American Journal of Biology and Natural Sciences
https://biojournals.us/index.php/AJBNS
ISSN: 2997-7185

The Effect of Some Non-Genetic Factors on Milk Production and Offspring Growth in the Iraqi Local Goat Breed

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Received: 2025, 15, Jun
Accepted: 2025, 21, Jul
Published: 2025, 21, Aug

Annotation: This work sought to investigate how several non-genetic elements affected goat milk production and offspring growth performance. The findings showed that neither daily nor total milk yield (P > 0.05) was significantly affected by the sex of the offspring. By contrast, the type of birth had a very significant impact (P < 0.01), with twin-bearing does outperforming those with single births in milk production. Maternal age also showed a very significant effect (P < 0.01), since older does produce more milk, With regard to mother weight, heavier does shows noticeably higher milk yield (P < 0.05). Milk output was not much affected by month of birth (P > 0.05), implying constant environmental and management conditions all year long. But the production year had a very significant impact (P < 0.01); 2024 had better milk yield than all other years). Regarding growth performance, the sex of the offspring had no appreciable impact on birth weight (P > 0.05), but had a highly significant effect on weaning weight and daily weight gain (P < 0.01), with male children outperforming female ones most likely due to androgenic influence. The type of birth also had a highly significant effect (P < 0.01) on all growth parameters since single-born children showed better performance than twins, probably due to more favorable intrauterine and postnatal conditions. Birth or weaning weights (P > 0.05) were not much influenced by maternal age; but, daily weight gain (P < 0.05) was much influenced by it. With heavier does producing better-performing children, maternal weight showed a highly significant effect on birth weight and daily weight gain (P < 0.01) and a significant effect on weaning weight Growth characteristics showed no appreciable influence from month of birth (P > 0.05). Similarly, the production year had a highly significant impact (P < 0.01) on daily weight gain in 2024, birth or weaning weights did not significantly change (P > 0.05).

Keywords: Milk yield, Non-genetic factors, Dam's Weight, Kid growth performance, Birth type.

Introduction

An essential part of Iraq's livestock industry, especially in rural production systems, is the local goat population. Because of their exceptional ability to adapt to challenging environmental conditions, these animals are crucial to ensuring food security in rural areas. Goats not only produce milk, meat, and leather, but they also produce organic fertilizer, which supports sustainable agriculture (FAO, 2020). In Iraq, goat husbandry is very common, particularly in the central and southern areas. Indigenous goats are well adapted to the semi-arid climate of Iraq due to their physiological and behavioral characteristics, which allow them to tolerate high temperatures and restricted feed availability. Their importance is especially noticeable in rural regions, where they frequently provide the majority of income when there are no other options for employment. Under conventional farming systems, Iraqi goats are comparatively productive. According to research, the native black goat produces between 0.8 and 1.5 liters of milk per day on average (Al-Fartosi et al., 2021). Additionally, these goats exhibit desirable reproductive and fertility characteristics, which supports their use in breeding and genetic improvement programs. From a genetic standpoint, research using microsatellite markers has revealed significant genetic diversity within and between regional goat populations. Programs for selection and improvement that aim to increase productivity, disease resistance, and environmental resilience can benefit greatly from this genetic diversity (Al-Samarrae and Al-Aubaidy, 2019). However, there are a number of obstacles in the way of efforts to enhance and record the genetic potential of Iraqi goats. The lack of a thorough national database, a lack of field-based research, and a lack of institutional support are major challenges. These problems make it more difficult to create policies that will advance the livestock industry (Al-Zubaidi and Al-Kaabi, 2022). In order to achieve sustainable food security and support rural development in Iraq, it is imperative that scientific research be strengthened, especially in areas pertaining to the genetic, reproductive, and productive traits of local goats.

Materials and Methods

This study was conducted at the Ruminant Research Station of the General Commission for Agricultural Research, Ministry of Agriculture, located in Abu Ghraib (25 km west of Baghdad). The objective was to estimate milk production and daily weight gain in local goats during the period from 2021 to 2024. The study was based on 310 records and aimed to evaluate the effects of various factors including: sex of the offspring, type of birth, month of birth, dam's weight at kiding, dam's age, and year of production on birth weight, weaning weight, and average daily weight gain, as well as to estimate daily milk yield.

3.1 Herd Management

The animals were housed in semi-open sheds (35% roofed, 65% open), designated for different goat groups, including sheds for twin-bearing goats, bred goats, goats under one year of age, selected kids, kids for sale, and isolated animals (culls). Herd management followed a comprehensive program covering nutrition, preparation for breeding season, and support through pregnancy and parturition stages, in addition to veterinary care and health management.

3.1.1 Feeding Management

Feeding at the station relied primarily on grazing. During the winter, animals were allowed to graze from 8:00 a.m. to 2:00 p.m., while in summer, grazing occurred from 8:00 a.m. to 12:00 p.m. and resumed from 3:00 p.m. to 6:00 p.m. Upon return to the station, nutritional requirements were supplemented with alfalfa (green fodder), barley mixtures, and berseem (clover). A flushing feeding strategy was implemented one month prior to the breeding season, where each goat received 750 g/day of concentrate feed, which was later adjusted to 500 g/day per head after breeding.

3-1-2 Natural Mating

The natural mating process at the station takes place from the beginning of May until mid-June. After this period, teaser bucks are released to detect estrus cycles and identify non-pregnant does, which are then isolated in designated pens to facilitate mating. As the expected kidding date approaches, pregnant does are placed in individual pens (1.5 x 1 meter) to ensure proper care. Within the first 24 hours postpartum, both the newborn and its dam are weighed, and the kid is identified with plastic ear tags.

If the birth is a singleton, the doe remains with her kid for three days. In the case of twin births, the doe stays with her offspring for ten days to ensure that the kids receive an adequate amount of colostrum. After all relevant data are recorded for both the doe and her offspring, the does are released to graze with the herd for 6 to 8 hours daily while leaving the kids in the pens. After 15 days, and under moderate temperature conditions, the kids are also allowed to accompany their mothers to pasture.

3-1-3 Veterinary Care

To maintain herd health, several essential health and vaccination measures are implemented to protect against various diseases:

1. Animal dipping is performed three times per season using a pyrethroid solution (Cypermethrin).
2. Administration of the "Cevapex" vaccine against *Enterotoxaemia* (also known as infectious enterotoxemia) for pregnant does, adult animals, and newborns.
3. Vaccination against Peste des Petits Ruminants (PPR).
4. Vaccination against Foot and Mouth Disease (FMD).
5. Vaccination against Sheep Pox.
6. Brucellosis vaccination for ewe kids and kids.
7. Spraying of pens with pesticides and disinfectants to control parasitic infestations.

3-2 Data Recording

This study included the recording of the following measurements:

3-2-1 Milk Production

Manual milking is the standard procedure used at the station. Milking begins 15 days postpartum, during which kids are separated from their mothers at night. Milk yield is recorded in the morning after 10 to 12 hours of separation. After milking, kids are reunited with their mothers to ensure complete udder emptying. This process is carried out weekly and includes the following measurements:

1. Daily milk yield
2. Total milk production

3-2-2 Body Weights and Growth Rate

Animals were weighed using a graduated scale, and body weight measurements were recorded at the following stages:

1. **Birth Weight:** The weight of each kid was recorded within 24 hours of birth.
2. **Weaning Weight:** Weaning weight was recorded at 120 days of age.
3. **Average Daily Weight Gain (ADG):**

Calculated using the following formula:

ADG (g/day)=Weaning Weight−Birth Weight / 120 days

3-3 Statistical Analysis

The Statistical Analysis System (SAS, 2012) software was used to perform the statistical analysis of the data in order to study the effects of various factors, based on the following mathematical models. The **Least Squares Method** was applied to analyze the data and estimate the effects of **non-genetic (fixed) factors** on the studied traits. Additionally, **Duncan's Multiple Range Test** (Duncan, 1955) was used to determine the significance of differences between means.

This model was used to investigate the effects of the studied factors on milk production and growth traits:

Yijklmno= μ +Si +Tj +Ak +Wl +Om +Yn +eijklmno

Where:

- YijklmnoY : The observed value of the studied trait for the otho^{th}oth doe, based on sex of the kid (i), type of birth (j), age group (k), dam's weight category (l), birth month (m), and birth year (n).
- μ: Overall mean.

- Si: Effect of kid's sex (male or female).
- Tj: Effect of type of birth (single or twin).
- Ak: Effect of dam's age (k = 1 to 5, corresponding to 2, 3, 4, and 5years).
- Wl: Effect of dam's weight category (l = 1 to 4, representing >50 kg, 51–60 kg, and <60 kg).
- Om: Effect of birth month (m = 1 to 5, representing October, November, December, January, and February).
- Yn: Effect of birth year (the study covered four years: 2021 to 2024).
- eijklmno : Random error, assumed to be independently and normally distributed with a mean of zero and variance σ2e .

Discussion

Factors Affecting Milk Production

4.2.1 Offspring Sex

The sex of the offspring had no discernible impact on daily or overall milk production, according to the study's findings (Table 1). For female offspring, the average daily milk yield was 343.75 ± 11.75 g, whereas for male offspring, it was 355.65 ± 11.69 g. Similarly, the total milk yield for male offspring dams was 20364.8 ± 81.84 g, while the total milk yield for female offspring dams was 20034.08 ± 82.30 g. The higher body weight of dams that gave birth to females may have contributed to increased milk production, equating yield with those that gave birth to males, which could explain why there was no discernible difference between dams of males and females. These findings are in agreement with Ustuner and Ogan (2013) and Al-Samarrae et al. (2016), Kumar et al.(2020) and Al-Qasimi et al. (2020) but contradict the results reported by Alkass et al. (2009) and Al-Jawari (2011), who found a significant effect of offspring sex on milk production.

Table 1. Effect of Offspring Sex, Type of Birth, and Dam Age on Daily and Total Milk Yield (Mean ± SE)

Factor	Category	N	Daily Milk Yield (g)	Total Milk Yield (g)
Overall Mean	—	310	326.50 ± 5.95	18,300.48 ± 40.68
Offspring Sex	Male	178	355.65 ± 11.69^a	20,364.8 ± 81.84^a
	Female	132	343.75 ± 11.75^a	20,034.08 ± 82.30^a
	Significance		n.s	n.s
Type of Birth	Single	208	332.84 ± 11.31^b	18,704.60 ± 79.20^b
	Twin	92	378.56 ± 12.45^a	20,591.44 ± 87.15^a
	Significance		**	**
Dam Age	2	70	280.17 ± 13.09^c	15,533.6 ± 91.69^c
	3	108	290.82 ± 12.30^b	16,298.0 ± 86.13^b
	4	90	458.74 ± 13.85^a	25,945.76 ± 97.00^a
	5	42	465.69 ± 15.80^a	26,145.12 ± 81.62^a
	Significance		**	**

- **SE**: Standard Error
- **n.s**: Not significant
- ******: Highly significant at $P < 0.01$
- Superscript letters (^{a}, ^{b}, ^{c}) within a column indicate statistically significant difference

4.2.2 Type of Birth

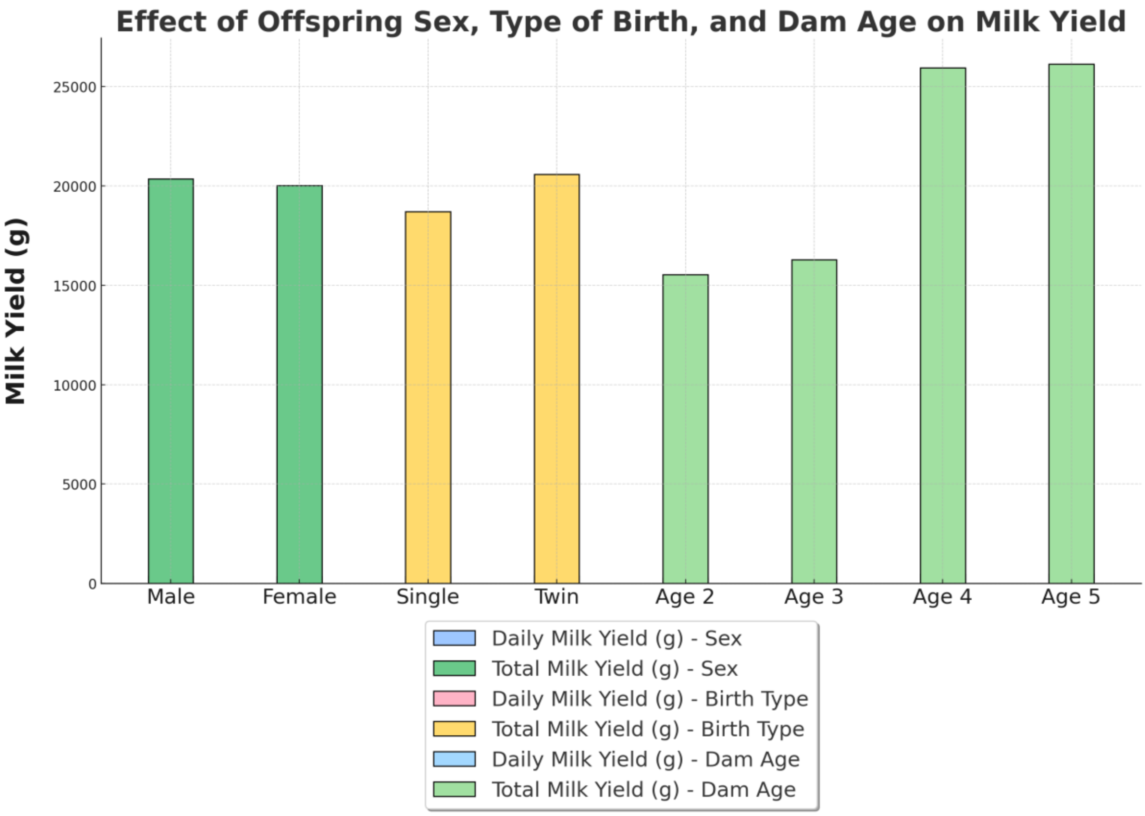
In favor of twin-bearing ewes, the results indicated a highly significant effect of the type of birth on daily and total milk production (P<0.01) (Table 1). The daily milk yield for twin births was 378.56 ± 12.45 g, whereas it was 332.84 ± 11.31 g for single births. For single births, the total milk yield was 1870.60 ± 79.20 g, while for twin births, it was 20591.44 ± 87.15 g (Table 2). The higher frequency of suckling by twin offspring compared to singletons may result in increased udder stimulation, which in turn encourages continuous milk production in favor of twin birth, explaining the superiority in milk production by twin-bearing goat. s.

These findings are consistent with those reported by Cardellion and Benson (2002), Abd-Allah et al. (2011) and Atoui et al (2024) but differ from those of Reiad et al. (2010), Abdelnour (2011) and Al-Qasimi et al. (2020) who found no significant effect of birth type on milk production.

4.2.3 Dam's Age

The findings showed that the dam's age significantly impacted daily and overall milk production (P<0.01) (Table 1). Goat that were 4 and 5 years old produced the most milk, with daily yields of 458.74 ± 13.85 g and 465.69 ± 15.80 g and total yields of 25945.76 ± 97.00 g and 26145.12 ± 81.62 g, respectively. Conversely, younger goat that were two and three years old produced 280.17 ± 13.09 g and 290.82 ± 13.309 g per day, respectively, and 15533.6 ± 91.69 g and 16298 ± 86.13 g overall. This discrepancy is probably caused by the larger rumen and more developed digestive systems of goat that are 4 and 5 years old, as well as the more mature mammary glands that reach their peak functioning at this age.These results are in line with those reported by Ustuner and Ogan (2013) and Al-Samarrae et al. (2016), but contradict the findings of Abd-Allah et al. (2011), who reported no significant effect of dam's age on milk production.

Figure 1: Effect of Offspring Sex, Type of Birth, and Dam Age on Milk Yield



4.2.4 Dam's Weight

According to the study's findings, the weight of the dam significantly impacted the amount of milk produced each day and overall (P<0.01) (Table 2). Milk yields from goat under 61 kg ranged from 374.47 ± 12.70 to 423.72 ± 19.92 g per day to 20970.4 ± 88.95 to 23728.56 ± 69.49 g per day. Goat over 61 kg, on the other hand, produced lower daily yields (314.60 ± 12.48 – 330.01 ± 13.98 g) and total yields (17616 ± 87.39 – 18480.8 ± 97.90 g). This could be explained by lighter-weight goat' larger rumens and higher feed conversion efficiency, which raise feed intake and, in turn, milk production. These findings are in line with those of Reiad et al. (2010) , Abdelnour (2011)and Al-Qasimi et al. (2020) who reported a highly significant effect of dam's weight on daily and total milk production, and differ from Al-Samarrae et al (2016), who reported only a significant (not highly significant) effect.

Table 2. Effect of Dam Weight, Month of Birth, and Production Year on Daily and Total Milk Yield (Mean ± SE)

Factor	Category	N	Daily Milk Yield (g)	Total Milk Yield (g)
Overall Mean	—	310	326.50 ± 5.95	18,300.48 ± 40.68
Dam Weight (kg)	< 50	85	328.01 ± 13.98^{b}	$18{,}480.8 \pm 97.90^{b}$
	51–60	130	314.60 ± 12.48^{b}	$17{,}616 \pm 87.39^{b}$
	61>	95	367.47 ± 12.70^{a}	$20{,}970.4 \pm 88.95^{a}$
	Significance		**	**
Month of Birth	Oct	71	361.09 ± 11.22^{a}	$20{,}221.04 \pm 78.60^{a}$
	Nov	79	355.48 ± 8.29^{a}	$19{,}907.12 \pm 58.08^{a}$
	Dec	70	365.05 ± 11.06^{a}	$20{,}442.8 \pm 81.25^{a}$
	Jan	63	368.43 ± 13.19^{a}	$20{,}632.32 \pm 92.39^{a}$
	Feb	27	344.85 ± 18.61^{a}	$19{,}312 \pm 70.29^{a}$
	Significance		n.s	n.s
Production Year	2021	113	387.62 ± 13.52^{a}	$21{,}706.8 \pm 94.67^{a}$
	2022	80	370.57 ± 14.38^{b}	$20{,}752.32 \pm 70.71^{b}$
	2023	54	332.86 ± 14.45^{b}	$18{,}640.32 \pm 61.16^{b}$
	2024	63	374.41 ± 15.61^{a}	$20{,}967.44 \pm 79.29^{a}$
	Significance		**	**

- **SE**: Standard Error
- **n.s**: Not significant
- ******: Highly significant at $P < 0.01$
- Superscript letters (^{a}, ^{b}, ^{c}) within a column indicate statistically significant difference

4.2.5 Month of Birth

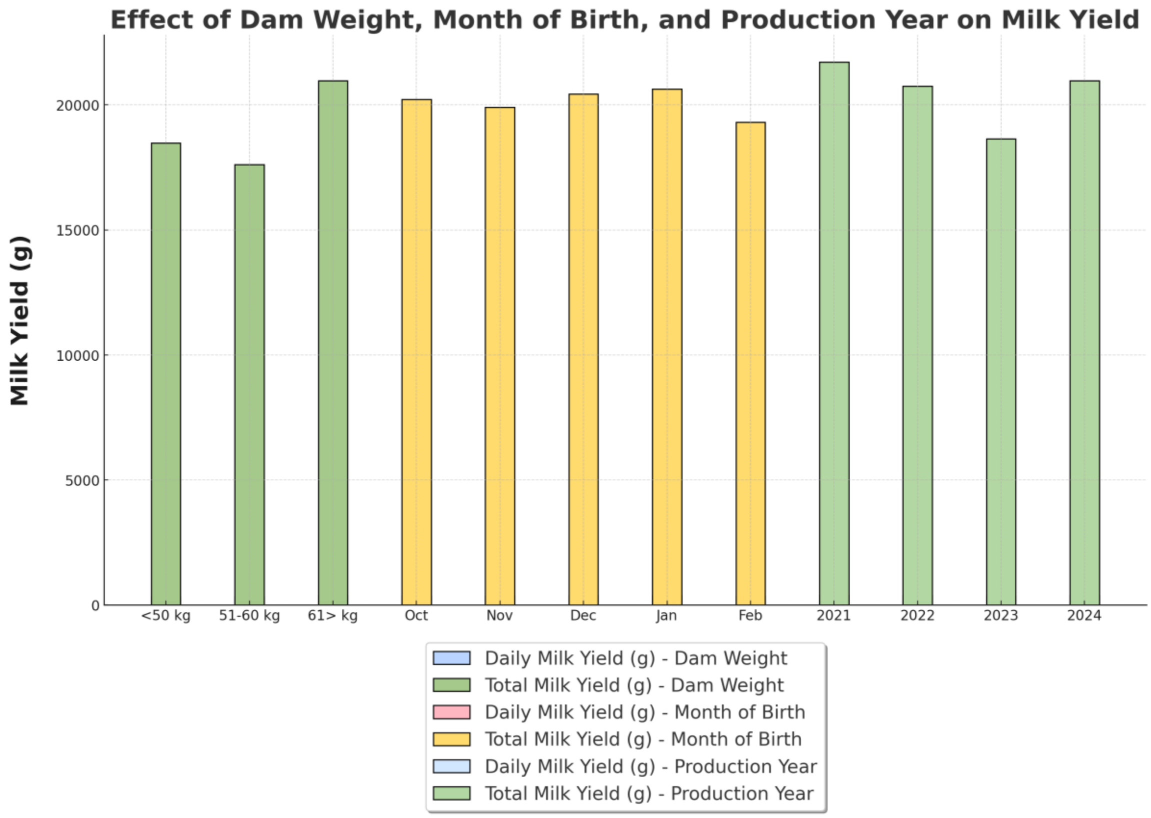
The findings showed that the birth month had no discernible impact on daily or overall milk production (Table 2). January had the highest daily milk yield (368.43 ± 13.19 g), while February had the lowest (344.85 ± 18.61 g). Likewise, January had the highest total milk yield (20632.32 ± 92.39 g), while February had the lowest (19312 ± 70.29 g). This might be the result of providing high-quality, varied feed throughout the winter and practicing good herd management.. These results align with those of Abdelnour (2011), who also found no significant effect of birth month on milk yield, but differ from Abillieira et al. (2010) and Al-Samarrae et al (2016), who reported a significant impact of birth month on milk production.

4.2.6 Year of Production

Significant variations in daily and total milk production were found between production years (P<0.01), according to the study (Table 2). 2014 saw the highest daily milk yield (387.62 ± 13.52 g), while 2016 saw the lowest (332.86 ± 14.45 g). In a similar vein, 2014 had the highest total milk yield (21706.8 ± 94.67 g), while 2016 had the lowest (18640.32 ± 61.16 g). In addition to the replacement of older animals with new ones, this variation is probably caused by variations in the climate over the years, which impacted the availability of feed.

These findings are consistent with those reported by Reiad et al. (2010).

Figure 2: Effect of Dam Weight, Month of Birth, and Production Year



Factors Affecting Offspring Growth

4.1.1 Kid Sex

With average birth weights of 3.96 kg for males and 3.72 kg for females, the study's findings showed that kid sex had no discernible impact on birth weight (Table 3). These results are in line with those of Ptacek et al. (2015), Aktas et al. (2015), Ahmed et al. (2015), Al-Samarai et al. (2016), Mellado et al. (2016), Villalobos et al. (2017), Eteqadi et al. (2017) and Kowalczyk et al. (2023) all of whom found no discernible differences between male and female kids at birth. They do, however, contradict the results of Al-Adl (2017) and Marufa et al. (2017), who found that there were notable variations according to kid sex.

On the other hand, weaning weight was significantly influenced by kid sex ($P<0.01$), with male kids weighing an average of 29.40 kg and females 26.20 kg. The early release of androgen hormones in male fetuses, beginning around days 30 to 35 of gestation, may be the cause of this discrepancy. These hormones are essential for fostering growth in later developmental stages. These findings are different from those of Ahmed et al. (2015), and Eteqadi et al. (2017), who did not notice such a significant effect, but they are consistent with those of Aktas et al. (2015), Ptacek et al. (2015), Al-Samarai et al. (2016), Mellado et al. (2016), Villalobos et al. (2017), Marufa et al. (2017), and Jawasreh et al. (2018).

Additionally, there was a highly significant ($P<0.01$) impact of kid sex on daily weight gain, with male kids gaining 0.207 kg daily while females gained 0.195 kg daily. The influence of sex hormones is probably to blame for this; whereas estrogen tends to inhibit bone elongation in females, androgens in males encourage muscle growth and longitudinal bone development. These results contradict the findings of Ahmed et al. (2015), but they are in line with and Ustuner and Ogan (2013), Aktas et al. (2015), Ptacek et al. (2015), Al-Samarai et al. (2016), Mellado et al. (2016), and Jawasreh et al. (2018).

Table 3. Effect of Offspring Sex, Type of Birth, and Dam Age on Growth Traits (Mean ± SE)

Factor	Category	N	Birth Weight (kg)	Weaning Weight (kg)	Daily Weight Gain (g)
Overall Mean	—	310	3.84 ± 0.08	27.86 ± 0.33	0.200 ± 0.001
Offspring Sex	Male	178	3.96 ± 0.11ᵃ	29.40 ± 0.45ᵃ	0.207 ± 0.003ᵃ
	Female	132	3.72 ± 0.12ᵃ	26.20 ± 0.47ᵇ	0.195 ± 0.001ᵇ
	Significance		n.s	**	**
Type of Birth	Single	208	4.00 ± 0.08ᵃ	28.23 ± 0.23ᵃ	0.202 ± 0.002ᵃ
	Twin	92	3.42 ± 0.20ᵇ	26.90 ± 0.34ᵇ	0.198 ± 0.001ᵇ
	Significance		**	**	**
Dam Age (years)	2	70	3.67 ± 0.29ᵃ	28.12 ± 1.11ᵃ	0.200 ± 0.003ᵇ
	3	108	3.93 ± 0.04ᵃ	28.16 ± 0.25ᵃ	0.201 ± 0.001ᵇ
	4	90	3.99 ± 0.05ᵃ	28.54 ± 0.33ᵃ	0.205 ± 0.001ᵃ
	5	42	4.00 ± 0.06ᵃ	28.80 ± 0.18ᵃ	0.206 ± 0.002ᵃ
	Significance		n.s	n.s	*

- **SE**: Standard Error
- **n.s**: Not significant
- ******: Highly significant at $P < 0.01$
- Superscript letters (ᵃ, ᵇ, ᶜ) within a column indicate statistically significant difference

4.1.2 Type of Birth

The study's findings showed that the type of birth had a highly significant (P<0.01) impact on the kids' birth weight, weaning weight, and average daily weight gain (Table 3). Kids born as singles weighed more at birth (4.00 kg) than kids born as twins (3.42 kg). Likewise, single-born kids weighed 28.23 kg at weaning, whereas twin-born kids weighed 26.90 kg. In terms of daily weight gain, single-born kids also outperformed twin-born kids, averaging 0.202 kg/day as opposed to 0.198 kg/day for twins. Compared to multiple fetuses sharing the same uterine environment, single fetuses have greater intrauterine space and nutrient availability, which enhances their growth potential. This is probably the cause of this difference. The findings of the current study are consistent with those of previous research conducted by Ustuner and Ogan (2013), Haga et al.,(2014), Aktas and Dogan (2014), Ptacek et al. (2015), Aktas et al. (2015), Al-Samarai et al. (2016), Mellado et al. (2016), Villalobos et al. (2017), Eteqadi et al. (2017), Marufa et al. (2017), and Jawasreh et al. (2018). However, they contradict the results reported by Mugerwa-Mukassa et al. (2000) and Al-Khazraji et al. (2014), who found no significant differences between single and twin births.

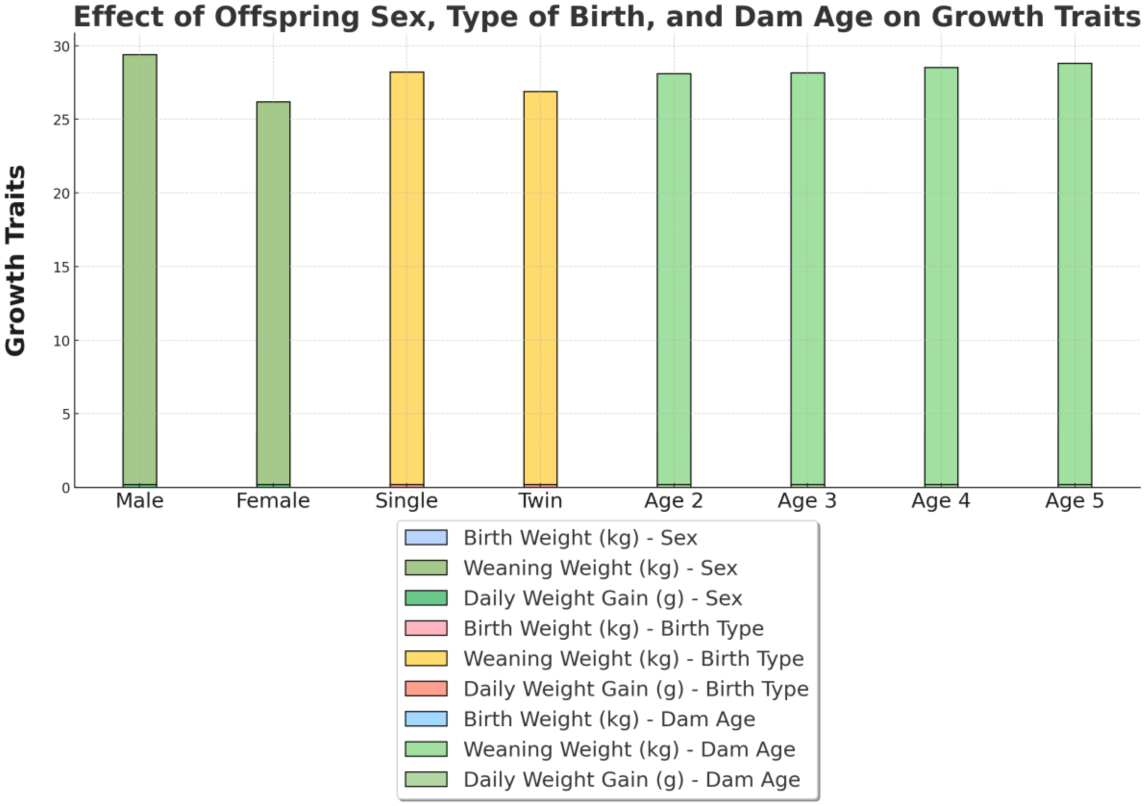
4.1.3 Dam Age

According to the study's findings, kid birth weight was not significantly impacted by dam age (Table 3). Kids born to 5-year-old goat had the highest average birth weight (4.00 ± 0.06 kg), while kids born to 2-year-old goat had the lowest (3.67 ± 0.29 kg). The genetic composition might be the cause of this lack of impact. These results are consistent with those published by Al-Najjar and Al-Saigh (1999) and Al-Adel (2017) .

However, kids born to goat that were 2, 3, 4, and 5 years old had weights ranging from 28.12 to 28.72 kg, indicating that dam age had a significant impact on weaning weight. Kids born to 6-year-old goat had the lowest weaning weight (27.16 ± 0.25 kg). Older goat' physiological decline is probably the cause of this decline (Marufa et al., 2017).(

Additionally, daily weight gain was significantly impacted by dam age (P<0.05). Kids born to 5-year-old goat had the highest gain (0.206 ± 0.001 kg/day), while kids born to 2-year-old goat had the lowest gain (0.188 ± 0.001 kg/day). The connection between productivity and dam age helps to explain this. The ewe's digestive system is fully formed by the time she is five years old, enabling her to use feed more effectively and produce more milk. On the other hand, older goat (≥5 years) may experience dental decay, which lowers their feed intake and, in turn, their milk production, which negatively impacts their progeny. These results are in line with those Aktas et al. (2015), Ptacek et al. (2015), Mellado et al. (2016) and Marufa et al. (2017).

Effect of Offspring Sex, Type of Birth, and Dam Age on Growth Figure 3:



4.1.4 Dam Weight

Dam weight had a highly significant (P<0.01) impact on kid birth weight, according to the study (Table 4). Lighter goat (>61 kg) gave birth to lighter kids (3.68 ± 0.11 to 3.77 ± 0.39 kg), while heavier goat (<61 kg) gave birth to heavier kids (ranging from 4.06 ± 0.05 to 4.41 ± 0.13 kg) (Table 7). This might be because heavier goat have larger uteruses, which create a better environment for fetal development. These findings are consistent with those of Ahmed et al. (2015), Mellado et al. (2016) Al-Adel (2017) and Bhattarai et al. (2018).

Dam weight also had a significant impact on weaning weight (P<0.05). The weaning weight of kids from goat weighing less than 61 kg was 28.53 ± 0.38 kg, while the weaning weight of kids from goat weighing more than 61 kg was 27.50 ± 0.45 kg. This could be because heavier goat produce more milk, Ahmed et al. (2015), Aktas et al. (2015), and Ptacek et al. (2015) and Bhattarai et al. (2018) all support these findings.

Furthermore, the average daily weight gain was significantly impacted by dam weight (P<0.01). Kids born to lighter goat (>61 kg) gained only 0.197 ± 0.002 kg/day, whereas kids born to heavier goat (<61 kg) gained 0.202 ± 0.001 kg/day. The reason might be that heavier goat produce more milk and have better feed conversion efficiency, which helps them meet the nutritional needs of their young. Al-Khazraji et al. (2014), Aktas and Dogan (2014) Aktas et al. (2015), Mellado et al.

(2016)and Bhattarai et al. (2018 are all in agreement with these findings

Table 4. Effect of Dam Weight, Month of Birth, and Production Year on Growth Traits (Mean ± SE)

Factor	Category	N	Birth Weight (kg)	Weaning Weight (kg)	Daily Weight Gain (g)
Overall Mean	—	310	3.84 ± 0.08	27.86 ± 0.33	0.200 ± 0.001
Dam Weight (kg)	<50	95	3.77 ± 0.39[ab]	27.85 ± 1.45[b]	0.197 ± 0.002[b]
	51–60	130	3.68 ± 0.11[b]	27.50 ± 0.45[b]	0.202 ± 0.001[ab]
	61>	85	4.06 ± 0.05[a]	28.53 ± 0.38[a]	0.206 ± 0.003[a]
	Significance		**	*	**
Month of Birth	Oct	71	3.72 ± 0.07[a]	27.22 ± 0.43[a]	0.196 ± 0.003[a]
	Nov	79	4.03 ± 0.17[a]	28.37 ± 0.66[a]	0.202 ± 0.001[a]
	Dec	70	3.60 ± 0.06[a]	27.32 ± 0.42[a]	0.201 ± 0.002[a]
	Jan	63	3.66 ± 0.07[a]	27.40 ± 0.42[a]	0.201 ± 0.001[a]
	Feb	27	3.84 ± 0.12[a]	28.40 ± 0.87[a]	0.204 ± 0.001[a]
	Significance		n.s	n.s	n.s
Production Year	2021	113	3.72 ± 0.15[a]	28.03 ± 0.59[a]	0.204 ± 0.001[b]
	2022	80	3.79 ± 0.06[a]	28.39 ± 0.38[a]	0.210 ± 0.002[a]
	2023	54	3.77 ± 0.08[a]	26.60 ± 0.45[a]	0.197 ± 0.003[b]
	2024	63	4.15 ± 0.38[a]	28.21 ± 1.51[a]	0.198 ± 0.003[b]
	Significance		n.s	n.s	**

- **SE**: Standard Error
- **n.s**: Not significant
- ******: Highly significant at $P < 0.01$
- Superscript letters ([a], [b], [c]) within a column indicate statistically significant difference

4.1.5 Month of Birth

The results indicated that **month of birth had no significant effect on birth weight** (Table 4). The highest average birth weight was recorded in kids born in November (4.03 kg), while the lowest was observed in December (3.60 kg). However, the differences between months were not statistically significant. These findings are consistent with those of Ahmed et al. (2015), who also reported no significant effect of birth month on kid birth weight.

Similarly, **no significant effect was observed on weaning weight** across different birth months. Weaning weights were 28.40 kg, 27.45 kg, and 27.00 kg for kids born in February, March, and April, respectively. This could be attributed to moderate temperatures and adequate forage availability during these months. The current results contrast with those reported by Al-Samarai et al. (2016), who noted a weaning weight of 29.18 kg in Goat kids born in January. Mellado et al. (2016) also found that Mexican Dorper kids born in spring had higher weaning weights (33.5 kg), and Marufa et al. (2017) reported that Abera sheep in Ethiopia born during the summer had the heaviest weaning weights.

Moreover, **average daily weight gain was not significantly affected by month of birth**, contrary to the findings of Ahmed et al. (2015), Al-Samarai et al. (2016), Mellado et al. (2016), and Marufa et al. (2017).

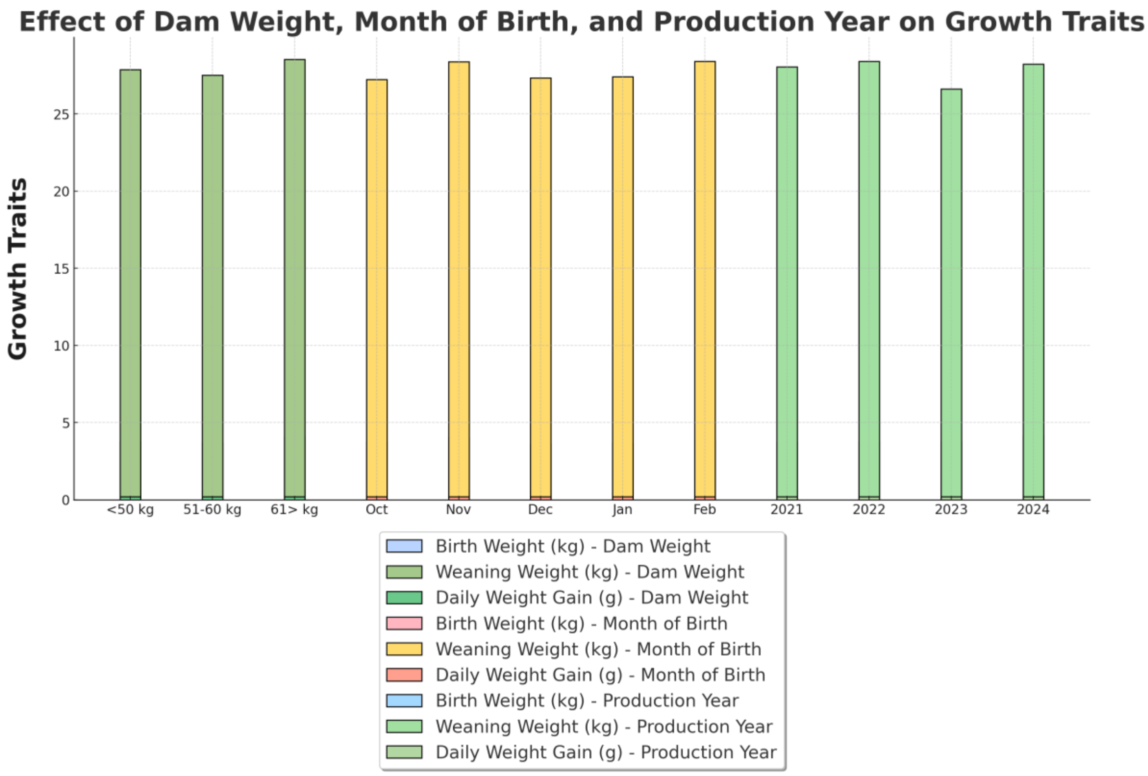
4.1.6 Production Year

According to the study, birth weight was not significantly impacted by the year of production (Table 4). 2014 had the lowest birth weight (3.72 ± 0.15 kg), and 2017 had the highest (4.15 ± 0.38 kg). These findings concur with those of Al-Azzawi et al. (1995) and Mellado et al. (2016)

Likewise, there was no discernible impact of the production year on weaning weight. 2015 had the highest average weaning weight (28.39 ± 0.38 kg), while 2016 had the lowest (26.60 ± 0.45 kg). This result is in line with Jawasreh's (2000) study.

On average daily weight gain, however, the production year had a highly significant impact (P<0.01). 2015 saw the greatest daily gain (0.210 ± 0.002 kg), while 2016 saw the lowest (0.197 ± 0.003 kg). This discrepancy may be explained by variations in the availability of green pasture, the state of the environment, and the caliber of animal management techniques. The findings are consistent with those of Said et al. (2000), Jawasreh (2000) and Mellado et al. (2016).

Figure 4: Effect of Dam Weight, Month of Birth, and Production Year on Growth Traits



Results

1. Offspring sex had no significant effect on daily or total milk yield produced by does (P > 0.05).
2. The type of birth had a highly significant effect (P < 0.01), with twin-bearing does producing more milk compared to those with single births.
3. Maternal age showed a highly significant effect (P < 0.01), where older does yielded higher milk production, likely due to better physiological maturity.
4. Maternal weight had a significant effect (P < 0.05), with heavier does producing greater milk yield.
5. Milk production was not significantly influenced by the month of birth (P > 0.05), indicating stable environmental and management conditions throughout the year.
6. The production year had a highly significant effect (P < 0.01), with 2024 outperforming other years in milk yield.

7. Offspring sex had no significant impact on birth weight ($P > 0.05$), but significantly affected weaning weight and daily weight gain ($P < 0.01$), with males outperforming females.
8. The type of birth had a highly significant impact on all growth parameters ($P < 0.01$), with single-born offspring exhibiting better performance than twins.
9. Maternal age did not significantly influence birth or weaning weights ($P > 0.05$), but had a significant effect on daily weight gain ($P < 0.05$).
10. Maternal weight had a highly significant impact on birth weight and daily weight gain ($P < 0.01$), and a significant effect on weaning weight ($P < 0.05$).
11. Growth characteristics were not significantly affected by the month of birth ($P > 0.05$), but the production year had a highly significant effect on daily weight gain in 2024 ($P < 0.01$).

Recommendations

1. Encouraging the breeding of twin-bearing does is advised to increase milk production and improve overall productivity.
2. Maternal age and weight should be considered in doe selection, as older and heavier does demonstrate superior productivity.
3. Maintaining stable environmental and management conditions year-round is essential to ensure consistent milk production.
4. Special attention should be given to the growth of male offspring due to their superior daily weight gain performance.
5. Additional care and management are recommended for single-born offspring to maximize their growth potential compared to twins.

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