Research Article

Predicting Milk Production and Some of its Components Through Some Biochemical Blood Traits in Three Breeds of Goats Raised in Central Iraq

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Abstract | Goats play a major role in Iraqi agriculture due to their adaptability to harsh environments and their ability to thrive on poor nutrition. Consequently, interest in goat farming is increasing, particularly because various breeds can be genetically modified. Thus, the objective was to determine the effect of breed on various biochemical blood traits, milk production characteristics, and the chemical composition of milk, including fat, protein, and lactose. Additionally, the study aimed to analyze the correlation and slope between milk traits and some of their components concerning the blood traits examined. The study was conducted in an agricultural field in the Al-Qasim district of Babil Governorate, focusing on a group of female goats divided into three categories: 8 local goats, 8 Shami goats, and 8 crossbred goats (local x Shami). The results indicated no significant differences among the genetic groups of goats concerning the biochemical blood traits of urea, cholesterol, and total protein. However, the genetic groups significantly influenced daily, monthly, and total milk production traits ($P \leq 0.05$). The crossbred female goats outperformed the local and Shami goats, while the Shami goats surpassed the local goats in all studied traits. The crossed group significantly outperformed the other genetic groups ($P \leq 0.05$) in terms of fat, protein, and lactose percentages. The results also indicated a significant positive correlation and regression ($P \leq 0.05$) between monthly milk production and blood cholesterol levels. Additionally, the fat percentage in milk showed a significant correlation and regression ($P \leq 0.05$) with the examined blood traits: urea, cholesterol, and total protein. Similarly, the percentage of milk protein demonstrated a significant positive correlation and regression ($P \leq 0.05$) with total blood protein. According to this study, crossbred goats produce significantly more milk on a total, monthly, and daily basis compared to black goats and Shami goats.

Keywords | Blood, Cholesterol, Goats, Lipid, Milk fat, Milk protein

Received | May 26, 2025; **Accepted** | July 26, 2025; **Published** | September 01, 2025
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Citation | Al-Qasimi RHH, Abbas SM, Mohammad WA, Jasim DA, Al-Khafaji LSK, Al-Thuwaini TM (2025). Predicting milk production and some of its components through some biochemical blood traits in three breeds of goats raised in central Iraq. J. Anim. Health Prod. 13(3): 791-795.
DOI | https://dx.doi.org/10.17582/journal.jahp/2025/13.3.791.795
ISSN (Online) | 2308-2801

INTRODUCTION

Goats are domesticated approximately 10,000 years ago in South and West Asia, and they are widely distributed around the globe, with 71% of the population located in developing countries (Hoffmann, 2012). In many regions of Asia and Africa, goats serve as a significant source of milk, meat, and fiber (Salim and Hariyono, 2025). In Iraq, the importance of goats is largely due to their ability to adapt to harsh environmental conditions and limited nutritional resources. Consequently, there has been a growing interest in goat breeding, particularly since

certain breeds show considerable potential for genetic improvement (Al-Hamdani, 2000; Al-Janabi *et al*., 2023). Despite ongoing selection processes—both natural and artificial—through breeding and enhancement programs, further efforts are needed to improve their genetic traits and enhance reproductive and productive efficiency. Several studies have been conducted to enhance milk production in local goat populations by crossbreeding them with international breeds, such as Cypriot and Afghan goats (Ali and Daker, 2016; Al-Janabi *et al*., 2023; Ali *et al*., 2024). In a study conducted by Al-Azzawi *et al*. (2015) on local and Cypriot goat breeds and their crossbreeding, significant differences have been observed in milk production, the duration of the milking season, and certain chemical components of the milk. Genetic variation among individuals and between different breeds can be utilized by selecting distinct individuals and crossing them with other unique individuals to achieve specific objectives. Consequently, the current study aimed to investigate the impact of breed on various biochemical blood characteristics, including urea, cholesterol, and total protein levels. Some productive traits of milk, including daily, monthly, and total milk production, as well as certain chemical components such as fat, protein, and lactose, were analyzed. Additionally, the relationship between these milk traits and specific blood traits was examined.

MATERIALS AND METHODS

Animals and Laboratory Analysis

An investigation of goats in the Al-Qasim District was conducted during the 2023/2024 period, following international recommendations (Federation of Animal Science Societies, 2010). Guidelines for the care of animals were approved by the Ethics Committee of the Department of Animal Production, College of Agriculture, Al-Qasim Green University, Iraq (Agri No. 022,9,24).The study was conducted in an agricultural field in the Al-Qasim District of Babylon Governorate/ Iraq (32°18′5″N 44°41′21″E), involving a group of female goats primiparous divided into three categories: 8 local goats, 8 Shami goats, and 8 crossbred goats (local x Shami).The goats ranged in age from 2 to 3 years and weighed between 40 and 45 kg. They were born simultaneously, and all the kids were single births. The animals were fed concentrated feed at a rate of 0.500 to 0.800 kg per day per animal, depending on their production status. Additionally, green feed, represented by hay, was provided based on field availability, with the animals grazing once daily. Veterinary care for goats includes vaccinating them against foot-and-mouth disease, administering ivermectin to protect them from internal and external parasites, and providing periodic treatments (Al Qasimi *et al*., 2019). Three milliliters of blood from the jugular vein were drawn using medical syringes at 6:00 a.m., before feeding the animals (Hussein *et al*., 2024). The blood was placed in glass tubes that were free of anticoagulants and left at room temperature, tilted, for two hours. The resulting clot was separated using a centrifuge for 15 minutes at 2,000 x g, and the serum was stored at -20˚C (Merzah *et al*., 2024). Subsequently, the serum was sent to the Babylon Central Laboratory for Veterinary Services in Hilla city for laboratory testing. The serum was analyzed using catalyst one veterinary chemistry analyzer manufactured by the American company IDEXX (Westbrook, Maine, USA). The test was conducted by placing the tube containing the serum in a designated slot within the device and inserting test strips for the components to be analyzed. Following this, the relevant information regarding the serum was entered, and the results were displayed after five minutes on a dedicated computer integrated into the device. The parameters tested by this device include urea, cholesterol, and total protein.

The daily milk production was assessed on the fourth day after birth by separating the kids from their mothers in the evening. The following morning, the kids were weighed before lactation, and a 100 ml milk sample was collected in specialized tubes for chemical analysis (Ali and Daker, 2016). Afterward, the newborns were allowed to nurse from their mothers, and they were weighed again to determine the amount of milk consumed by calculating the difference between the two weights. Milk samples were collected from each animal twice daily, once in the morning and once in the afternoon to estimate the daily milk production (ICAR, 1995). This process was repeated every ten days until weaning at three months of age. Milk samples were analyzed to measure the proportions of their chemical components using the Eko-milk Analyzer at the Public Health Laboratory of the College of Veterinary Medicine at Al-Qasim Green University, where the percentages of fat, protein, and lactose were determined.

Statistical Analysis

The Statistical Analysis System (SAS) software (2018) was utilized to analyze the data and examine the effects of different breeds on the studied traits, employing a completely randomized design (CRD) and the mathematical model outlined below. Significant differences between means were assessed using the least significant difference (LSD) test. Additionally, the correlation coefficient (r) and regression coefficient (b) were estimated to evaluate the relationships between blood traits and milk production and its components.

Mathematical Model of the Experiment

$$Yij = \mu + Bi + eij$$

Where;
Yij: The jth observation value for breed i
μ: The overall mean for the trait under study

Bi: The effect of breed i (three breeds A, B, and C)
eij: The random error is normally distributed with a mean of zero and a variance of σ2e.

RESULTS AND DISCUSSION

Effect of Breed on Some Biochemical Blood Traits in Goats

The current study did not find a significant effect among the goat breeds examined regarding biochemical blood traits such as urea, cholesterol, and total protein (Table 1). The absence of significant differences between the breeds in terms of biochemical blood traits may be attributed to their consumption of uniform diets and their upbringing under similar environmental conditions. These results are consistent with those reported by Al-Qasimi and Al-Lami (2016) in their study of the local black goat breed, as well as by Mohammed *et al.* (2016) in their examination of the Kuwaiti Aradi, exotic Damascus, and Barbari goat breeds. However, several other factors may also influence it, including age, sex, parity, and environment.

Table 1: Effect of breed on urea, cholesterol, and total protein levels.

Breed	Mean ± SE		
	Urea (dI/mg)	Cholesterol (dI/mg)	Total protein (dI/g)
Al-Shami	27.13 ± 0.62	8.39 ± 0.51	6.91 ± 0.54
Local black	26.67 ± 0.34	7.70 ± 0.49	7.49 ± 0.32
Crossbreed	27.87 ± 0.71	8.32 ± 0.48	7.64 ± 0.37
Value L. S. D	1.73 NS	1.49NS	1.27 NS

NS: Non-Significant.

Table 2: Effect of breed on daily, monthly, and total milk production rate.

Breed	Mean ± SE		
	Daily milk(kg)	Monthly milk(kg)	Total milk(kg)
Al-Shami	0.83 ^{b} ± 0.04	21.68 ^{b} ± 1.12	70.25 ^{b} ± 3.28
Local black	0.59 ^{c} ± 0.02	16.61 ^{c} ± 0.33	55.71 ^{c} ± 1.79
Crossbreed	0.98 ^{a} ± 0.06	26.18 ^{a} ± 1.27	80.94 ^{a} ± 3.45
Value L.S.D	0.12 *	3.01 *	8.86 *

LSM ±SE, Least square means ± standard error. Means with different letters within a column are significantly different from each other, * (P≤0.05).

The Effect of Breed on Daily, Monthly, and Total Milk Production in Goats

Table 2 demonstrates that breed significantly affects (P ≤ 0.05) daily, monthly, and total milk production rates. The Crossbreed goats outperformed both the Shami and local black goat groups. Additionally, the Shami goat breed surpassed the local black goat breed in all measured traits. The average daily milk production was 0.98 kg for Crossbreed goats, 0.83 kg for Shami goats, and 0.59 kg for local black goats. The average monthly milk production was 26.18 kg, 21.68 kg, and 16.61 kg, respectively. The average total milk production was 80.94 kg for Crossbreed goats, 70.25 kg for Shami goats, and 55.71 kg for local black goats. The superiority of the Crossbreed group may be attributed to its high milk production traits inherited from the Shami goat, combined with the environmental adaptability traits of the local goat. This finding contradicts the results of Ali and Daker (2016), who studied three goat breeds—the local black, Cypriot, and Afghan—and found that the local black goat breed excelled in daily, monthly, and total milk production. Similarly, the research conducted by Jassim and Khalil (2018) indicated that the local black goat group outperformed the Shami goat breed in total milk production. However, Hermiz (2001) reported no significant differences in milk production traits between the local and Shami goat groups. The discrepancies among these studies may be attributed to the varying environmental conditions in which the animals are raised or the different locations where the studies are conducted.

The Effect of Breed on the Proportions of the Main Milk Components in Goats

Table 3 demonstrates that breed had a significant effect (P ≤ 0.05) on the proportions of fat, protein, and lactose in milk. The group of goats crossed between Shami and local black goats outperformed both the Shami and local black goats in terms of milk fat percentage, recording averages of 4.97%, 4.18%, and 3.63%, respectively. Regarding the percentages of protein and lactose, the Shami goat breed significantly surpassed the local black goat breed (P ≤ 0.05), with averages of 4.09% and 3.80% for protein, and 5.35% and 4.58% for lactose. This finding contrasts with the results of Jassim and Khalil (2018), who reported that the local black goat breed outperformed the Shami goat breed in terms of fat and protein content in milk. However, Al-Azzawi *et al.* (2015) found no significant differences in milk fat, protein, and lactose traits between the local and Shami goat breeds.

Table 3: Effect of breed on the proportions of the main milk components.

Breed	Mean ± SE		
	Fat (%)	Protein (%)	Lactose (%)
Al-Shami	4.18 ^{b} ± 0.21	4.09 ^{a} ± 0.10	5.35 ^{a} ± 0.17
Local black	3.63 ^{b} ± 0.27	3.80 ^{b} ± 0.08	4.58 ^{b} ± 0.22
Crossbreed	4.97 ^{a} ± 0.5	3.89 ^{ab} ± 0.03	4.94 ^{ab} ± 0.08
Value L. S. D	0.64 *	0.23 *	0.50 *

LSM ±SE, Least square means ± standard error. Means with different letters within a column are significantly different from each other, * (P≤0.05).

Table 4: Estimate of the correlation coefficient between blood traits and milk production and components studied.

Traits	Correlation coefficient- r		
	Urea	Cholesterol	total protein
Daily milk	0.04	0.20	0.008
Monthly milk	0.05	*0.26	- 0.02
Total milk	0.04	0.08	- 0.02
fat	*0.27	*0.30	*0.36
protein	- 0.02	0.02	* 0.38
lactose	0.06	0.09	0.09

* (P≤0.05).

Table 5: Estimate of the regression coefficient of milk production and its component ratios on the studied blood traits.

Traits	Regression coefficient –b		
	Urea	Cholesterol	total protein
Daily milk	0.005	0.03	0.0001
Monthly milk	0.15	0.87 *	-0.09
Total milk	0.35	0.84	- 0.22
Fat	0.14*	0.18*	0.25 *
Protein	-0.0003	0.002	0.08*
Lactose	0.01	0.03	0.04

* (P≤0.05).

Correlation and Regression Analysis Between Milk Production and its Component Ratios on the Studied Blood Traits

Table 4 presents a significant positive correlation ($P \leq 0.05$) between monthly milk production and blood cholesterol levels, with a correlation coefficient of 0.26. Regarding the fat percentage in milk, it exhibited a significant positive correlation ($P \leq 0.05$) with the studied blood parameters: urea, cholesterol, and total protein, with correlation values of 0.27, 0.30, and 0.36, respectively. In terms of milk protein percentage, it demonstrated a significant positive correlation ($P \leq 0.05$) with total blood protein, yielding a correlation coefficient of 0.38. The research conducted by Khaled *et al.* (1999) identified both significant positive and negative correlations. The regression coefficient indicates the change in a dependent variable (such as Y) when an independent variable (such as X) changes by one unit. It is represented by a linear equation and is supported by the coefficient of determination (R^2). The coefficient of determination explains the proportion of variance in the dependent variable that can be attributed to the independent variable, as well as the degree to which the mathematical model accurately fits the data. These concepts are crucial when developing improvement plans, particularly for indirect selection in various herds of farm animals (Przemyslaw *et al.*, 2015). Table 5 demonstrates a significant positive regression ($P \leq 0.05$) between the monthly milk production trait and blood cholesterol levels, with a regression coefficient of 0.87. Additionally, it recorded significant positive regressions ($P \leq 0.05$) with the examined blood traits—urea, cholesterol, and total protein—yielding regression coefficients of 0.14, 0.18, and 0.25, respectively. Additionally, a significant positive regression ($P \leq 0.05$) was observed in the total protein levels in the blood, with a slope of 0.08. Consequently, the percentage of milk fat can be predicted based on the levels of certain blood components. This indicates that these components can be utilized for early selection and incorporated into improvement strategies to enhance economic returns for breeders. In a study conducted by Al-Jilawi *et al.* (2012) to investigate the relationship between the regression of milk production traits and their components with certain blood traits, a significant positive correlation is identified. Specifically, the study found a positive correlation between milk production and the levels of glucose and total protein in the blood. Additionally, there is a correlation between the percentage of milk fat and blood glucose levels, as well as between the percentage of protein in milk and the levels of total protein in the blood.

CONCLUSIONS AND RECOMMENDATIONS

This study demonstrates a significant superiority of the crossbred goat group over the local black goats and Shami goats in terms of total, monthly, and daily milk production. Therefore, it is recommended to increase the population of this genetic group in central Iraq. Furthermore, milk production traits and some of their components, such as milk fat percentage, can be predicted by examining specific biochemical blood traits, including urea, cholesterol, and total protein. This conclusion, however, is based on a limited sample size and a specific physiological state. Future studies with larger sample sizes may provide greater insight into the effects of breed on productivity.

ACKNOWLEDGEMENTS

The authors gratefully acknowledge the Al-Qasim Green University for its facilities.

NOVELTY STATEMENT

The novelty of our study has been its strong evidence of the effect of breed on some biochemical blood characteristics and milk production traits in crossbred (local x Shami) goat for the first time. Production systems and crossbreeding strategies can be developed to maximize early-life nutritional efficiency and reproductive management, ultimately enhancing the long-term performance of dairy

goats. However, further research is necessary to improve these various production systems.

AUTHOR'S CONTRIBUTIONS

Rahman H. H. Al-Qasimi: Formal analysis, methodology, investigation, writing – original draft. Sarah M. Abbas: Conceptualization, investigation, supervision, and validation. Waleed A. Mohammad: Data curation and investigation. Dhurgam A. Jasim: Data curation and investigation. Luai S. K. Al-Khafaji: Data curation and investigation. Tahreer M. Al-Thuwaini: Conceptualization and investigation.

Generative AI or AI-assisted Technology Statement

The author(s) declare that no Genrative AI was used in the creation of this manuscript.

Conflict of Interest

None.

REFERENCES

Aksad (2002). Goat Nutrition Guide. Second Edition. Damascus.

Al-Azzawi ZMM, Ibrahim SS, Muhammad NS (2015). Factors affecting total milk production and length of milk season in Cypriot and local goats and their crosses. Karbala J. Agric. Sci., 2(4): 166-177. https://doi.org/10.59658/jkas.v2i4.41

Al-Hamdani WAQS (2000). Study of the effect of some environmental and physiological factors on the production and composition of milk in genetic groups of goats (Doctoral dissertation, PhD thesis, College of Agriculture-University of Baghdad).

Ali HM, Daker AL (2016). Effect of breed and some non-genetic factors on fat and protein percentage and milk production in goats. Euphrates J. Agric. Sci., 8(2): 138-144.

Ali RA, Hamza RH, Habeeb HMH, Al-Nuaimi AJ (2024). Evaluation of semen characteristics, testicular measurements, and blood parameters for three genetic groups of goat bucks in iraq. J. Anim. Health Prod., 12(2): 233-239. https://doi.org/10.17582/journal.jahp/2024/12.2.233.239

Al-Janabi YAA, Habeeb HMH, Al-Qasimi RH (2023). Effect of Breed on some Production Traits and Reproductive Traits of Local Sheep. In IOP Conf. Ser. Earth Environ. Sci., 1262(7): 072096. https://doi.org/10.1088/1755-1315/1262/7/072096

Al-Jilawi JR, Salim AZ, Sinan SI (2012). The relationship between milk production and its components and some blood traits in Shami and Cypriot goats. Diyala J. Agric. Sci., 4(2): 67-79.

AL-Qasimi RH, AL-Lami JS (2016). Effect of addition Iraqi probiotic to rations of local goat kids on some cellular and biochemical traits of blood. Euphrates J. Agric. Sci., 8(2): 155-160.

Al Qasimi RH, Hassan AF, Khudair BY (2019). Effect of IGF-1 and GH genes polymorphism on weights and body measurements of Awassi lambs in different ages. Basrah J. Agric. Sci., 32(1): 39-46. https://doi.org/10.37077/25200860.2019.125

Federation of Animal Science Societies (2010). Guide for the Care and Use of Agricultural Animals in Research and Teaching. Champaign, IL 61822, 3rd edition.

Hermiz HN (2001). Genetic evaluation of local goats and their crosses Using Some Productive Traits (Doctoral dissertation, Ph. D. Thesis, University of Baghdad, Iraq).

Hoffmann I (2012). Status and rends of goat breed diversity at global level. In Animal Genetic Resources Branch, Animal Production and Health Division, FAO. Book of Abstracts xi international conference on goats. International Goats Association. Gran Canaria, Spain.

Hussein TH, Alrubayei ZMA, Al-Thuwaini TM (2024). Association between thyroid metabolic hormones and Awassi sheep reproductive performance. Adv. Anim. Vet. Sci., 12(12): 2478-2483. https://doi.org/10.17582/journal.aavs/2024/12.12.2478.2483

ICAR (1995). International Committee for Animal Recording. International regulation for milk recording in sheep. Institute del, Elavage, Paris.

Jassim SH, Khalil ZS (2018). Estimation of genetic parameters and some non-genetic factors of milk production and its components in local and Shami goats in central Iraq. Diyala J. Agric. Sci., 10(2): 26-35.

Khaled NF, Illek J, Gajdůšek S (1999). Interactions between nutrition, blood metabolic profile and milk composition in dairy goats. Acta Veterinaria Brno., 68(4): 253-258. https://doi.org/10.2754/avb199968040253

Merzah LH, Hussein TH, Al-Thuwaini TM (2024). Association of cortisol with litter size and lamb weight in awassi sheep. Adv. Anim. Vet. Sci., 12(11): 2246-2251. https://doi.org/10.17582/journal.aavs/2024/12.11.2246.2251

Mohamed AH, El Hawy AS, Sawalhah MN, Squires VR (2019). Middle East and North Africa livestock systems. Livestock: Production, Management Strategies and Challenges. Hauppauge, NY, USA: Nova Science Publishers.

Mohammed SA, Razzaque MA, Omar AE, Albert S, Al Gallaf WM (2016). Biochemical and hematological profile of different breeds of goat maintained under intensive production system. Afr. J. Biotechnol., 15(24), 1253-1257. https://doi.org/10.5897/AJB2016.15362

Przemysław S, Cezary P, Stanisław M, Krzysztof L, Barbara P, Zofia A, Maja F, Katarzyna Ż, Ząbek K (2015). The effect of nutritional and fermentational characteristics of grass and legume silages on feed intake, growth performance and blood indices of lambs. Small Rumin. Res., 123(1): 1-7. https://doi.org/10.1016/j.smallrumres.2014.11.008

Salim MA, Hariyono DNH (2025). The beneficial impact of legume supplementation on nutrient intake, digestibility, growth and reproductive performances of goats: A brief review. J. Adv. Vet. Res., 15(1).

SAS (2018). Statistical Analysis System, User's Guide. Statistical. Version 9.4th ed. SAS. Inst. Inc. Cary. N.C. USA.