International Journal of Biological Engineering and Agriculture
ISSN: 2833-5376
Volume 04 Number 01 (2025)
Impact Factor: 9.51
SJIF (2023): 3.916

www.inter-publishing.com

Article

The Effect of Calf sex and Number of Production Seasons on Milk Yield and Some Chemical Components in the Milk of Holstein Cows Raised in Sayed Dakhil City

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Abstract: This study was conducted in Iraq, Thi Qar Governorate, Sayed Dakhil District, Al-Nawi and Al-Ismail Village during the period from 10/1/2023 to 8/1/2024. To evaluating, the effect of the sex of the newborn and increasing the number of production seasons on the total and daily milk production and some chemical properties of the milk of Holstein cows raised in Sayed Dakhil City. The study included 380 raw milk samples taken from 38 Holstein cows of different ages suckling calves of different sexes. The results of the study showed a significant effect (P<0.05) of the sex of the calf on daily and total milk production, as mothers with female births significantly outperformed mothers with male births in daily and total milk production, with averages of (0.386±24, 115.82±7200) (0.358±18.52, 107.47±5557.58) respectively. The sex of the newborn also had a significant effect (p<0.05) on some chemical components of milk, as mothers with male births significantly (p<0.05) outperformed mothers with female births in the percentage of total solids, fat percentage, non-fat solids percentage, protein percentage, and mineral percentage. No significant effect (p<0.05) of the sex of the newborn was observed on the percentage of lactose sugar. The results showed a significant effect (p<0.05) of the number of production seasons on daily and total milk production. The highest average daily and total milk production was in cows with the fourth birth sequence and above, with averages of (0.251±25.25, 77.98±7575.54), while the lowest average daily and total milk production was in cows with the first birth sequence, with averages of (0.143±11.05, 43.02±3316), respectively. The birth sequence also had a significant effect (p<0.05) on some chemical components of milk, such as the percentage of total solids, fat percentage, and non-fat solids percentage. No significant effect (p<0.05) of the birth sequence was observed on the percentage of protein, lactose percentage, and ash percentage.

Keywords: Gender of calf; Number of production seasons; Chemical components of milk; Holstein

Citation: Al-Fayad, M. A. J. The Effect of Calf sex and Number of Production Seasons on Milk Yield and Some Chemical Components in the Milk of Holstein Cows Raised in Sayed Dakhil City. International **Journal of Biological Engineering and Agriculture 2025, 4(1), 89-95.**

Received: 10th Jan 2025
Revised: 11th Jan 2025
Accepted: 24th Jan 2025
Published: 27th Jan 2025

1. Introduction

Milk is considered a very important food for humans, and its derivatives are considered one of the main pillars of the diet followed. Cows are the largest source of milk consumed by humans in the world, followed by goats, sheep and camels (Maalouf et al., 2017). The Holstein cow breed is one of the best milk-producing breeds (Prasad, 2009). This breed is also characterized by its large size and high milk production. Its number in the United States was estimated at 11 million heads and its milk production was 60 million tons annually in 1980. In 2000, its number reached more than 9 million heads, producing more than 76 million tons of milk, according to FAO statistics. Its production increased in 2007 until it reached approximately 84 million tons of milk (Al-Qudsi and Elia, 2010). The average milk production of Holstein cows in Iraq for a 305-day season was 4566 kg (Al-Qarma, 2002).

Milk production and composition are affected by genetic and environmental factors. Genetics, season, production stage and environmental factors affect milk production and its components (Bucci et al., 2002). Milk production is also affected by the number of production seasons (Al-Abbasi, 2006). While Yang et al., (2013) indicated that milk components are affected by the frequency of births.

Minnick et al., (2001) indicated that milk production was significantly affected by the calf's sex, which was confirmed by (Al-Fayad, 2015). Milk composition and components are also affected by the sex of the newborn (Lande-Castillejos et al., 2005; Hinde, 2007). Al-Fayad (2015) and Taher et al., (2011) indicated that there was no significant effect of the calf's sex on milk components.

The study aims to know the effect of the sex of the newborn and the number of production seasons on the daily and total milk production and on some chemical properties of the milk of Holstein cows raised in the city of Sayed Dakhil.

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2. Materials and Methods

This study was conducted in Iraq, Dhi Qar Governorate, Sayed Dakhil District, Al-Nawi and Al-Ismail Village during the period from 10/1/2023 to 8/1/2024. To evaluating, the effect of the sex of the newborn and increasing the number of production seasons on the total daily milk production and some chemical properties of the milk of Holstein cows raised in Sayed Dakhil City. The study included 380 raw milk samples taken from 38 Holstein cows of different ages suckling calves of different sexes.

Nutrition:

The cows were fed concentrated, roughage and green fodder according to what was available in that season. Dry roughage and green fodder were given according to body weight, while concentrated fodder was given according to milk production at a rate of 1 concentrated fodder for every 2 kg of milk produced. The cows were in good health.

Estimating the amount of milk:

The milk was estimated using a Chinese-made electronic scale for calculating the daily milk production after the udder was completely emptied. The cows were milked manually twice a day, in the morning and evening.

Milk Sample Analysis:

380 raw milk samples were collected, each containing 100 ml. The samples were stored in a box containing crushed ice to prevent the samples from spoiling until they reached the laboratory for analysis. The milk components were estimated using a German-made Lacto Flash Funke Gerber device, while the percentage of total solids and ash were estimated according to (Al-Qudsi and Elia, 2010).

Statistical Analysis:

The data were analyzed statistically using the ready-made statistical program SPSS (2006) and the significance of the averages was tested using LSD.

3. Results

It is noted from Table (1) that there is a significant effect ($P<0.05$) of the calf's sex on daily and total milk production, as mothers with female births outperformed mothers with male births, with averages of (0.386±24, 115.82±7200) (0.358±18.52, 107.47±5557.58), respectively. This result is consistent with (Chegini et al., 2015; Hess et al., 2016; Djedovic et al., 2021; Cacic et al., 2022).

This may be due to the bias of mothers towards females as they produce more milk compared to males, and the sex of the fetus affects the ability of the mammary gland to formulate milk during the production season and also has dynamic effects across births as the sex of the fetus carried can enhance or reduce milk production during the lactation season, and the sex of the calf born in the first birth has a continuous effect on milk production and composition in subsequent births and that carrying female calves in the first birth increases milk production by about 445 kg in the following two seasons (Hinde

et al., 2014. These results are not consistent with what Graesbo et al., 2015; Haddad, 2020; Al-Fayad and Shareef, 2022).

Table 1. Average (±standard error) effect of the sex of the newborn on daily and total milk production

Gender	Daily milk production kg	Total milk production kg
Male	b18.52±0.358	b5557.58±107.47
Female	a24±0.386	a7200±115.82

Different letters within a column mean significant differences at the probability level (P<0.05).

Table (2) shows a significant effect (P<0.05) of calf sex on some chemical properties of milk, as mothers giving birth to males significantly outperformed mothers giving birth to females in the percentage of total solids, fat percentage, non-fat solids percentage, protein percentage, and minerals percentage. No significant effect (P<0.05) of calf sex was observed on the percentage of lactose sugar, and the averages were (0.072±11.77, 0.042±3.2, 0.164±8.33, 0.0177±3.10, 0.33±4.57, 0.033±0.58) (0.204±9.37, 0.114±2.74, 0.175±7.01, 0.0412±2.71, 0.14±4.2, 0.0042 ±0.49) respectively.

In the percentage of total solids, it agreed with (Al-Khauzia et al., 2020; Al-Fayad and Shareef, 2022). In the percentage of fat, the results agreed with (Hinde, 2007; Hinde, 2009; Atashi et al., 2012; Chegin et al., 2015; Al-Fartosi and Al-Moussawi, 2017; Cacic et al., 2022). In the percentage of non-fat solids, it partially agreed with (Al-Fartosi and AL-Moussawi, 2017; Haddad, 2020).

In the protein ratio, the results agreed with ande-Castillejos et al., 2005; Hinde, 2007; Cacic et al., 2022). The lactose ratio, the results agreed with (Al-Fayad, 2015; Al-Fartosi and AL-Moussawi, 2017; Al-Fayad and Shareef, 2022). Ash ratio, it partially agreed with (Al-Fartosi and AL-Moussawi, 2017) and did not agree with (Taher et al., 2011; Al-Fayad and Shareef, 2022).

This may be due to the fact that male calves are larger and grow better after birth than females (Minick et al., 2001). The male hormone testosterone increases protein and mineral metabolism, which causes an increase in muscle and bone mass, so males are larger than females (Al-Qudsi and Elia, 2010). Therefore, an increase in the content of milk components is observed when the newborn is male, with a decrease in milk production compared to female newborns (Hinde, 2007). It may also be due to the effect of differences in hormone levels in the udder of mothers with different calves' sexes, which affect the composition of the milk due to differences in the development of the mammary gland of cows (Lvell and Bathgate, 2002). It may also be due to differences in the concentrations of vital substances in milk, such as immune factors and hormones that affect the growth of offspring in the milk produced by males and females (Neville et al., 2012).

Table 2. Average (±standard error) effect of calf sex on some chemical properties of milk

Gender	TS%	F%	SNF%	P%	L%	Ash%
Male	11.77a±0.072	a3.2±0.042	a8.33±0.164	a3.10±0.0177	a4.57± 0.33	a0.58±0.033
Female	9.37b±0.0204	b2.74±0.114	b7.01±0.175	b 2.71±0.0412	a4.2±0.14	b0.49±0.0042

Different letters within a column mean significant differences at the probability level (P<0.05). (TS %: Total solids, F%: Fat, SNF%: Non-fat solids, P%: Protein, L%: Lactose, Ash%: Ash or mineral content).

It is noted from Table (3) that there is a significant effect (P<0.05) of the number of births on daily and total milk production, as cows with the fourth birth sequence and above outperformed significantly (P<0.05) over cows with the first, second and third birth sequences, and cows with the third birth sequence also outperformed significantly (P<0.05) over cows with the first and second birth sequences, while cows with the second birth sequence outperformed significantly (P<0.05) over cows with the first birth, and the averages reached (0.143±11.05, 0.132±15.75, 0.223±20.33, 0.251±25.25) (43.02±3316.67, 39.83±4725, 67.04±6100, 77.98±7575.54) respectively. This result is consistent with Al-Masry et al. (2012), Jonas et al., (2016), Koc (2017), and Al-Fayad and Shareef (2022).

This may be due to the large body size and increased development of the udder with repeated births, as the development of the udder tissues is completed and the size of the digestive system (rumen) increases, so older cows consume larger amounts of feed and water compared to younger cows (Al-Qudsi and Elia, 2010; Nyamushamba et al., 2014). Or because cows in their first production season could not fully show their genetic ability, and their systems are not fully mature, so the mammary gland of cows in the first season is not fully mature, while cows reach mature body weight in the fourth season of birth (Cilek and Tekin2005; Chenymabuga and Mseleko, 2009). This result does not agree with Gumessa and Melaku (2012), while Hadad (2020) found a decrease in milk production with the increase in the number of production seasons.

Table 3. Average (±standard error) effect of the number of milk production seasons on daily and total milk production

Lactation Number	Daily milk production kg	Total milk production kg
1	d11.05±0.143	d3316±43.02
2	c15.75±0.132	c4725±39.83
3	b20.33±0.223	b6100±67.04
and above 4	a25.25±0.251	a7575.54±77.98

Different letters within a column mean significant differences at the probability level (P<0.05).

Table (4) shows a significant effect (P<0.05) of the frequency of births on some chemical properties of milk in the percentage of total solids. Mothers with the first and second birth sequences significantly outperformed mothers with the third and fourth birth sequences and above. Likewise, mothers with the third birth sequence significantly outperformed mothers with the fourth birth sequence and above. There were no significant differences (P<0.05) between the first and second birth sequences. The averages were (0.171±11.93, 0.077±11.91, 0.268±11.48, 0.152±10.47) respectively.

As for the percentage of fat, cows with the second birth sequence were significantly superior (p<0.05) to cows with the first, third, and fourth birth sequences and above. Likewise, cows with the first and third birth sequence were significantly superior (p<0.05) to cows with the fourth birth sequence and above. No significant differences were observed (p<0.05) between cows with the first and third birth sequences. The averages were (0.059±3.45, 0.03±3.76, 0.097±3.37, 0.058±2.76) respectively.

In the percentage of non-fat solids, cows with the first birth sequence were significantly superior (P<0.05) to cows with the second, third and fourth birth sequences and above, and cows with the second and third birth sequence were significantly superior (P<0.05) to cows with the fourth birth sequence and above, and there were no significant differences (P<0.05) between cows with two births and three births, and the averages were (0.117±8.48, 0.066±8.15, 0.173±8.13, 0.104±7.70) respectively. No significant effect (P<0.05) of the number of production seasons was observed on the percentage of protein, lactose and ash.

The results of Table (4) show that the milk components in young or young animals were high compared to older animals, as indicated by (Al-Khauzi et al., 2020; Al-Zarkani et al., 2020; Haddad, 2020; Al-Fayad and Shareef, 2022). Or the reason may be due to the inverse relationship between the amount of milk production and the proportions of milk components (Al-Fayad, 2023).

Table 4. Effect of the number of milk production seasons on some chemical properties of milk

Lactation Number	TS%	F%	SNF%	P%	L%	Ash%
1	a11.93±0.171	b3.45±0.059	a8.48±0.117	a3.14± 0.044	a4.74± 0.063	a0.59±0.0167
2	a11.91±0.077	a3.76±0.03	b8.15±0.066	a3.01±0.025	a4.55±0.037	a0.58±0.0045
3	b11.48±0.268	b3.37±0.097	b8.13±0.173	a2.99±0.063	a4.53±0.095	a0.64±0.0218
4and above	c10.47±0.152	c2.76±0.058	c7.70±0.104	a2.9±0.060	a4.52±0.096	a0.56±0.0107

Different letters within a column mean significant differences at the probability level ($P<0.05$).

4. Discussion

The findings of this study provide valuable insights into the influence of calf sex and the number of production seasons on milk yield and its chemical composition in Holstein cows raised in Sayed Dakhil City. The data reveal a significant impact of calf sex on both daily and total milk production, with cows giving birth to female calves outperforming those with male calves. This aligns with previous studies (Chegini et al., 2015; Hess et al., 2016; Djedovic et al., 2021) that suggest maternal bias towards female offspring leads to increased milk yield. The underlying mechanisms could involve hormonal variations during gestation, which affect mammary gland development and lactation performance (Hinde et al., 2014).

Interestingly, while female calves are associated with higher milk yield, male calves correspond to higher concentrations of certain chemical components in milk, including total solids, fat, non-fat solids, protein, and mineral percentages. This could be attributed to the greater growth demands of male calves, potentially influencing maternal nutrient allocation (Minick et al., 2001; Neville et al., 2012). However, the lack of significant differences in lactose content across both groups suggests that lactose synthesis may be less sensitive to these maternal or fetal factors.

The number of production seasons also significantly affects milk yield, with the highest production observed in cows with four or more lactations. This trend is consistent with findings from Al-Masry et al. (2012) and Jonas et al. (2016), indicating that physiological maturity and enhanced mammary gland development over successive lactations contribute to increased milk output. Conversely, younger cows in their first lactation showed lower milk yield, likely due to incomplete mammary development and lower feed intake capacity (Nyamushamba et al., 2014).

Regarding milk composition, the percentage of total solids, fat, and non-fat solids was significantly influenced by the number of production seasons. Younger cows exhibited higher concentrations of these components, possibly due to an inverse relationship between milk volume and component concentration (Al-Fayad, 2023). This phenomenon reflects a dilution effect, where increased milk volume in older cows leads to lower concentrations of specific milk solids.

These results highlight the complex interplay between biological factors such as calf sex and lactation number on dairy production metrics. They underscore the importance of considering these variables in herd management practices to optimize milk yield and quality. Future research could further explore the hormonal and metabolic pathways involved in these effects, providing deeper insights into lactation biology and supporting improved dairy farming strategies.

5. Conclusion

It is concluded from this study that the sex of the newborn had a significant effect on daily and total milk production when the calf was female, and the sex of the calf had a significant effect on most of the studied chemical properties of milk when the calf was male. No significant effect of the sex of the calf was observed on the percentage of lactose. The increase in the number of births or the increase in the number of milk production seasons had a significant effect on daily and total milk production, as milk production increased with the increase in the number of production seasons, and the highest production was in the fourth birth and above. It is noted that this production will decrease because of tooth erosion due to the cows' advancing age. The sequence of births had a significant effect on the percentage of total solids, fat percentage, and non-fat solids percentage, and an insignificant effect on the percentage of protein, lactose percentage, ash percentage, or minerals.

REFERENCES

[1] L. Yang, Q. Yang, M. Yi, Z. H. Pang, and B. H. Xiong, "Effects of seasonal change and parity on raw milk composition and related indices in Chinese Holstein cows in northern China," *J Dairy Sci*, vol. 96, no. 11, pp. 6863–6869, Nov. 2013, doi: 10.3168/jds.2013-6846.

[2] N. K. Taher, H. J. Hassan, and B. J. Mohammad, "A study effect of age of dam and sex of birth on chemical and physical composition of milk in some farm animals," *Kufa Journal For Veterinary Medical Sciences*, vol. 2, no. 2, pp. 8–17, Dec. 2011, doi: 10.36326/kjvs/2011/v2i23906.

[3] M. V. Reddy, "Statistical Package for Social Sciences," in *Statistical Methods in Psychiatry Research and SPSS*, Apple Academic Press, 2019, pp. 305–322. doi: 10.1201/9780429023309-21.

[4] G. B. Nyamushamba, T. E. Halimani, V. E. Imbayarwo-Chikosi, and B. Tavirimirwa, "Comparative evaluation of non-genetic factors affecting milk yield and composition of Red Dane and Jersey cattle in Zimbabwe," *Springerplus*, vol. 3, no. 1, Feb. 2014, doi: 10.1186/2193-1801-3-88.

[5] A. Aydin, "Precision Livestock Farming in Animal Husbandry & Dairy Science," *Archives of Animal Husbandry & Dairy Science*, vol. 1, no. 1, Nov. 2018, doi: 10.33552/aahds.2018.01.000503.

[6] J. A. Minick, D. S. Buchanan, and S. D. Rupert, "Milk production of crossbred daughters of high- and low-milk EPD Angus and Hereford bulls.," *J Anim Sci*, vol. 79, no. 6, p. 1386, 2001, doi: 10.2527/2001.7961386x.

[7] L. A. Marasco, "Unsolved Mysteries of the Human Mammary Gland: Defining and Redefining the Critical Questions from the Lactation Consultant's Perspective," *J Mammary Gland Biol Neoplasia*, vol. 19, no. 3–4, pp. 271–288, Dec. 2014, doi: 10.1007/s10911-015-9330-7.

[8] A. J. García, T. Landete-Castillejos, J. J. Garde, and L. Gallego, "Reproductive seasonality in female Iberian red deer (Cervus elaphus hispanicus)," *Theriogenology*, vol. 58, no. 8, pp. 1553–1562, Nov. 2002, doi: 10.1016/s0093-691x(02)01048-8.

[9] "Milk production growth from 2006-08 to 2018," Jul. 2009, *Organisation for Economic Co-Operation and Development (OECD)*. doi: 10.1787/agr_outlook-2009-graph10_3-en.

[10] A. Koc, "Effects of Some Environmental Factors on Milking Time Milk Yield in Red Holstein Cows," *Turkish Journal of Agriculture - Food Science and Technology*, vol. 5, no. 8, pp. 917–922, Aug. 2017, doi: 10.24925/turjaf.v5i8.917-922.1240.

[11] E. MİKÓNÉ JÓNÁS, S. ATASEVER, M. GRÁFF, and H. ERDEM, "Macar Siyah Alaca İneklerinde Süt Verimi, Bileşimi ve Somatik Hücre Sayısını Etkileyen Genetik Olmayan Faktörler," *Kafkas Univ Vet Fak Derg*, 2016, doi: 10.9775/kvfd.2015.14672.

[12] K. Hinde, A. J. Carpenter, J. S. Clay, and B. J. Bradford, "Holsteins Favor Heifers, Not Bulls: Biased Milk Production Programmed during Pregnancy as a Function of Fetal Sex," *PLoS One*, vol. 9, no. 2, p. e86169, Feb. 2014, doi: 10.1371/journal.pone.0086169.

[13] R. Ivell and R. A. D. Bathgate, "Reproductive Biology of the Relaxin-Like Factor (RLF/INSL3)1," *Biol Reprod*, vol. 67, no. 3, pp. 699–705, Sep. 2002, doi: 10.1095/biolreprod.102.005199.

[14] K. Hinde, "Richer milk for sons but more milk for daughters: Sex-biased investment during lactation varies with maternal life history in rhesus macaques," *American Journal of Human Biology*, vol. 21, no. 4, pp. 512–519, Apr. 2009, doi: 10.1002/ajhb.20917.

[15] K. Hinde, "First-time macaque mothers bias milk composition in favor of sons," *Current Biology*, vol. 17, no. 22, pp. R958–R959, Nov. 2007, doi: 10.1016/j.cub.2007.09.029.

[16] M. K. Hess, A. S. Hess, and D. J. Garrick, "The Effect of Calf Gender on Milk Production in Seasonal Calving Cows and Its Impact on Genetic Evaluations," *PLoS One*, vol. 11, no. 3, p. e0151236, Mar. 2016, doi: 10.1371/journal.pone.0151236.

[17] A. Pratap, D. K. Verma, P. Kumar, and A. Singh, "Effect of Pregnancy, Lactation Stage, Parity and Age on Yield and Components of Raw Milk in Holstein Friesian Cows in organized Dairy form in Allahabad," *IOSR J Agric Vet Sci*, vol. 7, no. 2, pp. 112–115, 2014, doi: 10.9790/2380-0721112115.

[18] yahya öztrürk and M. Sarı, "Effect of Environmental Factors on Fertility and Milk Yield Traits of Simmental Cattle Raised on Different Production Scales in Tropical Region (Teke)," Mar. 2024, doi: 10.21203/rs.3.rs-3964674/v1.

[19] R. Djedović, D. Stanojević, V. Bogdanović, D. O. Andrić, L. Samolovac, and T. Stamenić, "Bias of Calf Sex on Milk Yield and Fat Yield in Holstein Crossbreed Cows," *Animals*, vol. 11, no. 9, p. 2536, Aug. 2021, doi: 10.3390/ani11092536.

[20] K. Græsbøll, C. Kirkeby, S. S. Nielsen, and L. E. Christiansen, "Danish Holsteins Favor Bull Offspring: Biased Milk Production as a Function of Fetal Sex, and Calving Difficulty," *PLoS One*, vol. 10, no. 4, p. e0124051, Apr. 2015, doi: 10.1371/journal.pone.0124051.

[21] Z. C. Lyimo, R. Nkya, L. Schoonman, and F. J. C. M. van Eerdenburg, "Post-partum Reproductive Performance of Crossbred Dairy Cattle on Smallholder Farms in Sub-humid Coastal Tanzania," *Trop Anim Health Prod*, vol. 36, no. 3, pp. 269–279, Apr. 2004, doi: 10.1023/b:trop.0000016834.65290.d6.

[22] M. Čačić, "The effect of calf gender on milk lactation traits and lactation gain of Holstein and Simmental cows," *Mljekarstvo*, vol. 72, no. 3, pp. 123–130, Jun. 2022, doi: 10.15567/mljekarstvo.2022.0301.

[23] U. Bernabucci, N. Lacetera, B. Ronchi, and A. Nardone, "Effects of the hot season on milk protein fractions in Holstein cows," *Animal Research*, vol. 51, no. 1, pp. 25–33, Jan. 2002, doi: 10.1051/animres:2002006.

[24] A. Chegini, N. Ghavi Hossein-Zadeh, and H. Hosseini-Moghadam, "Effect of calf sex on some productive, reproductive and health traits in Holstein cows," *Spanish Journal of Agricultural Research*, vol. 13, no. 2, p. e0605, May 2015, doi: 10.5424/sjar/2015132-6320.

[25] K. Al-Fartosi, "SERUM ESTRADIOL AND PROGESTERONE IN IMMATURE MALE AND FEMALE WATER BUFFALO(BUBALUS BUBALIS) IN MARSHES OF IRAQ," *Basrah Journal of Veterinary Research*, vol. 11, no. 1, pp. 116–121, Jun. 2012, doi: 10.33762/bvetr.2012.54765.

[26] Z. S. T. Al-Abbasi and A. K. A. Farhan Al-Janabi, "The Biological Impact of Co-Treatment with Coenzyme Q10 and Zinc Methionine on Some Biochemical Parameters in Awassi Ewes," *International Journal of Pharmaceutical and Bio-Medical Science*, vol. 04, no. 03, Mar. 2024, doi: 10.47191/ijpbms/v4-i3-15.

[27] D. F. Alfekaiki, "Characteristics of Fat Milk Iraqi Buffalo (Bubalus bubalis)," *Res J Pharm Technol*, vol. 11, no. 10, p. 4349, 2018, doi: 10.5958/0974-360x.2018.00796.5.

[28] A. YAyied and B. FZaqeer, "POLYMORPHISM OF COI GENE AND ITS ASSOCIATION WITH MILK PRODUCTION AND LAMB?S GROWTH BEFORE WEANING OF IRAQI AWASSI SHEEP.," *Int J Adv Res (Indore)*, vol. 6, no. 12, pp. 1317–1323, Nov. 2018, doi: 10.21474/ijar01/8272.

[29] S. F. Al-Dabbagh, "Study of the relationship between the production of milk and some of its components with the growth of lambs in two breeds of Iraqi sheep," *Iraqi Journal of Veterinary Sciences*, vol. 33, no. 2, pp. 87–95, Sep. 2019, doi: 10.33899/ijvs.2019.163172.

[30] A. Luaibi Dagher Al-Khauzai, R. Kawkab Al-Muhja, O. Ibrahim Mahdi Al-Ghalibi, R. mukheef Al-fatlawi, R. Neamah Kadhim, and B. Mohammed Kareem Al-Kafaji, "The effect of sex of calve and parity on milk production and its components in Iraqi buffaloes," *IOP Conf Ser Earth Environ Sci*, vol. 553, no. 1, p. 12031, Aug. 2020, doi: 10.1088/1755-1315/553/1/012031.

[31] I. K. A. Al-Zarkan, A. J. Ahmad, and N. N. Al-Anbari, "Effect of Location and Parity in Milk Production, Service per Conception and Growth in Iraqi Buffaloes," *Ann Trop Med Public Health*, vol. 23, no. 10, 2020, doi: 10.36295/asro.2020.231044.

[32] F. F. Jumaa1, N. N. A. Al-Hajo2, A. S. Abdulwahid3, and A. A. Al- Mijbel4, "CHITOSAN EFFECT ON MEAT QUALITY IN LOCAL QUAILS MALE," *iraq journal of market research and consumer protection*, vol. 13, no. 2, pp. 149–158, Dec. 2021, doi: 10.28936/jmracpc13.2.2021.(13).

[33] H. Atashi, M. J. Zamiri, and M. B. Sayyadnejad, "Effect of twinning and stillbirth on the shape of lactation curve in Holstein dairy cows of Iran," *Arch Anim Breed*, vol. 55, no. 3, pp. 226–233, Oct. 2012, doi: 10.5194/aab-55-226-2012.