183X	0.0183-	0.07
(%) Lactose content	NS	Y^= 11.63 +1.073X	1.073	0.07
(%) Protein content	*	Y^= 10.805 +0.216X	0.216	0.22
Non-fat solids percentage	*	Y^= 13.14 +0.238X	0.238	0.09
* (P<0.05), ** (P<0.01), and N.S. are not significant.				

percentage were reached 2.264,0.216 and0.238 and determination coefficient (R^2) 0.13,0.22 and 0.09 respectively. This reflects the role of protein content in milk production in young kids' growth at different ages after birth, although there was no significant regression for fat percentage and lactose.

3.4. Growth curves of shami goats

Exponential equations were adopted for the simple nonlinear regression analyses. The coefficient of determination (R^2) for Shami goat kids was presented in table (4), whereas the regression coefficient of weaning weight on birth weight was calculated through using the formula Y^= 12.95+0.162 BWT^2 positive and (0.162) with determination coefficient were0.24, as for the regression coefficient of 6^{th} months weight on birth weight according to the formula Y^= 12.95+0.162 BWT^2 positive and ranged (0.176) with determination coefficient were 0.41, and the regression coefficient of 6^{th} months weight on weaning weight according to the formula Y^=17.42 +0.298 WWT^2positive and(0.298) with determination coefficient were (0.62). From these results, it becomes clear the relationship represented by

TABLE 4. Characterization of the growth curves of Shami goats' kiddies with exponential equations.

Regression traits (kg)	Significant level	Prediction equation	Regression coefficient (b)	Determination coefficient R2
Weaning weight on birth weight	*	Y^= 12.95+0.162 BWT2	0.162	0.24
6th months weight on birth weight	*	Y^= 21.76 +0.176 BWT2	0.176	0.41
6th months weight on weaning weight	**	Y^=17.42 +0.298 WWT2	0.298	0.62
*(P≤0.05) **,(P≤0.01).				

the regression coefficient of the 6th month's weight on weaning weight is the best according to the formula Y^=17.42 +0.298 WWT2 according to the determination coefficient arbitrage with two equations (table4). Evaluation of the 6th month's weight is appropriate because it is considered weight marketing for kids and has a relationship with anther weights in shami goat kids.

3.5. Mean real and expected weights

The results showed in table (5) the expected birth weights, weaning weight and 6th months approach to real weights of shami goat kids by applied Logistic Equation and Brody Equation,

determination coefficient (R^2) for birth weights, weaning weight and 6th reached0.64 ,0.59 and 0.75 when applied Logistic Equation and reached 0.77,0.68 and0.79 when applied Brody Equation respectively. The Brody model has been used to find out the live weight of Kurdi lambs at late ages through utilizing early body weight data. This could be helpful in farm planning procedure management practices such as feeding and drug administration [4 and 15].

TABLE 5. Mean actual and predicted weights for goat Shami kids from birth to six months of age.

Traits	Real weight±s. e	expected weights±s. e	
		Logistic Equation	Brody Equation
Birth weight	0.13± 2.98	0.11± 2.74	0.10± 2.79
R2	-	0.64	0.77
Weaning weight	0.29± 13.44	0.17± 13.76	0.24± 13.61
R2	-	0.59	0.68
6th months weight	0.42± 20.82	0.51± 22.31	0.35± 22.57
R2	-	0.75	0.79

4.Conclusions

The expected birth weights, weaning weight, and 6th months approach to real weights of shami goat kids by applying Logistic Equation and Brody Equation. Evaluation of the 6th month's weight is appropriate because it is considered weight marketing for kids and has a relationship with anther weights in shami goat kids.

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وصف منحنى النمو ذو الدالة غير الخطية والتنبؤ بأداء الجداي من إنتاج الحليب وتركيبه في الماعز الشامي

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الملخص

تم إجراء دراسة معامل التحديد (R2) في محطة بحوث المجترات التابعة لدائرة البحوث الزراعية/وزارة الزراعة في أبو غريب (20 كم غرب بغداد) خلال الموسم الإنتاجي على عينة مكونة من (50) جدي مع أمهاتها . تم فحص مدى ملائمة خمسة نماذج غير خطية مقاربة لوصف إنتاج الحليب وتركيبه في الماعز الشامي ونمو وزن الجسم من الفطام إلى عمر 6 أشهر. أظهرت نتائج هذه الدراسة وجود معامل انحدار موجب ومعنوي (P<0.05) ، لوزن الفطام الجداء على إنتاج الحليب اليومي (كغم) بلغ معامله (3.419) كغم/كغم، أي أن وزن الفطام يزداد (3.419) كغم، وكان هناك معامل انحدار موجب ومعنوي (P<0.05) للجداء بعمر 6 أشهر (كغم) على إنتاج الحليب اليومي (كغم) بلغ (3.763) كغم/كغم. كان هناك معامل انحدار موجب ومعنوي (P<0.05) (ب) للزيادة الوزنية بين الفطام وعمر 6 أشهر (كغم) للجداء في إنتاج الحليب اليومي (كغم). بلغت نسبة محتوى البروتين والمواد الصلبة غير الدهنية 0.216،2.264، 0.238 ومعامل التحديد (0.13 (R2،0.22 و 0.09 على التوالي. أما معامل الانحدار لوزن الجداء بعمر ستة أشهرعلى وزن الولادة حسب الصيغة BWT2 0.162+12.95=Y^ موجب و كانت 0.176 و معامل التحديد (0.41). أوزان الولادة المتوقعة ووزن الفطام ومقاربة الشهر السادس للأوزان الحقيقية لصغار الماعز الشامي من خلال تطبيق المعادلة اللوجستية ومعادلة برودي.

الكلمات المفتاحية: الماعز الشامي، الحليب، معامل الانحدار، R2.