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Management of calves from birth to weaning: Milk feeding of calves from newborn through weaning

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Series summary

The care of young dairy calves is a key aspect of all modern dairy farming enterprises and an area of increasing awareness by society who expects humane treatment of all farm animals [1]. Studies have shown that an increase in farm animal welfare is frequently associated with an improvement in animal performance and farmers' job satisfaction [2].

Healthy, vigorous dairy calves who are provided high planes of nutrition and social contact early in life are more productive later in life [3,4]. Research on calf rearing has gained considerable traction over the last two decades providing new knowledge that has led to successful rearing of dairy calves in ways that benefit health but also considers their behavioral needs and promotes positive emotional states (see reviews [5,6]. This IDF Calf Management Factsheet (one in a series of IDF factsheets addressing novel approaches to improve calf rearing) provides a short comprehensive overview of the advantages of providing calves during the milk feeding period with higher planes of nutrition than the traditional 10% body weight (BW) equivalent of milk (e.g., ~ 4 L/d for a newborn Holstein calf).

Background

Globally most dairy calves are removed from their dam in the hours following birth to be reared by human caregivers. Whilst there is growing interest in systems involving prolonged cow-calf contact (see IDF factsheet "[Rearing of calves by dam-calf contact](#)" 38/2024), most farms artificially rear calves by feeding milk or milk replacer using controlled feeding practices. Despite evidence supporting calves' ability to consume high quantities of milk, i.e., 20% of a calf's BW [7], and findings showing some farms adopting higher plane of nutrition [8], many calves are still fed approximately 10% BW during the entire milk feeding period (on average <6L/d, [9, 10]). Feeding restricted milk allowances, over two to three meals, differs greatly from the natural feeding patterns for calves: in nature calves suckle from the cow frequently throughout the day. Under these naturalistic feeding systems, as the calf gets older the amount of milk consumed gradually decreases and solid feed intake increases until weaning, which, in natural settings, occurs around 8-11 months (reviewed by [11]). A plethora of research has investigated the best ways to feed and wean calves in the absence of the dam that promote higher standards of welfare. Here we describe the best, evidence-based, practices associated with milk feeding.

How should milk be delivered to the calf

Historically, but also still common in some regions, provision of milk has been delivered using buckets [12]. Bucket feeding does not allow calves to express their natural sucking behavior, promotes non-nutritive sucking and may lead to frustration [13, 14]. In contrast, feeding calves with teat bottles/ buckets or automatic feeders promotes natural nursing behaviors such as sucking and head-butting [15, 16]. Calves fed via artificial teats perform less non-nutritive sucking [17] and drink more milk, likely driven in part by the fact that they consume the milk at a slower rate than calves fed by bucket [15, 18]. When given the opportunity, calves will spend 30-40 min/d engaged in sucking behavior (i.e., [16]) and therefore for calves which are not being reared with their dam or a foster cow, sucking on an artificial teat when consuming milk should be accepted as a behavioral need.

How much and how frequently should milk be fed to calves pre-weaning?

For the first few weeks of life, until transitioned onto solid food, the calf's diet consists primarily of milk or milk replacer. In best practice, calves should be offered a minimum 20% of their BW in milk or milk replacer (i.e., 40 kg calf = 8 L/d), separated over at least two meals. However, the dry matter content must be taken into account. Based on 15% solids in natural milk, a 40 kg calf should be fed a minimum of 8 L/d with a dry matter content of 1.2 kg.

The use of automated milk feeding equipment provides opportunities for calves to be fed higher milk allowances spread over multiple meals compared to manual milk feeding, which is most often based on twice daily feeding [19] with some farms only feeding once daily [20]. Calves should be provided a minimum of two meals of milk per day. Once a day feeding deviates drastically from nature and likely results in hunger as time between milk feeding is increased. Coupling adequate milk allowances (equivalent to 20% body weight (BW)) to minimize hunger [21] and nipple-feeding with adequate milk flow allows for higher growth rates, a more complete suite of natural behaviors and reduces frustration [7, 13, 22, 23]. Whilst feeding cold milk is not recommended, there is evidence that feeding cooler milk (8°C), has no effect on the function of the esophageal reflex, indicating that there is likely minimal risk of cold milk entering the rumen. [24].

What are the advantages of feeding higher milk allowances?

Calves fed higher milk allowances, at a minimum of 20% BW [5], have been shown to have higher average daily gains (ADG) pre and post weaning than calves fed restrictive amounts [7, 25, 26]. Ad libitum milk feeding in the first weeks of life goes a step further and allows animals to express individual preferences in drinking behavior [15, 18] in addition to promoting growth [27] and health [28]. Higher growth rates during pre-weaning have been associated with long-term benefits, including increased first lactation milk yield [29]. In addition to advantages associated with growth and long-term performance, calves fed higher milk allowances also show less behavioural indicators of hunger (unrewarded visits to milk feeder [21, 30]; non-nutritive sucking [31]).

What are the risks of offering higher milk allowances?

There is a perception that feeding higher quantities of milk to calves can cause increased risk of digestive upsets including diarrhoea. Although consuming higher volumes of milk will result in softer faeces this does not necessarily mean that the calves are suffering from diarrhoea. Multiple studies that have implemented higher milk allowances do not support the claim that offering higher milk allowances increases diarrhoea [7, 13, 32]. Increased incidences of diarrhoea may be more likely attributed to challenges associated with housing conditions, sanitation, and farm management practices (reviewed by [5]).

Farmers should consult their veterinarian if they believe their calves are sick. Furthermore, larger quantities per meal (over 3 L) do not lead to overfilling of the abomasum when offered through a teat with a small opening [33].

One of the greatest concerns when feeding calves higher volumes of milk is how to wean them. Indeed, calves fed higher milk allowances will consume less solid feed (e.g., concentrates, calf starter or grain) before weaning [34] but these calves still on average have higher body growth [26, 34]. In addition, social housing has been shown to encourage solid feed intake (see Factsheet IDF N° 24/ 2023, [6]). That said, the effects of weaning distress should not be underestimated, and all calves should be weaned gradually to promote solid feed intake before complete cessation of milk. Please refer to the factsheet [Management of calves from birth to weaning: Pair housing of calves](#) (Factsheet of the IDF N° 24/2023) for best gradual weaning practices.

About the series

In 2019, the IDF Standing Committee on Farm Management and Standing Committee on Animal Health and Welfare identified a need to produce factsheets on management of calves from birth to weaning to provide information to dairy farmers and interested stakeholders.

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