Research Article

Colostrum Quality in Saudi Ewes: Breed, Parity, and Seasonal Effects on Immunoglobulins and Glucose Secretion Dynamics Postpartum

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Abstract | Lambs are born without immunoglobulins (Igs) in their bloodstream to fight off infections because the epitheliochorial nature "brick wall between the maternal and fetal blood supplies" of the ewe's placenta prevents transfer of immunoglobulins from the ewes to the fetus during pregnancy. The present study is designed to investigate the values of Igs and glucose in colostrum/milk of ewes across the four days postpartum through Harri, Najdi and Arabi ewe breeds, sex of newborns, months of deliveries, and parity. Colostrum and milk samples were collected from 110 ewes (48 Harri, 44 Arabi, and 18 Najdi) across days 1, 2, 3 and 4 postpartum. The Colostrum and milk samples of Harri, Najdi and Arabi ewes underwent refractometer immunoglobulins determination directly after milking in addition to glucose. The colostrum and milk immunoglobulins values were classified according to Arabi, Harri and Najdi ewe breeds, sex of newborns, months of deliveries, and parity. The results showed that Harri ewes gave higher twin rate (20/48; 41.66%) compared to Arabi (16/44; 36.36%) and Najdi (6/12; 33.33%) ewes during the experimental period. The Najdi ewes exhibited higher immunoglobulins values of colostrum and milk samples compared to Arabi and Harri ones across days 1, 2, 3 and 4 postpartum. Deliveries that occurred in October month showed higher immunoglobulins values of colostrum and milk samples compared to other months. Higher parity was associated with higher immunoglobulin values in colostrum and milk samples of all breeds. The male and/or female twin deliveries gave higher Igs values of colostrum and milk samples compared to single male or female deliveries. In addition, the Harri ewes exhibited higher glucose values of colostrum and milk samples compared to Arabi and Najdi ones across days 1, 2, 3 and 4 postpartum. In conclusion, Najdi breed, month of parturition, twin deliveries, and higher parity showed higher colostrum and milk Igs values if compared to Harri and Arabi breeds and corresponding variables.

Keywords: Harri, Arabi, Najdi, Ewes, Immunoglobulins, Lambs' Sex

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INTRODUCTION

In the Kingdom of Saudi Arabia, the livestock sector serves as a fundamental pillar of the national economy, driven by a deep-rooted cultural preference for mutton that necessitates a combination of local rearing and international trade. This industry provides a primary livelihood for approximately 80% of the rural populace, encompassing various production models from nomadic herding to integrated agricultural communities (Aldosari, 2018). Due to the region's formidable climate and poor soil fertility, which restrict traditional crop cultivation, sheep farming has emerged as the most viable and resilient strategy for small-scale agricultural stability. Reflecting this importance, recent national statistics report a sheep population of 20.5 million, with a staggering 19 million managed within traditional pastoral systems, highlighting their indispensable contribution to the Saudi agricultural landscape (MEWA, 2023).

The selection of sheep breeds in the Kingdom of Saudi Arabia is a critical factor that determines the economic and biological efficiency of the livestock sector. Saudi Arabia possesses a rich genetic diversity, primarily represented by the Najdi, Arabi, and Harri breeds, each specifically evolved to survive the Kingdom's hyper-arid climate, high temperatures, and sparse vegetation (Ayadi *et al*., 2014; Al-Mufarji *et al*., 2022). These breeds are not merely cultural symbols but are essential to national food security, as they exhibit unique physiological adaptations such as the fat tail sheep for energy storage or the heat-tolerant coat of the Harri that allow for sustainable meat production under extensive management (Suliman *et al*., 2021). Furthermore, breed type significantly influences reproductive parameters like litter size and twinning rates, as well as carcass quality and consumer preference (Suliman *et al*., 2021), making the preservation and genetic improvement of these local breeds a top priority for achieving the goals of Saudi Vision 2030 (MEWA, 2022).

The Harri sheep is a prominent indigenous breed primarily found in the western and southwestern regions of Saudi Arabia, particularly across the Hijaz Mountains (FAO, 2022). Unlike the fat-tailed breeds, the Harri is a thin-tailed, coarse-wool breed that has gained immense popularity among commercial producers due to its exceptional reproductive efficiency (Aldawish *et al*., 2025). It is widely recognized as the most prolific local breed, characterized by high twinning rates and a shorter lambing interval, which allows for a high turnover of offspring. Physically, the Harri is usually all-white with a medium-sized frame, and its physiological makeup allows it to adapt remarkably well to diverse topographical conditions, from rugged mountainous terrains to intensive farm settings. Due to its high fertility and rapid growth rates in lambs, the Harri is increasingly becoming the breed of choice for intensive production systems aimed at meeting the rising domestic demand for fresh lamb in the Kingdom (Ahmed *et al*., 2018).

The Najdi sheep is a prestigious and iconic breed of Saudi Arabia, originating from the Nejd plateau (Ahmed *et al*., 2018). It is easily recognized by its large frame, tall stature, and distinctive appearance, featuring a long, silky black fleece and a white face. Unlike many other desert breeds, the Najdi is a fat-tailed sheep but is specifically valued for its impressive size and rapid skeletal growth, making it the "giant" of the local breeds. While it is less prolific in terms of twinning compared to the Harri, the Najdi excels in producing high-quality meat and is often the breed of choice for luxury markets and traditional festivals due to its imposing aesthetic. Its physiological adaptations allow it to withstand the extreme dry heat of the central region, though it typically requires slightly better nutritional management than the Naeimi breeds to reach its full genetic potential in body weight and wool quality.

The Arabi sheep is a primary dual-purpose indigenous breed in Iran, utilized for both wool and meat production (Moradi *et al*., 2022). Predominantly found in the southwestern province of Khuzestan with a population exceeding 1.8 million, the breed is highly resilient to humid-tropical climates (Shokrollahi and Baneh, 2012; Roshanfekr *et al*., 2015). These sheep are fat-tailed displayed a variety of coat colors including white, cream, black, and brown. While rams are typically horned, ewes are polled, with mature weights ranging from 45–50 kg for females and 60–65 kg for males. Consequently, it forms the backbone of the traditional nomadic and semi-intensive production systems, playing a vital role in contributing significantly to the red meat supply. This study is designed to explore the concentrations of immunoglobulins (Igs) and glucose in colostrum/milk of Harri, Arabi and Najdi ewes across the four days postpartum. The data were presented according to impacts of Arabi, Harri and Najdi ewe breeds, Months of parturition, parity, and lambs' sex either single or twin on colostrum and milk Igs and glucose secretion dynamics postpartum. Therefore, the study shows the relationship between genetic and environmental factors on colostrum and milk Igs of Arabi, Harri and Najdi ewes during the peak delivery season in Al-Ahsa region.

MATERIALS AND METHODS

Experimental design and ethical approval

The present study aimed to evaluate the changes in immunoglobulins and glucose secretion dynamics across four days postpartum of Arabi, Harri and Najdi ewes according to breeds, sex of single and twin lambs, months of deliveries, and parities (Figure 1) (Alkhalifah Mohammed 2026). One hundred and ten Arabi (44), Harri (48) and Najdi (18) ewes of 1-5 lactations were chosen during the experimental period under semi-extensive management system. The environmental conditions during experimental period including temperature and relative humidity were presented in (Figure 2). The study protocol was approved by the King Faisal University ethical committee [KFU-REC-2025-SEP-EA256]. The Colostrum and milk samples of 44 Arabi, 48 Harri, and 18 Najdi ewes' breeds were collected from October 2025 to February 2026 and were analyzed in the animal and fish production department, Agriculture and Food Sciences College, King Faisal University.

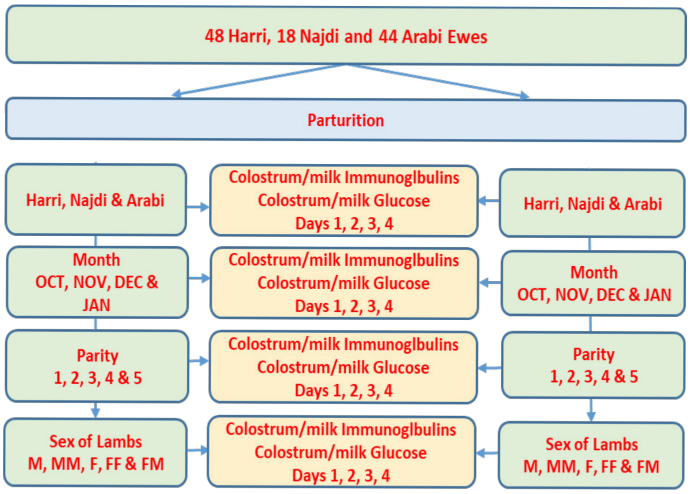

Figure 1: Experimental design of the study OCT October; NOV November; DEC December; JAN January; FEB February M. Male; MM twin male; F. Female; FF. twin female; FM. Twin male and female.

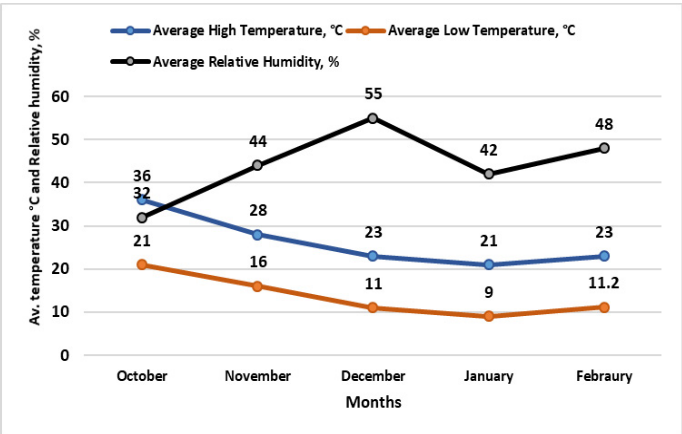

Figure 2: Average temperature (°C) and relative humidity (%) during the study.

Colostrum and milk collection

Colostrum and milk samples of 44 Arabi, 48 Harri, and 18 Najdi ewes collected after parturition but before lambs suckled for days 1, 2, 3 and 4 days. Colostrum and milk samples were collected using a sterile hand-milking technique into pre-labeled, plastic containers. The recorded labeled data on plastic containers were ewes' breeds (44Arabi, 48 Harri, and 18 Najdi ewes), lambs' sex (single and twin sex either male and/or female), month of parturition (October, November, December, January, and February), and parity (parity1 to parity 5). To ensure the safety of both the ewes and the milker, the ewes were gently restrained throughout the milking sample process. Standardized pre-milking sanitary measures were followed, including cleaning the udder and teats with warm water and drying them thoroughly with a sterile towel. To avoid contamination, the initial foremilk was stripped and discarded. Subsequently, 50 ml samples were collected during the initial postpartum milking, with follow-up collections performed on days 2, 3, and 4. Immediately following collection, the colostrum/milk samples were analyzed for determination of immunoglobulins (Igs) and glucose concentrations. Finally, the samples were labeled, sealed, and transferred to a freezer to maintain their chemical composition for subsequent laboratory analysis.

Immunoglobulins and glucose determination of colostrum and milk

The digital Brix refractometer was used to measure Igs values in colostrum and milk samples after immediate collection (SOONDA Official Store, China). The refractometer was cleaned and calibrated to 0.0% Brix value using deionized water. Colostrum/milk collected samples were thoroughly mixed before a 2–3 drop aliquot was applied to the prism via a disposable pipette. The cover was closed to ensure accuracy and to eliminate air bubbles, and a 15–30 second temperature equilibration period was observed before recording the digital Brix value. Between each sample measurement, the prism and cover were cleaned with distilled water and dried using clean cloth/tissue to avoid cross-contamination. The values of colostrum and milk glucose were recorded using blood glucose meter (ICare, Taiwan). Ten µl of colostrum and milk sample put on ICare glucose strips for recording colostrum and milk glucose values.

Statistical analysis

The immunoglobulins (Brix refractometer) and glucose values for colostrum and milk samples at day 1, day 2, day 3, and day 4 postpartum of Arabi, Harri, and Najdi ewes' breeds were compared (Corp 2020; SPSS version 27.0). The data were subjected to statistical analysis of repeated measures ANOVA for ewe breeds (Arabi, Harri, and Najdi), lambs' sex (single and twin sex either male and/or female) months (October, November, December, January and Febraury), and parity (parity1 to parity5), and using the General Linear Model (SPSS version 27.0). Comparison between the groups were considered statistically significant at $p < 0.05$.

RESULTS

Variables distribution throughout the study

The impacts of Arabi, Harri, and Najdi ewes' breeds, lambs' sex, month of parturition, and parity on immunoglobulins secretion dynamics and glucose values postpartum in colostrum/milk are presented in Figure 3A-D and (Table 1). The herd maintains an almost higher imbalance between the Arabi (44), Harri (48), and Najdi (18) ewes' breeds (figure 3A) as well as an almost 50.65/49.35 split between male and female offspring (78 males and 76 females) (Figure 3B). The parity bar chart shows a healthy herd structure, with the majority of dams in their prime (parity 1, 2, and 3) (Figure 3C). The Figure 3C illustrates the distribution of Arabi, Harri, and Najdi ewes based on parity (from 1 to 5) and birth type (single vs. twin). The data reveals a clear shift in reproductive trends as parity increases, with twin births becoming the dominant trait in higher parities for all Arabi, Harri, and Najdi ewes. In addition, the Arabi ewes gave 63.63% single and 36.37% twin, Harri ewes gave 58.33% single and 41.66% twin, and Najdi ewes gave 66.67% single and 33.33% twin. There is a significant upward trend in deliveries as winter progresses, peaking with 46 deliveries in December (Figure 3D). However, the 24 first-time dams (parity 1) represent a critical group that requires the most attention for colostrum management, especially during the January peak.

Immunoglobulins secretion dynamics

Immunoglobulins secretion dynamics in colostrum and milk of Arabi, Harri, and Najdi ewes is presented in (Table 1). The most prominent finding is the highly significant effect of days postpartum ($P < 0.001$) on the measured immunoglobulins levels. Regardless of breeds, genders, month, or parity, there is a consistent and sharp linear decline from day 1 to day 4. At day1, the immunoglobulins values were at their maximum, ranging from 25.00 to 27.018 versus values at day 4, which reach their minimum ranging from 11.600 to 14.562. In addition, Harri breed showed the lowest Igs values during the four days postpartum followed by Arabi and Najdi breeds.

The month of parturition exerted a highly significant impact ($P < 0.001$) on the immunoglobulins concentrations. Colostrum and milk samples measured in October started with significantly higher immunoglobulins levels (35.100 on day 1) compared to all other months. From November to February months, these months showed lower Igs levels (29.500–27.700 on day 1) and decreased gradually ($P > 0.05$) but significantly lower than October Igs levels. These trends for months' effect on Igs levels occurred throughout the four-day period of colostrum and milk samples.

There is a significant gradual increase of Igs values from parity 1 to parity 5. The fifth parity yielded the highest Igs values throughout the four-day period. This suggests a physiological peak in Igs production or quality during the fifth lactation season. The data showed that the Igs profile being measured is relatively higher in Najdi ewes if compared to Harri and Arabi ones. The Najdi ewes gave higher ($P > 0.05$) Igs (31.562) compared to those of Harri (27.733) and Arabi (28.675)

Table 1: Effects of Arabi, Harri, and Najdi ewe breed, month, gender, and parity on immunoglobulins secretions dynamics across four days postpartum

Factor	Level	Time				SEM	P value		
		Day1	**Day2**	**Day3**	**Day4**		**Breed**	**Day**	**Interaction**
	Harri	27.733^{a}	22.622^{b}	17.111^{c}	11.600^{d}	3.24	0.050	0.001	0.150
Breed	Arabi	28.675^{a}	23.756^{b}	18.486^{c}	11.864^{d}	3.40			
	Najdi*	31.562^{a}	25.937^{b}	20.375^{c}	14.562^{d}	3.38			
	OCT**	35.100^{a}	28.800^{b}	24.600^{c}	19.200^{d}	3.12	Month	Day	**Interaction**
Month	NOV	29.500^{a}	24.450^{b}	19.400^{c}	13.700^{d}	3.13			
	DEC	29.366^{a}	24.133^{b}	18.033^{c}	12.000^{d}	3.18	0.001	0.001	0.230
	JAN	26.175^{a}	21.300^{b}	15.925^{c}	9.775^{d}	3.16			
	FEB	27.70	22.60	16.60	10.50	3.21			
	M	28.666^{a}	23.566^{b}	18.233^{c}	12.666^{d}	3.17	Gender	Day	Interaction
	MM*	31.666^{a}	27.333^{b}	20.000^{c}	13.333^{d}	3.16	0.05	0.001	0.213
Gender	F	28.225^{a}	23.050^{b}	17.625^{c}	11.425^{d}	3.14			
	FF	31.666^{a}	25.333^{b}	19.333^{c}	14.666^{d}	3.26			
	FM	28.695^{a}	23.708^{b}	18.750^{c}	12.416^{d}	3.15			
Parity	Parity1	27.541^{a}	22.833^{b}	17.333^{c}	11.000^{d}	3.14	Parity	Day	Interaction
	Parity2	28.518^{a}	23.111^{b}	17.629^{c}	12.148^{d}	3.19			
	Parity3	28.739^{a}	23.478^{b}	18.260^{c}	12.826^{d}	3.14	0.05	0.001	0.225
	Parity4*	29.666^{a}	24.833^{b}	18.666^{c}	11.000^{d}	3.23			
	Parity5*	29.950^{a}	24.600^{b}	19.400^{c}	13.200^{d}	3.18			

$^{a–d}$; values with small superscripts within the same row differ significantly at $P < 0.05$. *,**; levels with star superscripts within the same column differ significantly at $P < 0.05$ and 0.01, respectively. OCT: October; NOV: November; DEC: December; JAN: January; FEB: Febraury. M: Male; MM: twin male; F: Female; FF: twin female; FM: Twin male and female.

Table 2: Glucose secretion dynamics (mg/dl) of Harri, Arabi and Najdi ewe colostral/milk across days 1, 2, 3 and 4 postpartum.

Breed	Time				SEM	P value		
	Day 1	Day 2	Day 3	Day4		Breed	Time	Interaction
Harri**	40.10^{a}	25.50^{a}	20.80^{c}	16.00^{c}	3.70	0.001	0.001	0.246
	(12/20)	(16/20)	(20/20)	(12/20)				
Arabi*	34.83^{b}	31.30^{a}	23.30^{b}	21.50^{c}				
	(12/20)	(14/20)	(20/20)	(16/20)				
Najdi*	31.00^{a}	24.60^{a}	17.00^{c}	14.66^{c}				
	(12/20)	(20/20)	(20/20)	(12/20)				

^{a,b} Values between Harri, Arabi and Najdi ewes' groups in the same row with different superscripts significantly differ at P < 0.05. *,**; levels with star superscripts within the same column differ significantly at P < 0.05 and 0.01, respectivelyGlucose standard detection range, 10–600 mg/dLSEM standard error of means.

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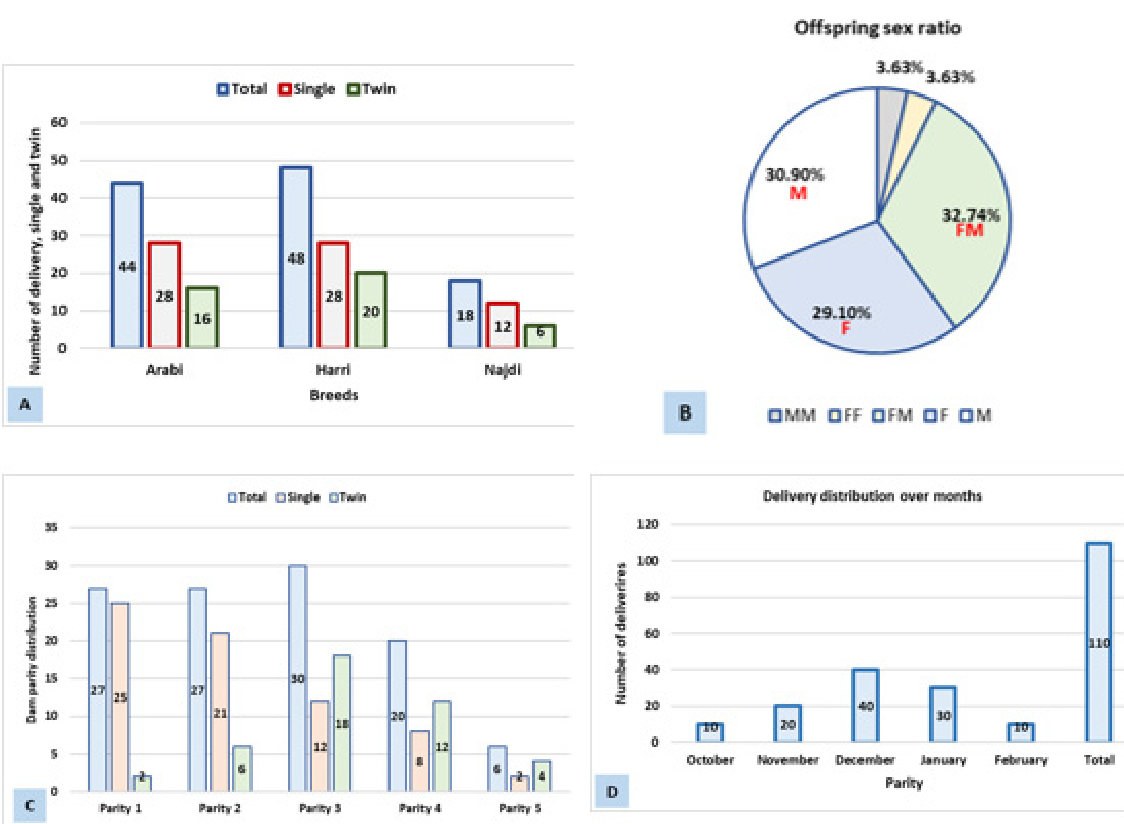

Figure 3: Ewes' herd population, deliveries, and sex from October 2025 to February 2026.

ones on day 1, and they followed identical patterns through day 4. Although single male lambs showed slightly higher Igs values in colostrum/ milk on day 1 if compared to single female lambs (28.666 vs 28.225), the difference was not statistically significant. The twin male and/or female births showed higher Igs values in colostrum/milk if compared to single births. The highest Igs values in colostrum and milk were observed with twin male (MM) or twin female (FF) births (31.666) followed by FM births (28.695). There is a significant interaction of breeds (P =0.05), month (P = 0.001), gender (P = 0.005), and parity (P = 0.001) with time.

Glucose secretion dynamics

The analysis of glucose presence in the colostrum and milk of Harri, Arabi and Najdi ewes across the experimental period revealed significant fluctuations influenced by both postpartum days and the ewes' breed (Table 2). The highest glucose concentrations were recorded on day 1 (colostral phase). Thereafter, glucose levels dropped significantly by day 2, 3, and 4. The Harri ewes exhibited significantly higher colostrum and milk glucose levels compared to Arabi and Najdi ewes throughout the study. The number of positive samples (glucose detection) remained relatively stable, ranging from 12/20 to 20/20 of total samples per day. This suggests that while the concentration of glucose

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is detected in some individuals, it is not detected in all ewes across the breeds.

DISCUSSIONS

The impacts of Harri, Arabi and Najdi ewe breeds, month of deliveries, parity, and lambs' sex on colostrum and milk immunoglobulins and glucose secretion dynamics across four days postpartum are presented in Figures (3 A-D) and (Tables 1-2). The findings of this study provide compelling evidence that colostrum and milk immunoglobulins and glucose secretion dynamics across four days postpartum were influenced by ewe breeds (Harri, Arabi and Najdi breeds) and environmental factors. Therefore, the differences that occur in immunoglobulins and glucose secretion dynamics across four days postpartum due to ewe breeds (Harri, Arabi and Najdi breeds), month, parity, and lambs' sex refine our current understanding of immunoglobulins and glucose secretion dynamics postpartum.

Ewes breed effects

The impact of ewes' breed on immunoglobulins secretion dynamics in colostrum/milk is a critical factor in determining the success of passive immunity transfer (Table 1). In the hierarchy of maternal immunity among Saudi indigenous sheep, the Najdi ewe typically is highest, while the Harri often demonstrates the lowest colostrum and milk Igs concentrations during the first four days postpartum. While the Harri, Arabi and Najdi ewes' breeds are well-adapted to the Al-Ahsa environment, the higher concentration of immunoglobulins (Igs) in the colostrum/milk of Najdi ewes compared to Harri and Arabi ewes can be attributed to a combination of genetic, physiological, and reproductive factors. Research suggests that breed-specific physiological traits can lead to significant differences in colostrum and milk quality (Luño et al., 2026). The body size of Najdi ewes were large if compared to that of Harri and Arabi breeds (El-Zarei et al., 2023). Larger breeds typically have a higher metabolic capacity to synthesize and transport bioactive components, including immunoglobulins, into the milk-secreting cells (Wilde et al., 1986). The animal breeds, known for its high milk-producing capacity and well-developed udder, demonstrated a high capacity for high milk yield (Guyo and Tareke 2025). Najdi ewes, being larger-framed animals than Harri and Arabi ewes, possess a larger mammary epithelial surface area, allowing for a greater density of receptors that capture immunoglobulins.

Month of parturition effects

The differences in Igs concentrations among the Harri, Arabi and Najdi ewes across different months of parturition are largely driven by seasonal environmental stressors, nutritional availability, and the specific physiological resilience of each breed presented in (Table 1). The seasonal effects of parturition on colostrum and milk composition and immunity have been confirmed in several studies of other species (Todaro *et al.*, 2023; Abdelrahman *et al.*, 2025). In Al-Ahsa, the observed peak in immunoglobulin levels during October is primarily driven by favorable climatic conditions and reduced physiological stress in ewes. During this month, temperatures typically range between 21.0°C and 36.0°C, placing the animals within their thermoneutral zone and allowing metabolic energy to be directed toward high-quality colostrogenesis rather than thermoregulation. The stable, dry air (32% humidity) further protects maternal antibody reserves by minimizing subclinical infections, while the lower deliveries in October (10) reduces competition for nutritional resources compared to the December peak (40). In contrast, the high humidity of February increases the effective thermal load and potential cortisol-induced stress, which can impair the efficient transport of immunoglobulins from the bloodstream to the mammary gland.

Ewes' parity effects

The effect of ewe parity is a primary determinant of colostrum quality and the subsequent success of passive immunity transfer in lambs (Figure 3 , Table 1) as indicated in other species (Yaylak et al., 2016; Aydogdu Guzelbektes 2018; Grodkowska et al., 2023; Mendoza et al., 2024). In our study of 110 deliveries, they were distributed across parities 1 to parity 5 and they showed significant implications for the resulting colostrum and milk immunoglobulin values (Figure 3C and Table 1). Data from the herd indicates that nearly 75.0% of the ewes are in parity 2 or higher, with a substantial core in parity 3 (30 ewes out of 110).

Parity serves as a significant determinant of colostrum and milk immunoglobulins values in ewes, with multiparous ewes generally exhibiting higher Igs content compared to primiparous ewes (Higaki et al., 2013; Torres-Rovira et al., 2017). This enhancement is primarily attributed to the cumulative antigenic exposure of older animals over successive lactations, which expands their systemic memory B-cell population and results in a more diverse and concentrated pool of circulating antibodies available for mammary transport (Ezzat Alnakip et al., 2014). Furthermore, as animal progress through multiple parities, the mammary gland undergoes extensive remodeling and increased epithelial development, leading to a higher density of neonatal Fc receptors (FcRn) that efficiently pull IgG from the bloodstream (Kacskovics, 2004; Butler et al., 2015). While primiparous dams often prioritize their own growth, multiparous dams can allocate greater metabolic resources toward colostrogenesis, often resulting in higher Ig volumes, and showing a significant shift toward twin births and increased maternal investment in later parities (Akhter et al., 2021).

Lambs' sex effects

The influence of twin versus single delivery and male lamb versus female lamb on the concentration of Igs in colostrum and milk is indicated in (Table 1). In the current study, the perfectly balanced sex ratio of 78 males (50.70%) and 76 females (49.30%) provides an ideal data set to examine whether the dam's body responds differently to the sex of the offspring it is preparing to nourish. The concentration of Igs in ewe colostrum and milk is significantly influenced by both litter size and the sex of the offspring, reflecting a complex biological strategy for maternal resource allocation. The average values of lamb serum immunoglobulins in relation to survival and mortality during the neonatal period indicated higher Igs values for male lambs compared to those of female ones (Demis *et al*., 2020). Research indicates that the sex of the newborns can "program" the mammary gland's output even before birth (Macias Hinck 2012). Interestingly, maternal investment in Holsteins appears to be sex-biased where cows gestating females yield significantly higher colostrum, milk and fat values than those with male offspring (Angulo *et al*., 2015). In our study, the male lambs resulted in slightly higher Igs in colostrum and milk versus female lambs. In many ruminant species, male newborns are often larger at birth and have higher growth rates, which can lead to a greater demand for energy and immune protection (Silva *et al*., 2024). In addition, the sex of the fetus influences the hormonal environment of the dam during late gestation, which is the critical period for colostrogenesis (Bigler *et al*., 2023). The fetal-placental unit produces different steroid hormone profiles depending on whether the fetus is male or female (Schuler *et al*., 2018). These hormones regulate the receptors in the mammary gland that "pull" immunoglobulins from the dam's bloodstream (Larson *et al*., 1980; Barrington *et al*., 2001; Mayer *et al*., 2002).

Glucose secretion dynamics

The influence of Harri, Arabi and Najdi ewes' breeds on the concentrations of glucose in colostrum and milk is indicated in (Table 2). The highest glucose values were recorded on day 1 and dropped significantly by day 2, 3, and 4. Furthermore, Harri ewes exhibited significantly higher colostrum and milk glucose values compared to those of Arabi and Najdi ewes throughout the study. Colostrum is not only rich in immunoglobulins as compared to milk but is also an excellent source of energy, vitamin A and essential minerals (Silva *et al*., 2024). Glucose in colostrum and milk is not just a nutrient; it is the primary osmotic regulator that determines milk volume and is a vital energy source for the neonatal lambs (Farooq *et al*., 2024). In the mammary gland, glucose is the precursor for lactose synthesis (Lin *et al*., 2016). Since lactose is the primary osmotic agent that draws water into the mammary alveolar lumen, glucose availability directly impacts the "energy density" and volume of the milk. The observation that Harri ewes exhibit significantly higher colostrum and milk glucose values compared to Arabi and Najdi ewes is a standout physiological finding. This may be an adaptation to their native mountainous environment (Hijaz region), where lambs require immediate high-energy intake to combat fluctuating temperatures.

CONCLUSIONS

This study identifies that colostral immunoglobulin (Ig) concentrations in Najdi, Harri, and Arabi ewes are driven by a combination of genetics, physiology, and environment, with Najdi ewes demonstrating the most superior profiles for passive immunity transfer. Data indicates that multiparous ewes and those bearing twins produce higher-quality colostrum than primiparous or single-bearing counterparts, while seasonal fluctuations further influence these levels. Because the first four days postpartum are critical for lamb survival, these findings provide a framework for breeders to optimize management protocols and ensure neonatal health in challenging environments.

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NOVELTY STATEMENT

The article presents, for the first time, the dynamics of immunoglobulins and glucose secretion in colostrum and milk of Harri, Arabi and Najdi ewe breeds reared under semi-extensive management system.

AUTHORS CONTRIBUTION

Ahmed Alhamd and Abd El-Nasser Ahmed Mohammed conducted the study, Ahmed Alhamd and Abd El-Nasser Ahmed Mohammed carried out the experimental design and statistical analysis of data, Ahmed Alhamd and Abd El-Nasser Ahmed Mohammed prepared the manuscript for publication.

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Generative AI and AI assisted technology

STATEMENT

The authors declare that no generative AI and AI assisted technology was used in the creation of this manuscript.

CONFLICT OF INTEREST

Authors declare no conflict of interest.

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