



# Imperative Aspects of Calf Rearing: An Overview

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## **Authors' contributions**

*This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.*

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## **ABSTRACT**

Farmers frequently ask about the best management practices for raising calves. Effective management practices, the minimally stressful environment, and the right feed supplementation can produce a healthy calf that will be productive once it enters the milking herd in the future, as previous studies have consistently shown and verified. Therefore, determining the optimum method for raising calves in each area is important. There have been numerous researches done over the years to determine the optimal management techniques for effective calf rearing. Due to the high

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expense of rearing calves, it is essential to establish the most effective means of ensuring sustainable techniques of raising calves that may ultimately prove to be profitable for dairy producers. Various key points in the calf rearing such as post-partum neonatal calf management, the correct management of the naval cord, colostrum feeding along with the housing and feeding requirements are discussed in the paper. This review paper aims to identify the most effective scientific management techniques for calf rearing from birth till it matures into a heifer, appropriate nutrition for the young calf, and the best approaches to maintain calf healthy and free from infectious diseases and stress.

**Keywords:** Calf; management; feed supplementation; rearing; profitable; dairy.

## 1. INTRODUCTION

The dairy farm's future stock is represented by calves. Hence, raising them is of utmost importance. Early calf management can significantly affect subsequent productivity (Cosentino and Smith, 2019). A dairy farm is regarded as successful if it uses scientific methods to raise its calves. Taking good care of the calf is essential for the calf's future stability as well as the preservation and maintenance of the good germplasm (Tiware et al. 2007). Calves have neither good immunity nor they are functioning ruminants when born. They must therefore overcome the challenge of acquiring immunity and consuming feed in a non-ruminant manner until the rumen develops (Kertz et al. 2017). Following the early postpartum period, colostrum management is the next step in scientific management procedures for rearing dairy calves. A calf initially relies on its mother's colostrum to develop immunity through the ingestion of antibodies (Mengesha et al. 2013). Before switching to a new diet, the calf's liquid diet offers an adequate supply of nutrients. Other elements that contribute to the effective raising of calves include appropriate housing, a comfortable environment, pre- and post-weaning feeding, illness prevention, deworming, appropriate vaccination, hygiene in the calf pens, sufficient ventilation, etc.

## 2. POST-PARTUM NEONATAL CALF MANAGEMENT

It is frequently believed that more than 70 per cent of neonatal deaths take place within the first hour of calving. As a result, management of newborn calf becomes essential (Nagy, 2009). The newborn calf should be physically examined soon after calving by checking its vital signs such as breathing, heart rate, and physical movement. By using a finger or straw, clear the calf's nasal receptors so that air can pass through. The calf should then be suspended upside-down for a

short period of time to encourage postural evacuation of lung fluids (Mee, 2008). In order to maximise a patent airway, try to position the calf in sternal recumbency, which enables lung expansion (Nagy, 2009).

## 3. REMOVING THE CALF FROM THE COW

It is recommended that calves stay near to their mothers until they are two weeks old, and then gradually begin to separate from them until they are fully weaned at six to eight weeks. A calf's mouth, nose, and naval are all susceptible to infection from the calving environment, according to recent studies. Therefore, early separation becomes mandatory (Bhateshwarand Muwal, 2022). Additionally, it causes less suffering to the cow and calf. Furthermore, if the calf is left with the mother, it can be challenging to ascertain how much or when the calf received colostrum. Therefore, the calf must be removed from the cow within an hour following calving and placed in a clean, newly-bedded area where it can be bottle-fed the sufficient quantity of colostrum. Separating the cow and calf within 24 hours of delivery is therefore the most cost-effective and minimally stressful option for both (Flower & Weary, 2001).

## 4. NAVAL CORD DISINFECTION/ NAVAL ANTISEPSIS

It is essential to perform naval antiseptic as soon as possible following birth. A calf's open naval is a breeding ground for bacteria and dangerous pathogens that can enter the body and put them at risk for a variety of diseases. Cut the calf's naval cord one centimetre below the ligature and bind it 2.5 cm away from the body (Bhateshwarand Muwal, 2022). In order to clean the internal and external surfaces of the umbilicus and disinfect the naval cord, the naval can be dipped into a clean container containing fresh iodine (Gorden & Plumer, 2010). Use only

a mild antiseptic to treat a naval wound so that the area can be cleaned and kept sterile from becoming infected. If a potent antiseptic is applied, the naval may become overly dried out, irritated, and inflamed, which could result in naval ill (Nagy, 2009). Maintaining a clean maternity pen, minimising the amount of time a calf spends in an unsanitary environment, ensuring colostrum intake, and administering naval antisepsis are the best ways to avoid naval ill or any other infection through the naval (Lorenz et al. 2011).

## 5. COLOSTRUM FEEDING

Colostrum feeding, a fundamental component of neonatal calf management, is frequently disregarded by dairy farmers. Immunoglobulins, nutrients, cytokines, and growth factors are among the many components of colostrum that are advantageous for the health of the calf as well as for the full development of the calf immune system (Conneely et al. 2013). Colostrum should be given to calves within thirty minutes of calving in order to promote passive immunity transmission, decrease mortality in the post-weaning period, promote growth, and delay the age at first calving (Godden, 2008). Colostrum that appears crimson or has a pink hue needs to be discarded right once since it can contain a lot of red blood cells that may cause diarrhoea (Lorenz et al.2011). Colostrum has three different immunoglobulin subtypes, with IgG, IgA, and IgM making up roughly 85.0 per cent, 5.0 per cent, and 7.0 per cent of the total. IgG content in colostrum is regarded as a criterion for assessing colostrum quality (Conneely et al.2013). Farmers also have a propensity to delay feeding colostrum to calves until after the placenta has been ejected because they think doing so will result in healthier calves. Farmers believe that feeding calves with colostrum just after calving may cause severe diarrhoea (Tiwari et al., 2007). The best course of action is to conserve the colostrum for later use because it's possible that not all of the colostrum being harvested will be used straight away. For later use, high-quality colostrum ought to be frozen or chilled. Pathogens' ability to survive reduces when colostrum is stored in a frigid environment (Stull & Reynolds, 2008).

## 6. HOUSING OF CALVES

Within an hour after birth, preferably within twenty-four hours, calves should be withdrawn from the dam and housed separately in a warm, clean, and dry environment so they may get acclimated to life outside. Since the calf's environment changes when it is separated from its mother, it experiences drastic temperature changes. If calves are taken away soon after giving birth, a calf pen should be properly heated for at least one to two days to prevent sudden temperature changes. It is because a heating source kept near calves leads them to expend less energy on maintaining their body temperature and more energy developing and strengthening their digestive and respiratory systems (Nagy, 2009). The ability of calves to resist extreme temperatures increases after three weeks of age (Drackley, 2008). To reduce the transmission of pathogens and the spread of diseases, calves should be housed separately. Individual housing makes it simple to keep an eye on a calf's health and give it any necessary medical attention (Stull & Reynolds, 2008). A possible significant contributor to the transfer of infections from calf to calf is group housing, which frequently results in cross contamination. Calves kept under various management regimes were compared for behaviour, health, and output by Curtis et al. in 1988. Comparing individual housing versus group dwelling, the study found that housing alone decreased mortality and morbidity. In their study, (Hill et al. 2009) found that calves kept in calf pens or nursery-style systems had greater average daily gains of roughly 4.0 per cent. Additionally, calves with straw bedding had a higher average daily growth of 11.0 per cent in contrast to calves with sand bedding or without bedding because straw bedding maintained a dry matter content of 81.0per cent. A study done by (Mustafa et al. 2010) revealed that dampness in a calf shed may have a negative impact on the growth performance of the calves as it increases the chances of infection and possibility of contamination. A calf should always have a dry bed. The incidence of diseases increased by 90per cent where calf sheds was not properly bedded.

**Table 1. Floor space requirement of calf shed**

Age group	Space (square feet)	Covered area (m <sup>2</sup> )	Open area (m <sup>2</sup> )
Below one month of age	20-25	1.0	2.0
Three to six months of age	30	1.5	3.0

Source: Costa et al. 2016: Journal of Dairy Science

## 7. CALF FEEDING STRATEGIES

In order to maintain themselves, grow, and produce energy, calves need nutrition. During pathogenic challenges that may be stress-induced, these nutrients keep the calf alive, maintain their body temperature, and support their immune system. Calves with the finest dietary management maintain a body score state of 2.5 to 3.75 (Stull & Reynolds, 2008). Neonatal calves may produce more milk in the future if fed milk or a milk replacer under scientific recommendations. Preweaning liquid and starter diet have a beneficial synergistic effect on milk, fat, and protein production, and heifers perform better throughout their first lactation as a result (Gelsinger et al. 2016). The Nation Research Council (NRC), 2001 established the protein and energy needs (metabolizable energy) for a calf. The ME (metabolizable energy) requirement for calves weighing 45.0 kg is 325.0 gm of milk solids, while the intake of whole milk is 2.5 litres. Calves need 3.0 litres of milk replacer because it has a lower content than whole milk. According to the NRC, 2001 protein needs for a 45.0 kg calf are around 30.0 gm per day, and these needs are further influenced by growth. Furthermore, calves can grow at 50per cent of their potential with a daily intake of 15.0per cent of their body weight. When being given 15.0per cent of their body weight, calves need to be fed twice daily. The calf's abomasum is susceptible to overload if it is only fed once a day, which could result in serious digestive issues (Lorenz et al. 2011). The ME requirements for whole milk would be 93.0per cent gross energy, while those for milk replacer would be 90.0per cent. (Drackley, 2008). In their study, Baldwin et al. (2004) recommended a gradual change from liquid to solid feed because it makes it easier for calves to eat and digest the feed, which further promotes growth during and after weaning. This additional feed is also beneficial for calves' early rumen development, growth of their salivary glands, and rumination behaviour. Calves should stay on the starter ration until they are 10 to 14 weeks old. After this time, they can switch to a grower ration with 16 per cent crude protein on a dry basis, which has a lower protein concentration. By this stage, forages can also be introduced. As calves reach breeding stage, dry hay should be restricted to ensure that calves consume between 2.5 and 5.0 kg of grower food daily (Drackley, 2008). Feeding highly palatable fermentable carbohydrate rich starter diet facilitates rumen development (Khan et al. 2016). In cold weather, the maintenance of

metabolisable energy (ME) increases. As a result, various strategies can be used in the diet of calves to maintain growth under such circumstances, including increasing the volume of milk or milk replacer at each feeding, providing a third feeding daily, switching to high energy milk replacer, and supplementing milk replacer with 20-22per cent crude protein, 15-20per cent fat, and 12.5per cent more milk solids (Cowles et al. 2006).

Carulla et al. (2023) found that the most extensively studied areas in calf nutrition are colostrum management and the introduction of solid starter feeds. They concluded that significant knowledge gaps are present particularly the absence of clear protocols for administering milk replacers to minimize hunger and also the lack of defined best practices for managing weaning to reduce stress. To address these issues, strong collaboration between the scientific research community and the dairy industry is crucial. Such partnerships are essential for developing standardized management practices that support healthy growth, ensure animal welfare, and promote a smooth weaning process on farms.

## 8. WATER: VITAL NUTRIENT FOR CALF

From the time the calf is born, it should always have access to water. In general, farmers tend to offer water after one to two weeks in the summer and after a month in the winter. In his research, Beede (2005) found that dairy producers do not provide new-born calves with drinking water because they believe that doing so might cause diarrhoea. So, they wait an average of 17 days before giving newborn calves water. In their study, Thickett et al. (1981) found that the age at which calves are initially introduced drinking water affects how big the calves grow. Additionally, an observational trial was done, and the results showed that calves receiving water from birth saw a greater than 30per cent increase in starting intake and weight gain than calves receiving water only until one month of age.

## 9. WEANING OF CALVES

The length of the weaning process has a significant impact on the stress levels of the calf. When to wean their calves is a question that dairy farmers have? Weaning stress has also been connected to breeding age and a heifer's output during lactation. Calves should therefore be weaned gradually. Sweeney et al. (2010) revealed that slow weaning boosted starter

intake during the weaning phase, whereas sudden weaning appeared to have an adverse effect on calf growth. According to (Drackley, 2008), calves shouldn't be weaned until they consistently begin ingesting 1.0 kg of starter each day. The recommended age for weaning is five to six weeks (Lorenz et al.2011). Calves that are weaned as soon as they are born experience reduced weaning stress (Budzynska & Weary, 2007). In their study, Mahla et al. (2015) discovered that the majority of farmers did not practise weaning of calves. Up until the age of six months, calves were permitted to nurse or suckle. Due to the lack of adequate quality feed, the weaning age of calves was increased.

## 10. CALF HEALTH MANAGEMENT

Three essential components of successful calf health management are immunisation/vaccination, deworming, and disbudding/dehorning (Sharma et al. 2019). According to a study by Gottardo et al. (2011), disbudding was typically done at around one month of age by large dairy farmers as opposed to small or marginal ones, and hot iron cauterization was favoured method by 91.0per cent of the dairy farmers for dehorning calves. A study done by Vickers et al. (2005), revealed that calves dehorned with caustic potash showed evidence of pain, but the pain subsided quickly, whereas calves dehorned with electric rod displayed greater pain than caustic potash. Additionally, they discovered that hot iron dehorning with local anaesthesia may lessen the discomfort of dehorning. In their study, Saharan et al. (2015) found that disbudding was not a practise that was widely used by the dairy farmers in Western Rajasthan. To increase their ability to sell the beef for more money, they only raised the calves for future beef fattening. In their study, Maousami et al. (2013) observed about the various calf management techniques used by dairy producers, such as deworming. Male calves are not often dewormed in comparison to female calves by the majority of dairy farmers. They added that frequent deworming cycles should be used to prevent parasite infestations and stated that deworming calves is important. This practise should begin at or before two weeks of age, and is to be continued after three to four weeks, and repeated roughly three to four times a year. Only 2.8per cent of farmers, who were regarded as very few, properly dewormed and immunised their calves (Islam et al.2020). The optimal time to vaccinate calves is when they are healthy, at ease, and their surroundings

are safe (McGuirk, 2008). Additionally, immunising the calves minimises the spread of viral infections by 48.0per cent (Windeyr et al. 2012).

## 11. DISEASES IN CALVES

The dairy farms are significantly impacted by calf diseases. This financial impact results from the direct costs of calf losses and the expenses associated with treating the calves (Lorenz et al. 2011). According to Wudu et al. (2008), one of the leading causes of death in calves younger than 30 days is calf scours or diarrhoea. Khan et al. (2007) in their study reported that internal parasitic infestation (83.0 per cent) and exterior parasite infestation (81.0 per cent) were the most common diseases in calves. Additionally, they documented 81.0 per cent scouring in calves, 70.8 per cent naval illness, and 27.0 per cent pneumonitis. Compared to small sized farms (67.0 per cent), large farms were more likely to contract illnesses (70.0 per cent). They came to the conclusion that since large farms have more calves than small farms do, the calves there are managed less carefully. Wale (2011) in his study outlined that 10.0 per cent of young calves had respiratory issues. He linked the incidence of these issues to various environmental factors, ventilation in the calf sheds, and the calves' lower immunity. Khan and Zaman (1991) discovered that male calves (77.7 per cent) had more health issues than female calves (47.4 per cent). Male calves received less attention and care because dairy farmers thought they wouldn't be profitable. Additionally, they claimed that male calves have a lower ability for immunoglobulin absorption than female calves, which results in a lower level of immunity in the male calves and leaves them more vulnerable to various infectious diseases.

## 12. MODERN CALF REARING PRACTICES

Modern calf rearing practices emphasize early-life care, hygiene, nutrition and welfare to produce healthy, productive animals. As the industry progresses the continued research, technology integration and adherence to welfare standards are very vital for improving the outcomes for both calves and farmers. These practices aim to enhance calf growth, reduce mortality and prepare calves for healthy and productive adult cow for dairy production. Karamaev et al. (2021) documented that the consumption of colostrum by calves in the first

day after birth is 32.5% and 51.4% more with the sucking method than with the suckling bottle, nipple pail and drenching respectively. Also, one of the most important factor influencing the successful transfer of passive immunity is the IgG immunoglobulin. The Brix refractometer is a suitable on-farm tool available for producers to measure colostrum quality because of its user friendliness and it functions independently of colostrum temperature (Bartier et al. 2015).

Baishya et al. (2025) in their study found that male calves had superior weight gain, more active play behaviour and their dams yielded more milk. Such findings suggest the development of gender specific calf management practices for enhancing productivity and optimizing the feeding strategies. McFarland et al. (2024) demonstrated that calves housed in pairs exhibited lower levels of fear, increased exploratory behaviour, and greater adaptability to new environments compared to those housed individually, as observed during behavioural tests. Sinnott et al. (2022) reported that, from 18 days of age onwards, indoor automatic feeding systems proved to be consistently more labour-efficient compared to indoor manual feeding, outdoor group hutches and individual hutch systems. Despite the differences in feeding methods, all systems supported positive calf development, with similar patterns observed in health and growth across treatments. Common Innovations also enhances the calf management efficiency and health monitoring such as:

1. **Automated Feeders:** Deliver consistent milk volumes and track intake.
2. **Activity Monitors:** Detect changes in behaviour that may signal illness.
3. **Data Systems:** Track growth, health records and feeding behaviours.

### 13. CONCLUSIONS

It is quite challenging to determine the optimal calf care techniques for calves from birth to weaning and until they become heifers. All facets of calf rearing are essential. In this review, the viewpoints of several researchers highlight areas where calf management might be improved, including colostrum feeding, weaning, nutritional interventions, disease control, and calf health management. Regularly employing sound scientific management techniques may lower calf mortality rates as well as treatment and feed expenses.

### DISCLAIMER (ARTIFICIAL INTELLIGENCE)

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc.) and text-to-image generators have been used during the writing or editing of this manuscript.

### COMPETING INTERESTS

Authors have declared that no competing interests exist.

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