

Health risks associated with the use of automatic milk feeders in calves

Gezondheidsrisico's geassocieerd met het gebruik van een drinkautomaat bij kalveren

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ABSTRACT

The objective of the present article was to summarize available evidence of the economic benefits and health risks associated with the use of automatic milk feeders (AMFs) in calves. Although AMFs are increasingly used in cattle production, clear evidence of their economic benefits (increased average daily gain, gradual weaning and reduced labor time) for the typical Belgian farm size and management is not available. Especially in smaller farms, where labor time is not a limiting factor, a careful economic consideration should be made. Regarding the association of AMFs with calf disease, studies have only been performed for bovine respiratory disease and confirmed an increased risk. However, since the use of AMFs is strongly related with several other risk factors (group housing at young age, large groups, age difference in a group, continuous system versus all-in/all-out), it is difficult to unequivocally identify the risk associated with AMFs alone. A group size of less than ten calves on a single drinking point, an all-in/all-out grouping system and a minimum age at introduction to the automat of three weeks are recommended for farms with AMFs. To the authors' knowledge, no scientific evidence supporting the presumed association of diarrhea and tongue ulcers with AMFs is available to date.

SAMENVATTING

Drinkautomaten voor kalveren worden steeds frequenter gebruikt in Vlaanderen, met als hoofddoel arbeidsbesparing. In dit overzichtsartikel wordt een samenvatting gegeven van de huidige kennis omtrent de technische aspecten van de drinkautomaat, de economische voordelen en de gezondheidsrisico's voor kalveren gehuisvest bij deze automaten. Er is geen overtuigend bewijs dat het gebruik van drinkautomaten in kleinere bedrijven economisch rendabel is. Hoewel er weinig wetenschappelijke literatuur beschikbaar is over de gezondheidsrisico's die geassocieerd zijn met drinkautomaten, zijn er duidelijke aanwijzingen dat grote groepen kalveren gehuisvest bij een drinkautomaat een hoger risico op pneumonie ("bovine respiratory disease" (BRD)) hebben. Of de automaat zelf een risicofactor is voor BRD of dat het eerder komt door de blootstelling van de kalveren aan reeds bekende BRD-*risicofactoren* (i.e. grote groepen, op jonge leeftijd in groep gehuisvest worden, het niet toepassen van het all-in/all-out-systeem, in het geval een drinkautomaatsysteem toegepast wordt), is echter onduidelijk. Naast BRD wordt er in de praktijk melding gemaakt van diarree en tongulcera, maar er is geen bewijs beschikbaar over de link met het gebruik van drinkautomaten. Om problemen op bedrijven met een drinkautomaat te beperken, zijn een groeps grootte van maximum tien kalveren per drinkstation, het toepassen van een all-in/all-out-systeem per groep en een minimumleeftijd van drie weken alvorens de kalveren bij de automaat te huisvesten de belangrijkste aandachtspunten.

INTRODUCTION

In the last decade, a marked increase in herd size has been seen in different cattle production systems in several European countries (Hemme, 2007; Hemme 2008). A larger herd size increases the farmers' work load and decreases the available time for crucial tasks regarding the farm's productivity, such as heat and disease detection (Washburn et al., 2002). To deal with this issue, farmers increasingly rely on automation. For feeding young calves, automated milk feeders (AMFs) are increasingly being used. AMFs allow calves to drink at their own needs, which is beneficial from a digestive and animal welfare point of view (Day et al., 1987). Because feeding is done automatically, the producers of AMFs claim a marked reduction in labor time for the farmers. However, the use of AMFs on a farm provokes several changes in calf management. For optimal use of the available AMFs, farmers tend to maximize group size and shorten the individual housing period. In recent years, an apparently increased risk for bovine respiratory disease (BRD), diarrhea and tongue ulcers in calves housed on AMFs has been reported in Belgium (Sustronck et al., 2014).

Therefore, the objective of the present paper is to summarize available evidence of the economic benefits and health risks associated with the use of AMFs in calves.

AUTOMATED FEEDING SYSTEMS FOR CALVES

Traditionally, the most common, non-automated feeding systems for calves are either suckling with the dam or bucket feeding. Several forms of automation have found their way to calf feeding systems.

A first method of automation is the use of milk mixers. These devices consist of a recipient with a

mixer and frequently a heater, which allow the farmer to consistently prepare larger quantities of milk replacer and to maintain the desired drinking temperature. These milk mixers are usually mobile, and several models are equipped with programs that record different data. This system allows the farmer to feed larger groups of animals in a shorter time span. In the veal industry, the milk mixer is stationary, and the milk reaches the different pens through a tube system (Pardon et al., 2013). However, this extended system is too expensive to be used on Flemish dairy and beef farms with an average of sixty newborn calves a year (Platteau et al., 2014).

A second form of automation is the provision of stationary drinking systems known as AMFs. In almost all of these drinking systems, both cow's milk and milk powder can be offered. The core of the milk feeder is the same for the different types of AMFs and consists of four parts: a unit where milk is prepared (Figure 1A), one or more drinking points, transponders for calf-recognition (Figure 1C) and a processor, which controls the system settings (Van Gansbeke, 2007). Several drinking points may be connected to a single unit of milk preparation. In systems, in which cooled cow's milk can be delivered, the milk is stored in a reservoir and heated on demand when the calves start to suckle. When milk replacer (MR) is used, it is freshly prepared on demand by mixing milk powder with water. All systems may maintain the desired drinking temperature at the drinking point, but regular punctual checks are required to assure compliance with the pre-sets of the AMF. There are also systems mainly using cow's milk, in which an amount of MR can be mixed according to the programmed feeding scheme. Calves are either allowed to drink ad libitum or follow a restricted feeding scheme. In the second case, calves wear a transponder (Figure 1C), and the milk is provided in small portions at every drinking attempt until the maximum programmed daily amount is consumed.



Figure 1. Automated milk feeder. A. Unit where the milk is prepared. B. Calf drinking from the nipple in a drinking point. C. Calf with transponder for recognition by the automat.



Figure 2. Different types of drinking points. A. Open system with free access and multiple nipples. B. Single drinking point with open access. C. Protected drinking point.

The AMF drinking points are either freely accessible (Figures 2A and 2B) or are protected (Figure 2C). A disadvantage of free access is that dominant animals may expel other animals, thus limiting feed uptake of the latter category. Protected systems consist of gates, which allow the calf to drink undisturbed. A drinking point can either be equipped with a nipple (Figure 1B) or a drinking cup (Van Gansbeke, 2007).

ECONOMIC BENEFITS

Three factors play an important role in the economic results or benefits of the automat. For the farmer, time reduction is often the most important factor. In addition to time benefit, increased average daily weight gain (ADG) and gradual weaning are to be expected. Finally, AMFs lead to improved animal welfare by allowing the calf to follow a more natural drinking scheme.

Automated milk feeders reduce labor time for milk feeding by 50% compared to a conventional system when milk preparation, milk feeding time and time needed for cleaning are taken into account (Van Gansbeke, 2007). Kung et al. (1997) showed that in an individual housing system with buckets, farmers needed 10 min/calf/day for feeding compared with 1 min/calf/day when calves were housed in groups nearby the AMF. In this study, thirty calves were split in two groups of 15 calves to avoid group size having impact. Besides reduced labor, there was also a redistribution of labor time. When working with AMFs, health checks of the calves can be freely planned in the daily working scheme instead of during busy feeding times (Van Gansbeke, 2007). In general, when time is not the limiting factor, investing in an AMF is not economically favorable (Van Gansbeke, 2007). The cost of an AMF can be regained in three years' time on a farm with two hundred cows, with a clearance rate of 35% and a calf mortality of 10% (Kung et al., 1997).

This beneficial effect is mainly based on a reduction in labor time. Economic benefits thus clearly depend on farm size.

AMFs allow calves to consume more milk and make it possible to program the weaning process. In addition, the milk composition is more constant compared to manual preparation, avoiding digestive upsets. Theoretically, these factors could result in an increased ADG of animals fed on an AMF. However, only one peer-reviewed study is available in the literature and no difference in ADG could be demonstrated between group-housed calves fed by AMF and individually housed calves fed by bucket twice daily (Kung et al., 1997). Abrupt weaning of calves leads to a reduced average daily gain (Sweeney et al., 2010). Therefore, gradual weaning over a longer period is indicated. It can be recommended to wean over a period of ten days' time (Sweeney et al., 2010). This gradual weaning improves starter intake, which is crucial. However, it is still important to check the amount of intake before weaning (Sweeney et al., 2010; Eckert et al., 2015). AMFs may offer these detailed and prolonged weaning schemes. Unfortunately, no studies could be found in the literature, in which automated weaning versus traditional weaning schemes are compared.

Finally, animal welfare may contribute to economic benefits. Animal welfare has become increasingly important in the public opinion, and AMFs may contribute to higher welfare levels. AMF systems offer several portions of milk to calves over the day, which matches their natural behavior better than being fed two times a day. Management failures that may easily occur in traditional milk feeding, such as large portions, irregular feeding times, differences in doses and temperature, may be prevented if farmers use AMFs and perform regular checks of the AMFs (Van Gansbeke, 2007). However, beside these positive welfare aspects, there are some negative aspects. In groups of 24 animals, there is more competition between the

calves to access the feeder and they have to wait longer before they can drink than calves, which are housed in groups of 12 animals (Jensen, 2004). In order to limit the waiting time and competition in large groups, it may be helpful to feed the calves larger amounts of milk per access to the feeder (Jensen, 2004).

ASSOCIATION BETWEEN AUTOMATED MILK FEEDERS AND DISEASES

Calf health issues on farms with AMFs have been increasingly reported. Observed diseases are bovine respiratory disease (BRD), diarrhea and tongue ulcers (Hepola, 2003; Sustroenck et al., 2014). Below, an overview of the available literature on the relationship between AMFs and these diseases is provided.

Bovine respiratory disease

Bovine respiratory disease is a multifactorial disease with a very important economic impact due to mortality, weight loss, carcass quality loss and increased antimicrobial use (Griffin et al., 2010; Pardon et al., 2013). Bovine respiratory disease is caused by viral and bacterial pathogens and several risk factors are known to mitigate the pathogenesis.

An increased risk of BRD has been evidenced in calves housed in pens with AMFs (Maatje et al., 1993; Lundborg et al., 2005; Svensson and Liberg, 2006). However, to date, the exact mechanism is not clear yet. The risk of BRD increases with increasing herd size (Norström et al., 2000; Gulliksen et al., 2009b), and since AMFs are more frequently applied in large farms than in small farms, the link between AMF and BRD might be biased by herd size. Furthermore, calves, which are fed with AMFs, are frequently housed in larger groups, and increasing group size is a well-known risk factor for BRD (Losinger and Heinrichs, 1996; Svensson et al., 2003; Svensson and Liberg, 2006). Svensson and Liberg (2006) showed that calves on AMFs have a reduced BRD risk when housed in small groups (six to nine calves), compared to large groups (twelve to eighteen calves). They have also reported that calves younger than nine days are 47% more susceptible to BRD, than calves aged 19 days and more at the time of being fed by AMFs (Svensson and Liberg, 2006). In order to optimally use the AMF, farmers increase the group size per automat, switch from an all-in/all-out grouping system to a continuous system and put the animals at very young age on AMFs. By doing so, the animals are exposed to risk factors for BRD and diarrhea (Gulliksen et al. 2009a, 2009b). The use of a continuous grouping system creates larger age differences and is a known risk factor for BRD (Maddox-Hyttel et al., 2006; Gulliksen et al., 2009b). In contrast, the all-in/all-out grouping system has been shown to reduce the BRD risk (Brscic et al., 2012; Woolums et al., 2013). A recent study on a limited number of farms in Flanders showed that the

number of calves held in a group on a single drinking point varied between fifteen and thirty (Janssens, 2015). None of these farms used a continuous system and the animals were housed in pens with an automat, starting at a mean age of ten days (Janssens, 2015). In that study, age differences between the calves housed on a single drinking point, ranged between 15 and 32 days. Next to exposure to those risk factors, a single drinking nipple for all animals may facilitate pathogen transmission between animals. However, this possible transmission has not been investigated yet. Although several disinfection systems have been applied in practice, to date, no evidence of their efficacy is available yet. In a limited study, differences in the prevalence at nose and lung levels of *Mannheimia haemolytica*, *Pasteurella multocida*, *Histophilus somni* and *Mycoplasma bovis* could not be demonstrated in herds with and without AMFs (Janssens, 2015).

It is clear that further research on the exact risk of the automat itself and the role of the shared drinking nipple in pathogen transmission is urgently required in order to create an optimal situation for the use of AMFs in farms, thus limiting respiratory health issues.

Diarrhea

Diarrhea is a common problem in neonatal calves and often occurs in calves housed in pens with an AMF. The disease is multifactorial and the most common pathogens are bovine rotavirus, bovine coronavirus, enterotoxigenic *Escherichia coli* and *Cryptosporidium parvum* (Torsein et al., 2011). Several risk factors for neonatal diarrhea have been identified, but up till now, no direct association between housing calves with an AMF and neonatal diarrhea has been reported. However, in management systems, in which AMFs are used, the calves are exposed to risk factors for diarrhea. Herd size (Klein-Jöbstl et al., 2014; Frank and Kaneene, 1993; Gulliksen et al., 2009a), group housing at young age (Barrington et al., 2002; Svensson and Liberg, 2006; Svensson et al., 2006; Gulliksen et al., 2009a) and substantial age differences between calves housed together in one group (Barrington et al., 2002; Svensson et al., 2006) increase the risk of neonatal diarrhea. Diarrhea pathogens are transmitted through the orofecal route, and the drinking point possibly forms a single area of contamination both by the nipple as by the unhygienic conditions, which are created in this frequently used pen area.

On the other hand, AMFs may as well limit the risk of nutritional diarrhea in young calves, since they assure a constant and correct preparation of MR. Moreover, in systems with transponders, excessive milk uptake may be avoided.

Tongue ulcerations

Tongue ulcerations are generally traumatic lesions of variable size induced by the incisors and are usually

situated on the ventral side. These tongue ulcers are commonly associated with *Fusobacterium necrophorum*, which also causes necrotic stomatitis (McIntosh, 1938). In the literature, no studies have been found, in which the prevalence of tongue ulcers in suckler calves, calves with traditional bucket feeding and in calves fed by an AMF are compared. However, in a study by Sustronck et al. (2014), tongue ulcerations have been suggested to occur more frequently in calves fed with AMFs, in Flanders (Sustronck et al. 2014). Possibly, the Belgian blue breed, which is frequently born with macroglossia due to its hypermuscularity, is more prone to develop traumatic ulcerations when drinking from nipples. In the literature, tongue ulcers in calves are underdocumented, and besides age (most frequently between two weeks and three months of age), no risk factors have been identified (Holliman, 2005). McIntosh (1938) showed that pathogens related to tongue ulcers may be indirectly transmitted between animals via materials. It might hence be possible that these pathogens are efficiently transmitted by allowing animals to suckle on the same nipple. Up till now, no studies have provided enough evidence to support an association between the use of AMFs and the development of tongue ulcerations.

CONCLUSIONS

Although AMFs are increasingly used, clear evidence of their economic benefits (increased ADG, better weaning management and reduced labor time) for the typical Belgian farm size and management is not available. Especially in smaller farms, where labor time is not a limiting factor, a careful economic consideration should be made. Taking into account the possible association of AMFs with calf disease, studies have only been performed for BRD and confirmed an increased risk. However, since the use of AMFs in farms is strongly related with several other risk factors, i.e. large groups, all-in/all-out, large age differences within the same group, group housing at young age, it is difficult to clearly identify the risk associated with the AMF alone. A group size of less than ten calves housed in a pen with a single drinking point, an all-in/all-out grouping system and a minimum age at introduction to the automat of three weeks may be recommended. To the authors' knowledge, no scientific evidence supporting the presumed association of diarrhea and tongue ulcers with AMFs is available so far.

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