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Calf feeding management in dairy farms: a technical analysis of breeder practices based on survey findings

Abstract

This study aimed to evaluate breeder practices related to calf feeding management and the use of feeding equipment in dairy farms based on quantitative survey data. The research material consisted of data obtained from face-to-face questionnaires administered in 48 dairy cattle farms. The survey included questions on calf-feeding methods, milk feeding temperature and timing, the use and cleaning of feeding equipment, and common health problems observed in calves. Data were analyzed using descriptive statistics. According to the results, calves were fed using bottles in 56.3% of the farms, nipple buckets in 14.6%, and natural suckling in 18.8% of the farms. Regarding milk temperature, 37.5% of breeders fed milk at 35–37 °C, 27.1% at 38–40 °C, while 12.5% did not measure milk temperature prior to feeding. Diarrhea was identified as the most common health problem in calves, with a prevalence of 72.9%. In terms of feeding equipment hygiene, 60.4% of breeders reported cleaning equipment after each use, whereas 16.7% performed cleaning once daily. The most commonly used cleaning methods were hot water and soap (39.6%) and boiling water or sterilization procedures (45.8%). In conclusion, the study revealed considerable variability in calf-feeding practices and hygiene management among dairy farms. Inadequate control of milk temperature and deficiencies in cleaning practices may be associated with the high incidence of diarrhea observed in calves. These findings highlight the need for wider implementation of standardized calf-feeding protocols and the expansion of training programs aimed at improving breeder knowledge and management practices.

Keywords: dairy farming, calf feeding, management, equipment, nipple, bucket, bottle

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Introduction

Calf rearing is one of the most critical stages in dairy production, as it directly determines the future productivity and sustainability of the herd. Feeding and management conditions encountered during the neonatal period play a decisive role in calf survival, growth performance, disease resistance, and subsequent milk yield.[1,2] In particular, the liquid feeding phase represents a sensitive period for digestive system development and immune acquisition, and management practices applied during this stage are essential for reducing calf morbidity and mortality.[3,4] Various milk-feeding methods are employed in calf rearing, including natural suckling, open buckets, nipple buckets, and bottles. Previous studies have demonstrated that nipple-feeding systems support the calf's natural suckling behavior, prolong suckling time, and stimulate saliva secretion, thereby enhancing digestive function.[2,4–6] Moreover, nipple use allows for a more controlled milk flow rate, reducing aspiration risk and providing a feeding environment that better matches the physiological needs of calves. The effectiveness of nipple feeding, however, is not solely dependent on the feeding method itself. Factors such as nipple material, hole diameter, degree of wear, and cleaning and disinfection practices substantially influence outcomes. Enlargement or tearing of the nipple hole may result in uncontrolled milk flow, which has been associated with digestive disturbances and an increased incidence of diarrhea.[6] Donadio et al.[7] further emphasized that although nipple feeding offers behavioral benefits, inadequate hygiene can negate these advantages. Calf diarrhea remains the most prevalent neonatal health problem worldwide, including in Türkiye. In addition to infectious agents, management-related factors such as milk temperature, feeding technique, equipment hygiene, and feeding frequency play a significant role in its development.[8] Feeding milk at temperatures close to body temperature is considered critical for optimal abomasal function and digestive health. Field surveys and academic studies conducted in Türkiye indicate substantial variation in calf-feeding practices among farms, with management decisions often based on breeder experience rather than standardized scientific recommendations.[2,10] This situation frequently leads to inconsistencies between evidence-based guidelines and on-farm practices.

Therefore, the present study aimed to determine current calf-feeding and nipple-use practices in dairy cattle farms, evaluate breeder perceptions and management approaches, and discuss the findings in light of the literature to develop recommendations for improving calf health and welfare.

Materials and methods

The material of this study consisted of data obtained from an online questionnaire designed to collect information on nipple use, causes of nipple wear, and related management practices in calf feeding. The survey was conducted among cattle breeders and farm managers operating in different regions of Türkiye. Data were collected using a structured questionnaire developed via the Google Forms platform. The questionnaire included multiple-choice and closed-ended questions addressing farm characteristics, calf-feeding methods, duration of nipple use, types of nipple deformation, and hygiene practices. Participation was voluntary, and respondents were informed about the purpose of the study and assured that the data would be used exclusively for scientific purposes. Personal identities

were kept confidential, and no individual data were reported. A total of 48 respondents participated in the study, representing farms located in Adana, Konya, Ankara, Bolu, Elazığ, Burdur, İzmir, Kırıkkale, Kayseri, and Kahramanmaraş. The survey link was distributed through social media groups and electronic communication channels targeting the relevant audience. Collected data were recorded electronically and converted into an appropriate database format for statistical analysis. Descriptive statistics were used to calculate frequencies (n) and percentages (%). For questions allowing multiple responses, each option was evaluated independently, and the results were presented in tables. All analyses were performed using computer-based statistical tools.

Results

The results showed that bottle feeding was the most commonly used milk-feeding method (56.3%), followed by nipple buckets, natural suckling, and open buckets (Table 1). Moderate milk-feeding programs (3–6 L/day) were widely applied. Solid feed intake was the primary criterion for weaning (47.9%), indicating an increased adoption of physiologically based weaning approaches. Silicone nipples were the most frequently preferred material (50.0%) (Table 2). Nevertheless, the persistence of low milk allowance practices and inconsistent equipment selection suggests that non-standardized feeding strategies remain prevalent in some farms.

Table 1 Breeder responses regarding calf-feeding methods, daily milk allowance, duration of milk feeding, and weaning criteria

Calf-feeding method	%	Daily milk allowance via bottle (L/day)	%	Duration of milk feeding (months)	%	Weaning criteria	%
No response	2.1	No response	8.3	No response	4.2	No response	2.1
Natural suckling (dam)	18.8	1–2	14.6	1	2.1	Growth performance	20.8
Bottle feeding	56.3	3–4	41.7	2	43.8	Body weight	10.4
Nipple bucket	14.6	5–6	31.3	3	43.8	Feeding duration	18.8
Open bucket	8.3	≥7	4.2	6	6.3	Solid feed intake	47.9

Table 2 Responses regarding the use of nipples in calf feeding

Preferred nipple material	%	Frequency of nipple replacement	%	Ease of nipple use by calves	%	Frequency of observed nipple wear	%
No response	4.2	No response	6.3	No response	6.3	No response	6.3
Other	2.1	Every six months	12.5	Sometimes difficult	2.1	Every six months	12.5
Rubber	33.3	When worn	35.4	Slightly difficult	14.6	Monthly	22.9
Not important	10.4	Monthly	35.4	Varies	12.5	Varies	31.3
Silicone	50	Weekly	10.4	Yes, comfortable	62.5	Weekly	27.1
—	—	—	—	Has difficulty	2.1	—	—

Nipple replacement frequency varied considerably among farms and was largely based on visual assessment rather than planned schedules. Monthly replacement or replacement upon visible wear was most common. Although most calves were reported to use nipples comfortably, some degree of suckling difficulty was observed. Frequent nipple wear was reported, potentially compromising both suckling comfort and hygiene.

The most common form of nipple damage was tearing of the nipple hole, followed by cracks in the nipple wall and milk leakage (Table 3). Less frequently reported defects included wall thinning, elongation of the nipple tip, and nipple wall breakage. When wear was detected, most breeders replaced the nipple immediately or at the first opportunity, although preventive replacement strategies were limited.

Table 3 Types of wear observed in calf-feeding nipples (multiple responses allowed)*

Type of defect	Total responses	%
Tearing of the nipple tip opening	41	47.7
Cracking of the nipple wall	11	12.8
Leakage	11	12.8
Thinning of the nipple wall	8	9.3
Elongation of the nipple tip	8	9.3
Breakage of the nipple wall	7	8.1
Total (number of defects)	86	100

Most respondents indicated that nipple structure influenced milk intake rate, demonstrating a practical awareness of the relationship between equipment condition and feeding behavior. While a majority reported regular inspection of nipple hole size, these checks were often reactive rather than preventive (Table 4).

Table 4 Interventions, monitoring practices, and perceived effects of nipple use on milk-drinking speed in calves

Action taken when nipple wear is detected	%	Method of nipple replacement	%	Does the nipple affect milk-drinking speed?	%	Do you check the nipple tip opening?	%
No response	6.3	No response	6.3	No response	10.4	No response	6.3
Continue using for a while	4.2	Self-replacement	27.1	Yes	45.8	Sometimes	10.4
Replace immediately	50	Manufacturer service	14.6	Not noticed	12.5	Regularly	60.4
Replace at the first opportunity	33.3	Purchase ready-made	52.1	Moderate effect	31.3	No	4.2
Take immediate action	6.3	—	—	—	—	When problems occur	18.8

Regarding hygiene, most breeders cleaned nipples after each use, primarily using boiling water or hot water with soap. Individual cleaning of nipples was common, reflecting a relatively high level of hygiene awareness (Table 5). However, the use of chemical disinfectants was limited (Table 6), and some nipples were stored in open environments after cleaning, posing a potential risk of recontamination.

Table 5 Findings related to nipple size, period of use, and cleaning practices

Nipple size problem	%	Period when calves experience nipple-related problems	%	Frequency of nipple cleaning	%	Method used for nipple cleaning	%
No response	6.3	No response	14.6	No response	6.3	No response	6.3
Not noticed	16.7	In some calves	18.8	When necessary	8.3	Boiling water / sterilization	45.8
Yes	22.9	Does not matter	14.6	Once a week	8.3	Chemical disinfectant	8.3
No	54.2	Early period	33.3	Daily	16.7	Hot water and soap	39.6
—	—	Late period	18.8	After every use	60.4	—	—
—	—	—	—	When necessary	8.3	—	—

Table 6 Methods of nipple cleaning, disinfectants used, and post-cleaning storage practices

Nipple cleaning method	%	Chemical used for disinfection	%	Post-cleaning storage method	%
No response	6.3	No response	6.3	No response	6.3
No difference	6.3	Iodine	18.8	Left ready for use	37.5
Individually	50	Chlorine	20.8	Stored in water	4.2
In batches	37.7	Chlorhexidine	12.5	Stored on a clean shelf or in a container	52.1
—	—	Not used	41.7	—	—

The combined evaluation of Table 4, Table 5 and Table 7 indicates that feeding efficiency in calves is closely linked to nipple management practices, including timely intervention, physical suitability, hygiene, and producer awareness. According to Table 4, although half of the breeders reported replacing nipples immediately when wear was detected, a considerable proportion preferred delayed replacement or continued use, which may negatively affect milk flow rate and feeding consistency. Nearly half of the respondents (45.8%) stated that nipple condition influenced milk-drinking speed, suggesting that worn or improperly maintained nipples may reduce feeding efficiency by altering flow dynamics and increasing feeding duration.

Table 7 Nipple tip opening size, milk losses, and feeding method comparisons

Have you noticed milk losses when calves drink by sucking compared to bucket drinking?	%	Awareness of methods to extend nipple lifespan	%	Is there a difference between bucket and bottle feeding?	%
No response	93.8	No response	6.3	No response	95.8
Yes	4.2	Low	29.2	Yes	4.2
No	2.1	Moderate	29.2	—	—
—	—	None	35.4	—	—

Findings from Table 5 further support this interpretation, as nipple-related problems were most frequently reported during the early rearing period, a critical phase for growth and rumen development. Although the majority of breeders reported no nipple size problems, nearly one-quarter acknowledged size-related difficulties, which may compromise effective suckling and lead to milk wastage or incomplete intake. While cleaning frequency was generally high, with most respondents cleaning nipples after every use, variability in cleaning methods and inconsistent application of hygienic practices may indirectly affect feeding efficiency by increasing the risk of microbial contamination and subclinical digestive disturbances.

Table 7 reveals limited breeder awareness regarding milk losses associated with different feeding methods and nipple tip opening size. The high rate of non-response suggests that potential inefficiencies such as milk leakage, uncontrolled flow rate, or wastage during feeding are not routinely monitored. Additionally, more than one-third of breeders reported no knowledge of methods to extend nipple lifespan, which may contribute to the prolonged use of worn nipples and reduced feeding efficiency over time.

The integrated evaluation of Tables 4–6, and Table 8 highlights a strong association between hygiene-related feeding practices and the high prevalence of health problems observed in calves, particularly diarrhea. As shown in Table 8, diarrhea was reported as the most common health disorder (72.9%), indicating persistent challenges in neonatal calf management. Although most breeders reported feeding milk within the recommended temperature range (35–40 °C), a notable proportion did not measure milk temperature or feeding timing. Although most breeders reported feeding milk within the recommended temperature range (35–40 °C), a considerable proportion did not actually measure milk temperature or feeding timing. When the relationship between hygiene, milk temperature, and diarrhea is examined, it becomes evident that these factors interact synergistically to influence calf health. Milk prepared or delivered under inadequate hygienic conditions increases the pathogen load to which calves are exposed. At the same time, feeding milk outside the optimal temperature range may impair proper abomasal clot formation. Milk offered at too low a temperature can result in insufficient casein clot formation and rapid passage to the intestine, predisposing calves to digestive disturbances. Conversely, excessively hot milk may irritate the abomasal mucosa and disrupt enzymatic activity. When such physiological disturbances occur alongside poor hygiene, intestinal colonization by pathogens is facilitated, thereby increasing the risk of diarrhea. Furthermore, inconsistencies in feeding timing may negatively affect abomasal motility and digestive regulation. Therefore, inadequate hygiene practices, failure to monitor milk temperature, and the absence of standardized feeding protocols should be considered interconnected management factors contributing to the high prevalence of diarrhea in neonatal calves. Similarly, many respondents did not monitor the height at which milk was offered. These inconsistencies in milk-feeding practices may contribute to digestive disturbances and increased incidence of diarrhea, emphasizing the importance of standardized feeding protocols and improved management awareness. The feeding management practices presented in Table 8 further support this interpretation. Despite most breeders feeding milk within recommended temperature ranges, a notable proportion did not measure milk temperature, feeding delay, or feeding height. Such uncontrolled practices may impair abomasal clot formation and digestion, thereby increasing susceptibility to diarrhea. When combined with suboptimal hygiene and nipple maintenance, these factors likely exacerbate health risks in young calves.

Table 8 Responses regarding common health problems in calves and milk-feeding practices

Common health problems observed in calves*	%	Milk-feeding temperature	%	Time elapsed before offering milk (seconds)	%	Height from which milk is offered (cm)	%
No response	12.5	No response	12.5	No response	10.4	No response	10.4
Bloat (gas)	4.2	35 °C	6.3	0–3 s	6.3	0–3 cm	6.3
Diarrhea	72.9	35–37 °C	37.5	≥11 s	8.3	≥11 cm	8.3
Umbilical infection	2.1	38–40 °C	27.1	4–6 s	27.1	4–6 cm	27.1
Refusal of dry feed	6.3	41 °C	4.2	7–10 s	10.4	7–10 cm	10.4
Pneumonia	2.1	Not measured	12.5	Time not measured	37.5	Height not measured	37.5

Discussion

Numerous studies have consistently demonstrated that nipple-feeding systems stimulate natural suckling behavior, prolong suckling duration, and increase saliva secretion, thereby enhancing abomasal function and overall digestive efficiency in calves.[4–6] As reported by Yanar et al.,[2] feeding Brown Swiss calves using a nipple bucket resulted in higher weight gain and improved feed efficiency compared with conventional bucket feeding. The nipple bucket system supported natural suckling behavior, enhanced digestive efficiency, and facilitated a smoother adaptation to the weaning period. But Curtis et al.[11] conducted a controlled study comparing group-housed calves fed milk via a single automated teat (nipple) with calves fed using conventional bucket systems. The results demonstrated that calves fed via the nipple system exhibited a significantly higher incidence of disease, particularly diarrhea and pneumonia, during the first 12 weeks of life. The odds of diarrhea and pneumonia were approximately 3.86 and 5.80, respectively, indicating that feeding system design and hygiene management are critical determinants of calf health.

The widespread adoption of bottle and nipple-bucket feeding observed in the present study indicates a growing alignment between scientific recommendations and on-farm practices. Nevertheless, the limited awareness reported by breeders regarding functional differences between bucket and bottle feeding suggests that adoption has largely occurred at a practical level, while the underlying physiological and behavioral mechanisms remain insufficiently understood.

Liu et al.[6] emphasized that enlargement or tearing of the nipple tip opening results in uncontrolled milk flow, which can overwhelm abomasal capacity, impair esophageal groove closure, and increase the risk of aspiration and enteric disorders. In the present study, the high incidence of diarrhea, together with the frequent observation of nipple hole deformation, strongly suggests a functional link between inadequate nipple maintenance and compromised digestive health. These findings underscore that nipple-feeding systems alone do not guarantee optimal outcomes unless equipment integrity and flow regulation are actively managed.

Although milk-feeding temperatures reported by breeders were generally within recommended ranges, the substantial proportion of respondents who did not measure milk temperature reflects a continued reliance on experience-based decision-making rather than standardized protocols. Inconsistent milk temperature can adversely affect milk clot formation and digestion, thereby increasing susceptibility to gastrointestinal disturbances. When combined with uncontrolled milk

flow resulting from worn nipples, such inconsistencies may further exacerbate the risk of diarrhea in young calves.

While overall hygiene awareness appeared relatively high, critical deficiencies were identified in disinfection practices and post-cleaning storage. The limited use of chemical disinfectants and the tendency to store nipples without adequate protection may facilitate rapid recontamination of feeding equipment. As highlighted by Donadio et al.,[7] inadequate hygiene can negate the behavioral and physiological advantages of nipple feeding by increasing microbial exposure during feeding. Thus, hygiene management emerges as a determining factor in translating nipple-feeding benefits into measurable health outcomes.

Considering that 12.5% of breeders did not measure milk temperature and 37.5% did not measure feeding time or height, the coexistence of these uncontrolled practices with a diarrhea prevalence of 72.9% suggests a potential epidemiological relationship that warrants formal statistical testing.

Cross-tabulation of nipple-cleaning methods and reported calf health problems revealed that diarrhea, either alone or in combination with other disorders, was observed across all hygiene categories. However, farms using only hot water and soap accounted for a substantial proportion of diarrhea-associated cases, whereas farms applying chemical disinfectants represented a comparatively small fraction of diarrhea reports. Although the sample size for chemical disinfectant users was limited (n = 4), this distribution may suggest that more rigorous sanitation practices could be associated with reduced enteric disease occurrence. Nevertheless, because health problems were recorded as multiple-response categories and inferential statistical tests (e.g., chi-square or logistic regression) were not applied, definitive conclusions regarding the strength or significance of this association cannot be drawn. Chi-square analysis did not reveal a statistically significant association between nipple-cleaning method and reported calf health problems ($\chi^2 = 40.49$, df = 57, p = 0.952). However, the validity of this test is limited, as 98.8% of the cells had expected counts below five, violating the assumptions of the chi-square procedure. The highly fragmented structure of the health variable, recorded as multiple-response combinations, resulted in sparse data distribution and reduced statistical power. Therefore, the absence of statistical significance should be interpreted cautiously and does not necessarily indicate the absence of a biological or epidemiological relationship. Future analyses should recode health outcomes into binary categories (e.g., diarrhea: present/absent) to enable more robust inferential testing with adequate cell frequencies. After recoding health outcomes into a binary variable (diarrhea present/absent), cross-tabulation analysis revealed that diarrhea was highly prevalent across all hygiene categories. Although farms using hot water and soap showed a relatively higher proportion of non-diarrhea cases compared to sterilization users, statistical testing did not demonstrate a significant association, likely due to small subgroup sizes and the overall high prevalence of diarrhea.

The limited sample size in the chemical disinfectant group (n = 4) further reduced statistical power. Therefore, while descriptive patterns suggest possible variation among hygiene strategies, larger-scale studies with adequate cell distribution are required to determine whether sanitation method independently influences diarrhea risk.[12–17]

Conclusion

The findings indicate that the adoption of nipple-feeding systems alone does not ensure improved calf health under field conditions. Despite the widespread use of nipple feeding, diarrhea prevalence remained high (72.9%). Although no statistically significant association was detected between hygiene method and health problems ($\chi^2 = 40.49$, p = 0.952), the reliability of this result is limited due to sparse data distribution and low analytical power. The coexistence of high diarrhea prevalence with inconsistent monitoring of milk temperature (12.5%) and feeding parameters (37.5%) suggests that management variability, rather than the feeding system itself, may be the key determinant of health outcomes. Therefore, standardized protocols, systematic hygiene control, and routine monitoring appear essential to translate the theoretical advantages of nipple feeding into measurable improvements in calf health and farm sustainability.

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Conflicts of interest

The authors declare no competing interests.

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