Feeding and Management Strategies for Surplus Dairy Calves

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Abstract

Surplus dairy calves consist of all male and non-replacement female calves that are sold from the dairy farm soon after birth. There are several feeding and management considerations for surplus calves as they transition from the dairy farm to veal or dairy-beef production, including neonatal care, marketing, and transportation. Calves face several potential challenges to welfare during this early-life transition, including suboptimal neonatal care on the dairy farm, prolonged fasting, disease, and stress from handling, social mixing, and novel environments. Although some surplus calves are sold directly to a slaughter establishment or calf-raising facility, most are sold through a third-party (e.g., live auction or livestock dealer) within the first week of life. Consequently, a high prevalence of failed transfer of passive immunity, hypoglycemia, and disease have been documented on calf arrival at slaughter establishments and calf-raising facilities. Opportunities to improve surplus calf welfare in the short-term include delivering high-quality neonatal care, ensuring calf fitness for transport, utilizing direct marketing strategies, and reducing total transportation events and duration.

Introduction

Approximately 9.5 million dairy calves are born every year in the United States (USDA NASS, 2018). Nearly all male calves and any non-replacement female calves are sold from the source dairy farm soon after birth as "surplus" to the requirements of the dairy operation (Bolton and von Keyserlingk, 2021; Creutzinger et al., 2021). Surplus calves are sometimes perceived to be a byproduct of dairy production (Cave et al., 2005); nonetheless, they have important consumer perception and economic impacts on the dairy and surplus calf industries alike (Ritter et al., 2022). After they are sold from the dairy farm, surplus calves generally enter 1 of 3 production chains: "bob" veal (harvested < 3 weeks of age), "special-fed" veal (harvested at 20 to 22 weeks of age), or dairy-beef (harvested at 12 to 14 months of age). This proceedings paper will summarize several early-life feeding and management considerations for surplus calves as they transition to veal or dairy-beef production.

Overview of the Surplus Dairy Calf Production Chain

Neonatal care on the source dairy farm

Surplus calf welfare in veal and dairy-beef production is inextricably linked to the quality of neonatal care on the dairy farm

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of birth (Windeyer et al., 2014); colostrum administration, navel care, and housing have large impacts on disease incidence later in life. Despite the importance of high levels of maternal immunoglobulins to calf health, failed transfer of passive immunity **(FTPI)** remains a challenge and occurs in an estimated 25% of surplus dairy calves (Renaud et al., 2020; England et al., 2023). Comparatively, this is nearly double the national FTPI prevalence for dairy heifer calves (Lombard et al., 2020). Calves' risk of mortality is highest within the first 21 days after arrival at calf-raising facilities (Bähler et al., 2012; Pardon et al., 2012; Winder et al., 2016), and it is well documented that FTPI increases the risk of morbidity and early mortality (Stillwell and Carvalho, 2011; Renaud et al., 2018); calves with FTPI have 1.5 times greater risk of having diarrhea, 1.8 times greater risk of having respiratory disease, and twice the risk of dying compared to calves with successful transfer of passive immunity **(TPI)** (Raboisson et al., 2016). Thus, colostrum management likely predetermines calf welfare within veal and dairy-beef production. To achieve successful TPI, calves must receive an adequate quality and quantity of colostrum quickly after birth with minimal contamination (Godden et al., 2019). However, male dairy calves sometimes either do not receive any colostrum (Renaud et al., 2017) or receive a suboptimal quality (Fecteau et al., 2002) or quantity (Shively et al., 2019) of colostrum relative to female heifer calves, significantly increasing their risk of welfare compromise in veal and dairy-beef production.

In addition to colostrum management, navel care is an important factor in the prevention of calf morbidity and early mortality (Renaud et al., 2018). The umbilicus is exposed after parturition and open to potential contamination by pathogens present in the maternity pen, calf housing areas, trailer environments, etc. Pain associated with navel infection is a welfare concern and interferes with calves' normal sickness behavior, such as lying down to conserve energy (Studds et al., 2018). Navel infection may remain localized, but it can also become systemic and lead to neurological symptoms, severe lameness, and possibly death (Grover and Godden, 2011). Navel infection is a significant issue in surplus calf production, with studies consistently reporting approximately one-quarter of calves having navel infection on arrival at slaughter establishments (England et al., 2023) and calf-raising facilities (Pempek et al., 2017; Renaud et al., 2018a). However, it is not yet clear if preventive measures are adequately implemented on source dairy farms.

Marketing and transportation

Marketing and transportation are well-known stressors for animals of any age; however, this process can be particularly stressful for young animals, such as surplus calves (Roadknight et al., 2021). Marketing to a slaughter establishment or calf-raising facility can occur directly (i.e., source dairy farm to destination) or indirectly (i.e., source dairy farm to a third-party to destination); nearly two-thirds of all dairy operations (61.8%) in the U.S. reported using a live auction to sell their male calves (USDA, 2018). Live auctions and livestock dealers frequently assemble surplus calves from several different source dairy farms or other third-party facilities in a common environment. Most live auction or livestock dealer facilities are not routinely cleaned and disinfected, representing a high biosecurity and infectious disease risk (Cruetzinger et al., 2021). In addition, calves are generally withheld from milk and water during marketing, unless they are held at facilities over a 24-hour period, likely impacting hunger and thirst.

Approximately 80% of surplus calves are transported from source dairy farms in early life

(USDA, 2018). An increasing number of dairies are electing to breed dairy cows with beef semen (e.g., "beef on dairy"), resulting in a greater proportion of surplus calves leaving the source dairy farm compared to previous years (Foraker et al., 2022; McCabe et al., 2022). Calves in the U.S. are transported at an average age of 3 days of age and sometimes less than 24 hours of age (USDA, 2011; Cramer, unpublished data). The only federal law regulating transportation in the U.S. is the *Twenty-Eight Hour Rule*, whereby surplus calves and other food animal species cannot be transported more than 28 hours without access to feed or water or the ability to rest (49 U.S. Code§ 80502). Although nationwide data on transportation distances for surplus calves in the U.S. are lacking, some research has reported that "formula-fed" veal calves were transported 280 miles (450 kilometers) to 607 miles (977 kilometers) from live auctions to calf-raising facilities in the Midwest (Pempek et al., 2017); these data, however, only included the last known transportation event, and it is likely that calves were transported at least once prior. Comparatively, data on heifer calves shows that 40% of calves are shipped more than 20 miles (USDA, 2018).

Cattle can experience multiple stressors during marketing and transportation, including feed and water restriction, commingling, various handling techniques, and thermal stress (Trunkfield and Broom, 1990). However, young calves have undeveloped immune systems, less mature physiological stress responses, and cannot thermoregulate well, which makes them especially susceptible to these stressors (Pardon et al., 2015; Hulbert and Moisá, 2016). The vulnerability of the neonate, coupled with potential suboptimal management of surplus calves in early life, means that the current surplus calf production chain model, including indirect marketing and long-distance transportation, can be a large welfare concern for calves.

In addition to FTPI and navel infection, dehydration, diarrhea, and hypoglycemia are also documented welfare concerns on calf arrival (Pempek et al., 2017; England et al., 2023). Consequently, the mortality risk in "formula-fed" veal production is reportedly as high as 7%, with 42% of deaths occurring in the first 21 days after calf arrival (Renaud et al., 2018b). Thus, this high disease incidence results in frequent antimicrobial use (Cheng et al., 2022). Consequently, the levels of antimicrobial resistance in commensal organisms and pathogens from surplus calves are unusually high (Hutchinson et al., 2017). Therefore, improved preventive measures for surplus calves are necessary to protect both calf welfare and human well-being.

Feeding and Management Strategies to Optimize Surplus Dairy Calf Welfare

Provide high quality neonatal care

One strategy to optimize surplus dairy calf welfare is to encourage high-quality neonatal care for all calves, regardless of their destination or sex. It is acknowledged that modifications to current colostrum management practices likely require attitudinal and behavioral changes among dairy producers, which can be complex and multifaceted, particularly given the current economic climate (Wilson et al., 2021; Creutzinger et al., 2022). Still, similar colostrum management practices should continue to be encouraged by industry professionals for both male and female dairy calves to reduce calves' risk of having FTPI. Preventative measures can also easily be implemented on the source dairy farm to minimize the risk of navel infection, including adequate intake of high-quality colostrum, maternity pen hygiene, decreasing the amount of time newborn calves spend in the maternity pen, and ensuring the cleanliness of other calf housing environments before

sale (Mee, 2008). Further, navel antisepsis has long been recommended as best practice for navel care for newborn calves and is still recommended today by industry experts (Grover and Godden, 2011; Wieland et al., 2017).

Handle calves with care

Young calves are typically not responsive to being moved by flight zones and must often be moved individually (AABP, 2019). Special care is required to move young calves to minimize stress and avoid slips and falls (CCQA, 2022). The authors suggest the following acceptable handling techniques for young surplus calves: 1) place one hand around the rump and one hand under the chin; use the hand around the rump to apply gentle pressure to encourage the calf to move forward, while guiding the direction of movement with the hand under the chin; 2) walk beside the calf while gently running a hand up their spine and withers, moving caudally to cranially; and 3) lift the calf by placing one arm around and under the rump and one arm under the neck to support the chest; carry the calf to the trailer; slowly bend down to gently set the calf in the trailer. The following are never acceptable when handling young calves: electric prods, sole handling by the ears and tail, dragging, throwing, kicking, etc. (AABP, 2019).

The trailer environment and design can also play a key role in calf welfare during transportation. Calves may more easily and willingly enter the trailer if ramps are used; ramp angle should not exceed 25 degrees (CCQA, 2022). All walking surfaces should have adequate traction and be free of moisture and debris to avoid slips and falls. Trailers should be clean and dry and have non-slip flooring and adequate bedding (AABP, 2019). A calf's thermoneutral zone is between 60 to 78°F (15 to 26°C; Spain and Spiers, 1996; Davis and Drackley, 1998). When transporting calves in temperatures <60°F (15°C), transporters can consider adding extra bedding that allows calves to nest, calf jackets to maintain warmth, and covering roughly 50 to 70% of the holes in the trailer (CCQA, 2022). For transportation in temperatures >78°F (26°C), transporters can consider transporting calves during cooler temperatures (i.e., in the morning or at night).

Prepare calves for transportation

Fitness for transport, which the American Association of Bovine Practitioners **(AABP)** defines as "an animal's ability to withstand transportation without compromising their welfare", is a critical aspect to assess in young calves because the stressors experienced with transportation are compounded when cattle are sick or injured (i.e., not fit for transport; Edwards-Callaway et al., 2019). Neither an industry-wide definition nor transportation regulations exist regarding fitness for transport in cattle (Edwards-Callaway et al., 2019). However, industry groups, such as AABP and Calf Care Quality Assurance **(CCQA)**, have put forth general guidelines for calf transportation. Given that calves arrive at slaughter establishments and live auctions in suboptimal condition (e.g., dehydration, ill, etc.), there is opportunity to improve decision-making at the source dairy farm prior to transportation to ensure only fit calves are transported from the operation (Pempek et al., 2017; Renaud et al., 2018; Wilson et al., 2020). In addition to receiving high-quality colostrum or colostrum replacer, as well as having access to milk and fresh water prior to transportation, calves should also be assessed for fitness for transport (AABP, 2019). Trained caretakers should assess calves for the following prior to transportation: disease, dehydration, body condition, wounds, lameness, and ability to walk or stand easily. Conditions, such as disease (e.g., diarrhea, respiratory disease, navel, or joint inflammation), dehydration, lethargy,

bone fractures, difficulty breathing, thin body condition, inability to walk or stand easily, open wounds, or severe lameness would all deem a calf unfit for transport (CCQA, 2022). Sick or injured calves should only be transported if they are directly being taken to receive veterinary care (AABP, 2019). Only calves that are well hydrated, free of injury and disease, and able to stand unassisted should be transported to calf-raising facilities, slaughter establishments, or live auctions or livestock dealers (AABP, 2019).

Perhaps one of the largest welfare concerns with calf transportation is the deprivation of milk and water (Creutzinger et al., 2021). The lack of milk and water provision during all phases of transportation likely limits the calf's ability to maintain normal blood glucose levels and hydration, given that a previous study found a large proportion of "bob" veal calves arrived at a slaughter establishment hypoglycemic (74%) and dehydrated (68%; England et al., 2023). Not only do hypoglycemia and dehydration impact calf welfare immediately, but they can also have longer-term impacts. For example, calves that were dehydrated upon arrival to a "formula-fed" veal facility had an increased hazard of preweaning mortality, and hypoglycemia was associated with increased mortality in calves with diarrhea (Trefz et al., 2017; Renaud et al., 2018b). In addition to maintaining normal glucose levels and hydration, milk provision is an important welfare consideration from the perspective of satiety. When given free-choice access to milk, calves will drink milk 4 to 10 times per day, on average (Appleby et al., 2001; Miller-Cushon and DeVries, 2015). Thus, if milk is withheld from calves for long periods of time, calves become hungry, which is a negative emotional state, and therefore, an animal welfare concern (von Keyserlingk et al., 2009).

Ideally, calves would have access to milk and water or oral electrolytes throughout the entirety of transportation and during marketing; however, this is not common practice (Pempek et al., 2017; Creutzinger et al., 2021). Again, by focusing on preparing calves for transportation, some of the negative consequences of transporting young calves can be mitigated. Three preconditioning strategies can help support calves throughout marketing and transportation: 1) provide a milk feeding ($\geq$ 2 L) as close to transportation as possible, 2) administer an oral electrolyte solution prior to transportation, and 3) provide access to clean and fresh water at all times prior to transportation and during marketing.

Reduce transportation duration and number of events

Transporting surplus calves is a reality of the current supply chain structure. However, adjustments to the current model can be made so that it is less stressful for young calves. First, reducing transportation duration can be prioritized, as this has been associated with decreased mortality, lower prevalence of diarrhea post-transport, maintenance of normal blood glucose, and increased body weight, compared to calves transported for longer durations (Boulton et al., 2020; Rot et al., 2022; Goetz et al., 2023a,b). Similarly, calves that are marketed through live auctions or assembled at livestock dealers are likely to experience more stressors (e.g., more handling, loading/unloading, commingling, and longer time without milk and water) than calves that are transported directly from the source dairy to either a calf-raising facility or slaughter establishment (Pempek et al., 2017; Creutzinger et al., 2021). For example, calves purchased from some live auctions were reported to have a greater prevalence of dehydration and depression, compared to calves that were transported directly to "formula-fed" veal facilities from source dairy farms (Pempek et al., 2017). Exploring marketing

options for calves closer to the source dairy farm and/or direct marketing options could reduce both economic costs and calf welfare concerns. If this is not currently feasible for a source dairy farm, a focus on preconditioning is critical to minimize the welfare challenges calves experience during indirect marketing and transportation. Furthermore, transporters could consider providing water on trailers or making more frequent stops to provide milk, water, and/or electrolytes.

Conclusions

Surplus dairy calves have important consumer perception and economic impacts on both the dairy and surplus calf industries. Compared to adult cattle, young calves are particularly vulnerable to compromised welfare and are at a relatively high risk of morbidity and mortality in the first weeks of life. Dairy producers play a critical role in calves' success in veal and dairy-beef production, and high-quality neonatal care (e.g., colostrum administration, hygiene, and navel antisepsis) is necessary to safeguard calf welfare. Feeding and management strategies to reduce fasting and increase calf comfort during marketing and transportation must also be prioritized to achieve more marketable animals and optimize surplus calf welfare in veal and dairy-beef production.

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