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Faculty of Veterinary Medicine and Animal Science

Strategies for keeping cow and calf together in six European countries

Strategier för att hålla ko och kalv tillsammans i sex europeiska länder

Sofia Gundersen

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Abstract

The modern practice for dairy calf management is to separate the cow and calf a few hours after birth. That practice is highly debatable and consumers often oppose of it. There are several benefits for keeping cow and calf together for a longer period of time and letting the calf suckle. Calves develop a more advanced social behaviour, have a higher daily growth and develop less abnormal oral behaviours such as cross-sucking. Cows can get a better udder health and a longer lactation period when they are being suckled. Some studies have also shown that it can be economically beneficial to have a cow-calf contact system. This master's thesis studied innovative systems for keeping cow and calf together in six European countries. The participating countries were Austria, France, Germany, Italy, Sweden and Switzerland. A total of 119 farmers were interviewed over phone with a standardised questionnaire. The criteria for entering an interview was that the farmer had to keep cow and calf together for more than seven days. The results showed that there was a wide range on how long cow and calf were allowed to be together, from 7 to 305 days. The main system was rearing by dam and some farms had foster cows. Fishbone milking parlour was the most commonly used milking system. The overall herd size was similar to the average herd size of dairy farms in EU (2016: 33 dairy cows), but the farms ranged from 1 to 500 dairy cows. The farmers were asked to give their perception of cow and calf health and the overall answer was that it was better in systems allowing cow-calf contact for more than seven days. This thesis showed that there are active dairy farms using systems where cow and calf are kept together and that it is possible to implement a cow-calf contact system on a farm with a modern milking system. This thesis also showed that larger farms (> 36 cows) more frequently used a calf rearing system with foster cows or a mixed system (foster cow and dam), rather than only mother.

Keywords: cow-calf contact, calf rearing system, cow-calf separation, dairy production

Sammanfattning

Det moderna sättet att hålla mjölkraskalvar är att skilja dem från kon några timmar efter födsel. Tidig ko-kalv separation är ett debatterat ämne och något som många konsumenter ifrågasätter. Det finns flera positiva effekter av att hålla ko och kalv tillsammans en längre period och att låta kalven dia. Kalvarna utvecklar ett mer avancerad socialt beteende, de har en högre daglig tillväxt och utvecklar mindre onormala orala beteenden så som suga på inredning och andra kalvar. Korna kan få en bättre juverhälsa och en längre laktationskurva när de blir diade. Vissa studier visar också att det kan vara ekonomiskt försvarbart att ha ett system med ko-kalvkontakt. Det här examensarbetet har studerat innovativa system för att hålla ko och kalv tillsammans i sex europeiska länder. De medverkande länderna var Österrike, Frankrike, Tyskland, Italien, Sverige och Schweiz. Totalt intervjuades 119 bönder över telefon med ett standardiserat frågeformulär. Kriteriet för att bli intervjuad var att bonden skulle hålla ko och kalv tillsammans i mer än sju dagar. Resultatet visade på en stor spridning av hur länge ko och kalv fick vara tillsammans, från sju till 305 dagar. Det mest förekommande systemet var att ha kalven hos moderkon men vissa hade även amkor. Mjölkning i fiskbensgrop var det mjölksystem som användes mest. Gårdarna var av medelstorlek och var jämförbart med EUs medel (2016: 33 mjölkkor) på besättningsstorlek. Den minsta gården hade en ko och den största 500 mjölkkor. Bönderna blev tillfrågade att bedöma kornas och kalvarnas hälsa och de flesta upplevde att hälsan var bättre när ko och kalv hölls tillsammans jämfört med ett traditionellt system. Det här examensarbetet visade att det finns aktiva mjölkgårdar där ko och kalv hålls tillsammans och att det finns möjlighet att implementera ett system med ko-kalvkontakt på moderna mjölkgårdar. Det här examensarbetet visade också att större gårdar (> 36 kor) mer frekvent använde sig av amkosystem eller ett blandat system (amko och moderko), till skillnad mot ett system med endast moderko.

Nyckelord: ko-kalv kontakt, kalvhållningssystem, ko-kalv separation, mjölkproduktion

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Introduction

A hot topic in the dairy industry today is early cow-calf separation. The usual practice on farms is to separate cow and calf a few hours after birth and then keep the calf housed in another location than its dam and feed it artificially with whole milk or milk replacer (Busch, *et al.*, 2017). Consumers are getting more and more educated and often oppose the way we rear our production animals. Cow-calf separation shortly after birth is a common concern (Agenäs, 2017). Separating the cow and calf later have several benefits. For example, suckling up to seven weeks can have a positive impact on the farms economy (Asheim, *et al.*, 2016), the cows' udder health can be improved by suckling (Fröberg, *et al*., 2007; Fröberg, *et al*., 2008) and it is considered a more natural calf rearing strategy (von Keyserlingk & Weary, 2007).

An objection towards cow-calf rearing systems is that it becomes more stressful when breaking the bond that have formed between cow and calf when they are allowed to spend more time together (Ventura, *et al.*, 2013).

There are great possibilities to advance the calf rearing system for dairy calves when it comes to animal welfare, housing, feeding and health. This master's thesis was written within the frame of the EU-funded research project ProYoungStock. The purpose of this study was to identify and describe innovative strategies that allow cow-calf contact in dairy production in six European countries; Austria, France, Germany, Italy, Sweden and Switzerland. Farmers from these countries have been interviewed by phone to gather data. The criteria for entering an interview was that the dairy farmer had to keep the calves with a cow (dam or foster) for more than seven days.

The hypothesis is that calf rearing system varies depending on herd size, it should be an easier task to rear calves by its mother on smaller farms. Another hypothesis is that cows that are suckled have a better udder health than cows that are not suckled or only suckled for a shorter period of time.

Literature

Cow-calf contact

The first time the cow and calf meet is when the cow turns around after birth. The cow usually starts smelling the calf and licking it dry (Kiley-Worthington & de la Plain, 1983). Licking the calf is good for the calf's blood flow and seems to be important to strengthen the bond between mother and calf. Kiley-Worthington and de la Plain (1983) observed the behaviour of cattle and found that during the first three hours after birth the cows did not go more than five metres away from their calves. The proximity between cow and calf seemed to be controlled foremost by the cow the first few hours even though their actions between each other appeared to be somewhat synchronized (von Keyserlingk & Weary, 2007). As some might think it is not the mother that leave the calf in a secure spot, the calf will seek out a safe place to lay on its own (Kiley-Worthington & de la Plain, 1983). In the wild or in a more "natural" rearing system the calves will stay hidden during the first days with their mothers grazing nearby (Vitale, *et al.*, 1986). The distance between mothers and calves increase with the calf's age. The natural time for weaning is about nine months for cattle (Kiley-Worthington & de la Plain, 1983).

On conventional farms the cow and calf are separated shortly after birth. The reasons why early separation of cow and calf is practised is to ensure the calf gets the proper nourishment and care, improve calf health, reduce stress that is associated with later separation and avoid practical challenges following keeping cow and calf together (Mee, 2008; Ventura, *et al*., 2013). Practical challanges could for example be housing and feeding system that is not equipped for having cow and calf together (Ventura, *et al.*, 2013). It is also believed that early separation is more economically profitable because it increases the amount of saleable milk (Flower & Weary, 2003).

Effects on welfare

Effects on behaviour

A major amount of artificially reared calves develop abnormal oral behaviour such as cross-sucking (Roth, *et al*., 2009). Cross-sucking is when a calf suckles other calves or the interior (Kilgour & Dalton, 1984). Cross-sucking often occur right after the calf has been fed and quickly finished their milk. The calf will start suckling other calves' ears, navel, teats or their own pen. Calves that suckled a cow showed a significantly lower frequency of cross-sucking compared to calves that where artificially reared (Fröberg, *et al.*, 2007; Fröberg, *et al*., 2008; Roth, *et al.*, 2009). One reason for this could be because their need to perform a suckling behaviour was satisfied (Roth, *et al.*, 2009). Even the calves that only had access to their mother for 15 minutes twice a day showed a radically less amount of cross-sucking compared to artificially reared calves, where almost all calves performed cross-sucking.

Lidfors (1996) made a study of the behavioural effects of separating the calf immediately (< 1 h) or four days (96 h) postpartum. Her results showed that cows that had their calves taken directly lay down more, performed more oral behaviour and were more inactive during the first hours. The oral behaviour included mainly sniffing the bedding that was wet from amniotic fluid. Cows that stayed together with her calf lay less. The calves stood sooner but learned to suckle later compared to the calves separated immediately. After the separation at 96 hours the newly separated calves performed more oral behaviour by sniffing the interior and bedding for about half an hour before falling asleep. The calf was placed four metres from the calving pen in a crate at separation, so the cow was able to see it. The cows started vocalising more frequently after separation at 96 hours but the calves did not respond directly to their mother, if they vocalised it was without looking at their mother. The cows did however have a higher frequency of vocalisation during the first hours after birth than at separation. This study did not differentiate the calls but it was discussed that it should have been different calls. Cows that still had their calves vocalised more the first two hours after birth than cows that had been separated from their calf. The immediately separated calf did on the other hand vocalise more than the calf that was separated later. Flower and Weary (2001) was able to see in their study comparing separation at day one and after two weeks that the cows separated later had a stronger response to separation. With more vocalisation and movement compared to cows separated from their calf earlier. They also concluded that calves that had spent two weeks with a cow showed more social behaviours when they were introduced to an unfamiliar calf. Buchli *et al.* (2017) made a similar conclusion according to social competence and cardiac stress response in young calves that had contact with a cow. They had two tests, one with isolation and novel object and one with confrontation with an unfamiliar cow. Calves involved in the

test had either been separated from their mother within 24 hours postpartum or been reared with dam or foster for 30 up to 180 days. The results showed that cardiac stress response was lower for calves that had been reared by a cow during the first test with isolation and novel object. The second test with confrontation showed that calves reared by a cow responded more submissive than the other calves and were better at reacting to threatening behaviour from the unfamiliar cow.

Effects on health

Long-term suckling have several positive effects on cow's health. Suckling accelerate the involution of the uterus after calving (Hunter, 1980). It can also reduce the risk of retained foetal membranes (Krohn, *et al*., 1990).

The cows' udder health may improve by being suckled (Fröberg, *et al*., 2007; Fröberg, *et al*., 2008). Cows that had been suckled showed a lower CMT (California Mastitis Test) score (Fröberg, *et al.*, 2007). Fröberg *et al.* (2007) had 24 cows with calves split into two treatment groups, restricted suckling (RS) where the calves were able to suckle one quarter at milking and artificial rearing (AR) where the calves were fed by nipple bottle. The RS cows and AR cows had CMT score one (on a five graded scale) in 85 % and 68 % of the udder quarters respectively. The AR cows had 14 % of their udder quarters with a score of five while the corresponding figure in RS cows was 7 %. The AR cows had a lower lactose content but on the other hand a higher fat content than the RS cows. The RS cows in a study by Mendoza *et al.* (2010) also showed a lower level of fat in the milk compared to AR cows.

In a study by Asheim *et al.* (2016) four suckling management strategies was compared. The long suckling groups suckled seven or 13 weeks, the short suckling group suckled for three days postpartum and a no suckling group. In their study the proportion of cows that was treated for a disease was 32 % in the long suckling groups compared to 46 % for the short suckling group and 68 % for the no suckling group. They could also see that the proportion of cows treated for mastitis was lower in the long suckling groups (6 %) than in the short suckling group (9 %) and the no suckling group (16 %).

Having calves reared by their mother can also affect their health. Svensson *et al.* (2003) and Roth *et al.* (2009) found that calves that suckled had a higher frequency of diarrhoea than artificially reared calves. Others found that by letting calves suckle for four days resulted in fewer bouts of diarrhoea during the first three weeks of the calves' lives (Weary & Chua, 2000). Wagenaar and Langhout (2007) also found diarrhoea to be less frequent for suckling calves compared to artificially reared calves.

Effects on growth

In the conventional manner calves are usually fed milk replacer from a bucket two times a day with a total intake of about 10 % their body weight (Jasper & Weary, 2002). According to Grøndahl *et al*. (2007) have recent studies and their study indicated that feeding calves 10 % of their body weight results in underfeeding and therefore should the recommendations be changed. In the study by Jasper and Weary (2002) conducted in Canada, calves fed ad libitum drank 80 % more milk before weaning than the conventionally fed calves. Conventionally fed calves drank a total of 176 litres of milk and calves fed ad libitum drank 316 litres before weaning at 37-42 days. The conventional calves had on the contrary a higher intake of concentrate and hay compared to the ad libitum-fed calves pre weaning. The high intake of milk for the ad libitum group contributed to a more rapid growth rate. The daily growth rate up to weaning at day 36 was 0.48 kg/day for conventional calves and 0.78 kg/day for calves fed ad libitum. In this study by Jasper and Weary (2002) the higher weight gain of the ad libitum-fed calves lasted the whole experiment period of 63 days.

Other studies showed a dip in weight gain after weaning for suckling (restricted or unrestricted) calves in comparison to artificially reared calves (Bar-Peled, *et al.*, 1997; Roth, *et al.*, 2009; Fröberg, *et al.*, 2011). These studies also showed that the average daily weight gain for suckle calves was higher before weaning than calves that did not suckle.

Effects on farm economics

Bar-Peled *et al.* (1997) made a study there they let 40 Holstein calves either drink milk replacer or suckle the dam for 42 days postpartum. After that all calves got the same treatment and were weaned at 60 days of age. They found out that having a heifer suckle as calf might lead to a lower calving age. The heifers also had a slightly higher body weight at conception and during calving compared to the conventionally reared heifers and they had a significantly shorter time to conception. Bar-Peled *et al.* (1997) concluded that milk production during the first lactation tended to be higher for heifers that had suckled as calves. The energy intake during this first critical growth period can have an effect on milk production during first lactation (Sejrsen, 1994).

Farmers might argue that it is economically beneficial to separate cow and calf early because that results in more saleable milk (Flower & Weary, 2003). Calves do still need milk and can be served milk that cannot be sold or milk replacer that might cost less than fresh milk.

Norwegian farmers in the study by Asheim *et al.* (2016) experienced that suckling was less time consuming when it came to calf feeding. The time it took to separate the calf before milking the cow had to be taken into account. They assumed that no or three days of suckling did not lower time spend with calf-associated work but seven and thirteen weeks of suckling could lower work by five and ten hours per calf, respectively.

The conclusion drawn by Asheim *et al.* (2016) was that suckling up to seven weeks can have a positive impact on the farm economy compared to systems where calves are separated after three days. In organic dairy farming in Norway cow and calf need to be together for at least three days. Calves with longer suckling period had a better growth and lower disease incidence in cows and calves that could compensate for the investments and increased herd size that was needed to make a profit in a suckling system. There was a limit on how long the calf should suckle before it no longer was profitable. Suckling up to 13 weeks was not recommended on the grounds that the calf will drink a lot of milk during the end of the period. Another thing to take under consideration is that modern farm buildings today are not designed for housing cow and calves together (Asheim, *et al.*, 2016). For example, could slatted floors designed for cows be a problem for the calves. Therefore, might some farmers need to invest in other buildings and interior if they consider having cows and calves together in a loose-housing system.

Juniqueira *et al*. (2005) were able to draw a conclusion that a cow suckled by a calf was more profitable per lactation than a cow not suckled. In their experiment with 105 F_1 Holstein × Gir crosses conducted in Brazil they separated the cows in to two groups, C+ that was milked with a calf (for 60 days) and C- that was milked without a calf. They were able to demonstrate that C+ had a higher average total milk yield than C- (2652 ± 184 kg vs 2184 ± 176 kg, $P > 0.07$) and a longer lactation period (251 ± 12 days vs 216 ± 12 days, $P > 0.04$). The higher milk yield was connected to the longer lactation for C+ cows since they did not have a higher daily milk yield. The calves in the C+ group drank in average more milk than C- calves that were fed four kg milk a day in a bucket (268 kg vs 210 kg). They measured C+ calves' milk consumption by the weight-suckle-weight procedure (Neidhardt, *et al.*, 1979). To do this Juniqueria *et al.* (2005) weight C+ calves at one and two months of age during both daily milkings. Despite of C+ calves drinking more milk the C+ cows were able to produce 410 kg more saleable milk than C-. Juniqueira *et al.* (2005) concluded that the C+ cows made 33.51 US$/lactation/cow more in profit than C-. Fröberg *et al.* (2007) made a similar conclusion about saleable milk. In their study the suckled cows produced 14 % more saleable milk than the other cows (7.59 ± 0.22 kg/day vs 6.56 ± 0.23 kg/day). They discussed that it probably was an effect of a higher frequency of udder emptying.

Cow-calf systems in dairy production

Free cow-calf contact

A system with free contact between cow and calf imply that the dam and her calf are kept together 24 hours a day (Johnsen, *et al.*, 2016). The weaning usually takes place around six to twelve weeks after birth. During these weeks the cows are still milked up to two times daily. The cow and calf are able to interact and the calf can suckle at any time. This has been implemented in automatic milking system with cubicle housing and a calf creep (Fröberg & Lidfors, 2009; Fröberg, *et al.*, 2011), milking parlour with cubicle housing and a calf area with a selection gate accessing the cow barn (Wagner, *et al*., 2013) and milking parlour with deep straw bedding, calf creep and an outdoor area (Grøndahl, *et al.*, 2007; Johnsen, *et al.*, 2015a).

Benefits with free cow-calf systems are that calves gets a high weight gain because of the unrestricted milk intake (Grøndahl, *et al*., 2007; Roth, *et al.*, 2009; Fröberg, *et al.*, 2011; Veisser, *et al*., 2013) and social interactions with dam, other cows and calves (Lidfors, 1996). Calves showed less abnormal oral behaviours as cross-sucking pre-weaning than artificially reared calves (Fröberg & Lidfors, 2009; Roth, *et al*., 2009). Cow and calf are also allowed to naturally regulate the frequency and timing of suckling bouts (Fröberg & Lidfors, 2009). Grøndahl *et al.* (2007) concluded in their study that this system was easy to manage and may satisfy the public concern regarding immediate cow-calf separation. Disadvantages with free cow-calf systems is the vocalisation by cows and calves during the first days after separation which could indicate distress (Johnsen, *et al*., 2015b). Calves that suckle often have a low intake of solid feed before weaning (Roth, *et al*., 2009; Fröberg, *et al*., 2011). The sudden shift from milk to solid feed at separation can result in a low weight gain post weaning and behavioural signs of stress for the calves (Fröberg & Lidfors, 2009; Johnsen, *et al*., 2015a).

Restricted suckling contact

Systems with restricted suckling does only permit the calf to suckle one to two times a day from its own dam (Johnsen, *et al*., 2016). During the rest of the day the cow and calf are kept separate. The time for suckling often appear around milking. For example can the calf suckle the cow two times a day two hours after milking (de Passillé, *et al*., 2008), two times daily for 15 minutes before milking (Roth, *et al*., 2009) or two times a day for 30 minutes (Fröberg, *et al.*, 2007; Mendoza, *et al.*, 2010). Restricted suckling systems are a common practise in countries with tropical climate (Das, *et al.*, 2001; Fröberg, *et al.*, 2007; Fröberg, *et al.*, 2008).

Benefits with this system is the positive social interactions between cow and calf with recognition of each other and bonding (Fröberg, *et al*., 2007; Fröberg & Lidfors, 2009; Roth, *et al.*, 2009). The occurrence of cross-sucking was low (Fröberg, *et al*., 2007; Fröberg & Lidfors, 2009; Roth, *et al.*, 2009). It is suggested that the regular separation between cow and calf may help in the development of social independence and would be benificial in the later permanent separation (Newberry & Swanson, 2008). Disadvantages are that calves have a lower intake of concentrate than calves that are artificially reared and that a low growth rate might occur after separation and weaning (Hepola, *et al*., 2007). There are limitations for the calf to learn from the cow and leading the calves to and from the cows for nursing might be labour intensive (Johnsen, *et al*., 2016).

Half day cow-calf contact

Half day cow-calf contact systems are a combination of free and restricted suckling systems (Johnsen, *et al*., 2016). The cow and calf do only have access to each other during a period of around twelve hours a day. Cow and calf could be together during the day and separated at night (Veisser, *et al*., 2013). Benefits are that the calves have a high weight gain pre and post weaning (Veisser, *et al*., 2013; Johnsen, *et al*., 2015c). The cow and calf was able to perform bonding behaviours (Johnsen, *et al*., 2015c). Disadvatages might be that the daily separation and reuniting of cow and calf is labour intensive. Some studies have shown that a system like this could be automated (Roth, *et al*., 2009; Wagner, *et al*., 2012).

Foster cow

A foster cow system involves two to four calves suckling a single cow (Johnsen, *et al*., 2016). The cow might have her own calf among the calves, but it is not given. The cows are traditionally not milked but it depends on stage of lactation and number of calves per cow. Benefits with a foster cow system is that the calves are able to perform a natural suckling behaviour, live in a group and have contact with adult cows (Loberg & Lidfors, 2001). Disadvantages can occur if the foster cow does not accept or form a bond with the alien calves. Most foster cows do accept calves (Loberg & Lidfors, 2001) but fostered calves might not receive as much social connecting behaviours from the foster cow (Loberg, 2007). The foster cow often prefers one to two specific calves (Loberg, 2007). Behavioural reactions to separation on foster cow and calves indicate that they experience considerable stress (Loberg, 2007; Loberg, *et al*., 2008).

Attitudes towards early cow-calf separation

Busch *et al.* (2017) made a survey of the US and German population on the topic of cow-calf separation in dairy production. A total of 476 US and 491 German participants completed the survey. Most (55 % of the Americans and 56 % of the Germans) stated that they never been to a dairy farm, 21.6 % and 21.8 % said they been visiting a dairy farm once, 21.8 % and 20.5 % a few times and 1.5 % and 1.4 % that they regularly visited a commercial dairy farm, respectively. The survey was in two steps, first the participants answered all question and then they were asked to answer the questions once again but this time with balanced arguments stated at each question. The majority of participants, both from the USA and Germany, opposed early cow-calf separation. Busch *et al.* (2017) noticed that the arguments did not create a larger swift in opinions among participants.

Ventura *et al.* (2013) had a web-based forum on a Canadian website there people could share their views on controversial issues in dairy production. They asked the question "Should dairy calves be separated from the cow within the first few hours after birth?" and the participants were able to answer "yes", "no" or "neutral". After that they could write a reason to support their views or select reasons provided by others in the forum. There were a total of 163 participants. Of the participants 31 % had no involvement in the dairy industry and the rest had some involvement. 33 % were students and teachers, 13 % animal advocates, 11 % producers, 9 % veterinarians and 3 % other dairy industry professionals. Less than half (44 %) of the participants chose "yes", 48 % "no" and 9 % "neutral". The reasons for opposing were that it was emotionally stressful for calf and cow to be separated, it compromises the health for calf and cow, it is unnatural, and it is possible for the dairy industry to accommodate cow-calf pairs and should therefore do it. Supporters to early separations gave reasons such as early separations minimize distress because a bond has not been developed yet, that it is beneficial for calf and cow health and that the dairy industry has limited abilities to accommodate cow-calf pairs.

Materials and methods

Study design and study population

This master's thesis was written within the frame of the EU-funded research project ProYoungStock. During the fall of 2018 telephone interviews with dairy farmers were conducted in seven European countries; Austria, France, Germany, Italy, Poland, Sweden and Switzerland.

The criteria for entering an interview was that the farmer had to have dairy production and keep calves with a cow (dam or foster) for more than seven days. The farmers interviewed were selected by "Snowball sampling" (Goodman, 1961) as this way of cow-calf keeping was believed to be uncommon in all participating countries. Snowball sampling was considered the best alternative to reach as many farmers with cows and calves together as possible. Snowball sampling was applied by asking each interviewed farmer if they knew any other farmer that had innovative strategies for rearing cow and calf together. This strategy was supplemented with advertisements in social media, through contacts at dairy organisations and by asking researchers.

Questionnaire and data editing

The interviews followed a standardised questionnaire that was prepared in agreement among the consortium members. The survey included 55 questions (Appendix 1) and each country was responsible to conduct the interviews for their own country.

The survey focused on how the calves were reared from birth to weaning. One area of interest was how much contact the calves had with the cows and if it was permanent or restricted. Further, the farmers were asked about their main drivers to use their present rearing system, how long they had it and what was the main barriers for them before they started. Other examples of questions were if they had the dam

or a foster cow with the calves, how long the calves were allowed to suckle and how long they had cow-calf contact. The farmers were also asked how they experienced the cows' and the calves' health, if it was better, worse or no difference. One of the last questions was if the farmer thought their system was more time consuming than a traditional system.

A workshop was given to calibrate the interviewers. During this workshop a person with expertise in qualitative research methods discussed the procedures of performing interviews. Each question in the questionnaire was also discussed among participants.

The answers were entered into Netigate (Netigate AB, 2019) by representatives from each country. The compilation of all answers was done at the Swedish University of Agricultural Sciences, with help from representatives of the other countries. The work in this thesis did only analyse the answers from the interviews and did not take part in constructing the questionnaire or the telephone interviews. Each country checked their answers in Netigare to eliminate wrongly entered answers. The data material in Netigate were then corrected by Swedish represents. Analyses were done in Netigate and in Microsoft Excel.

Statistical analysis

Statistical analyses to test the two hypotheses were done in Minitab using Chi-square tests. To test if the calf rearing system depended on herd size, the rearing systems were sorted into "with dam" in one group against the other options. The median herd size value (36 cows) was used as cut-off to create even group sizes. To test if cows that are suckled are perceived by farmers to have a better udder health than cows that are not suckled or only suckled for a shorter period of time, the option "Better" was put in one group and the other options in another group. The suckling period was sorted into two groups, where one group was herds with cows that were suckled less than 90 days and the other group was herds with cows that were suckled more than 90 days. A test result was considered statistically significant when the P-value was < 0.05.

Results

Herd size and milking system

A total of 119 farmers were interviewed; 15 from Austria, 27 from France, 20 from Germany, 19 from Italy, 20 from Sweden and 18 from Switzerland. Poland fell out of this study because they reported that they did not have any farmers that fit the criteria. The herd sizes ranged from 1-500 dairy cows. The average herd size was 53 dairy cows and the median was 36 dairy cows. Twelve farms had a herd size of 100 dairy cows or above. The farmer with only one dairy cow had it as a foster cow among seven suckler cows. The average herd size of dairy farms in the EU was 33 cows in 2016 (European Commission, 2018). Milking systems for the different farms are presented in Figure 1. The most common milking systems was milking parlour of fishbone type (38 %). Under the option "Other" the farmers were able to

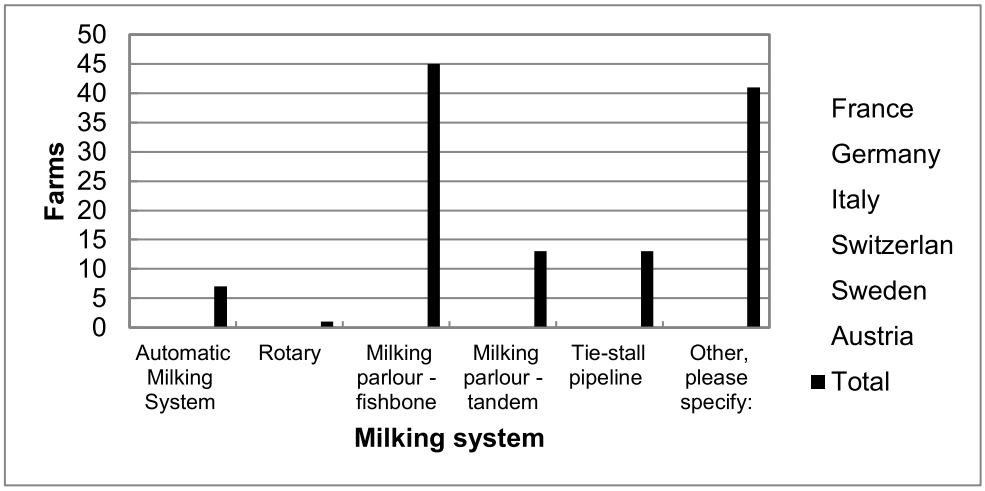

Figure 1. Milking system for participating farms.

leave a written answer. Here under "Other" the answers mainly included manual milking done by hand or with portable milking machine.
Figure 2 presents the income by percent that each farmer makes on their dairy production. It is wide spread, and all interviewed farmers in France claimed that they had 76-100 % of their income from dairy production while farmers from the other countries had a lower proportion of income from dairy production. It was not possible to find a connection between longer suckling period and a higher proportion of income from dairy production. A pattern was that larger farms had a higher proportion of income from dairy production than smaller farms.

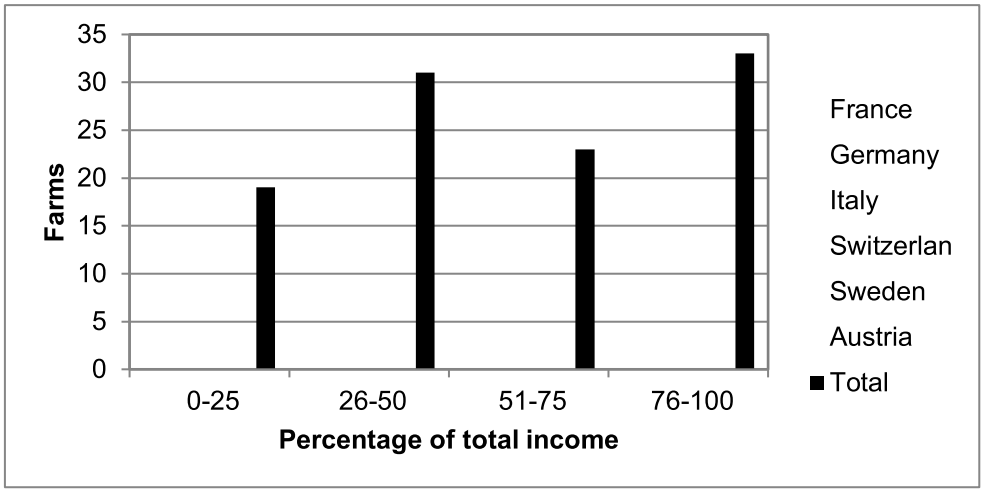

Figure 2. Percentage of income from dairy production for participating farms.

Rearing and housing systems

Calf rearing systems are presented in Figure 3. Most farms (42 %) had a system with dam rearing. It was shown that larger farms (> 36 dairy cows) more frequently used a cow-calf contact method with foster cow, mixed system or "other" ($P < 0.001$) and not keeping the calf with its own mother. Most farmers (91 %) answered that colostrum was normally fed to the calf by suckling the dam. The number of days the calves were allowed to suckle varied greatly among farms, ranging between 0-305 days. The question about how calves were housed during the first twelve weeks was only targeting heifers. Majority of farms (94 %) reared their own heifers. The answers regarding housing showed that heifers were kept with the mother cow during the first week of life in 80 % of the farms. During week two, 55 % of the calves were reared by the mother, 23 % by a foster cow and 39 % were kept in group boxes.

In week twelve, 22 % were reared by mother, 30 % by foster and 60 % were kept in group boxes. Since it was possible to choose more than one answer (a "mixed" system) the answers exceed 100 percent. The calves were weaned at 3-44 weeks of age. Problems that occurred during separation were mainly that cows and calves were vocalising more than usual. Three small farms (3-16 dairy cows) from Sweden did not let the calves suckle a cow. One did let the calves suckle the mother during one day for the colostrum while the other two separated the cow and calf immediately and fed the calves colostrum by hand. The calves were later reunited with the older cows at week two, four or twelve, respectively but were fed milk by bucket until weaning. The reason seemed to be that the calves first would imprint on humans instead of the mother cow but also have the social interactions with older cows.
The distribution of calves that had permanent or restricted cow-calf contact with opportunity to suckle was 47 % and 53 %, respectively. Figure 4 shows when farmers schedule cow-calf contact during the day. If the calves are not permanently with a cow they are allowed to suckle before or after milking. Under "Other" farmers gave answers that calves were allowed to suckle both before and after or that they were allowed to suckle during milking.

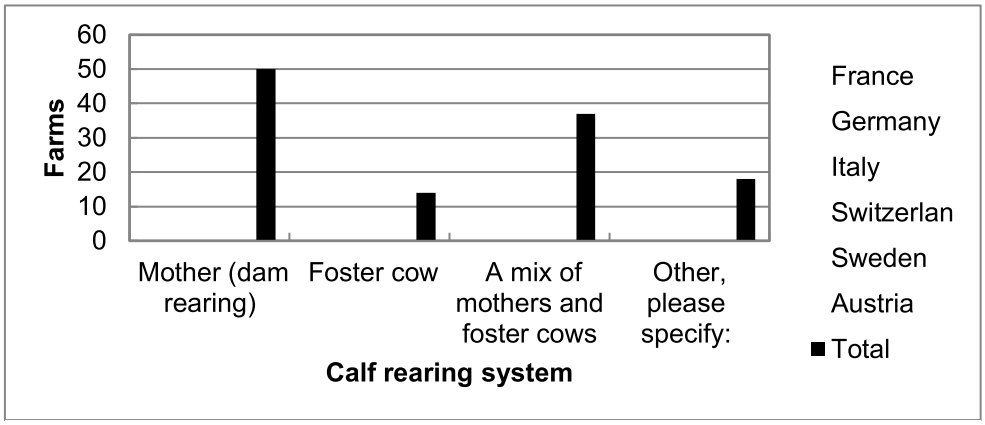

Figure 3. Different calf rearing systems on participating farms.

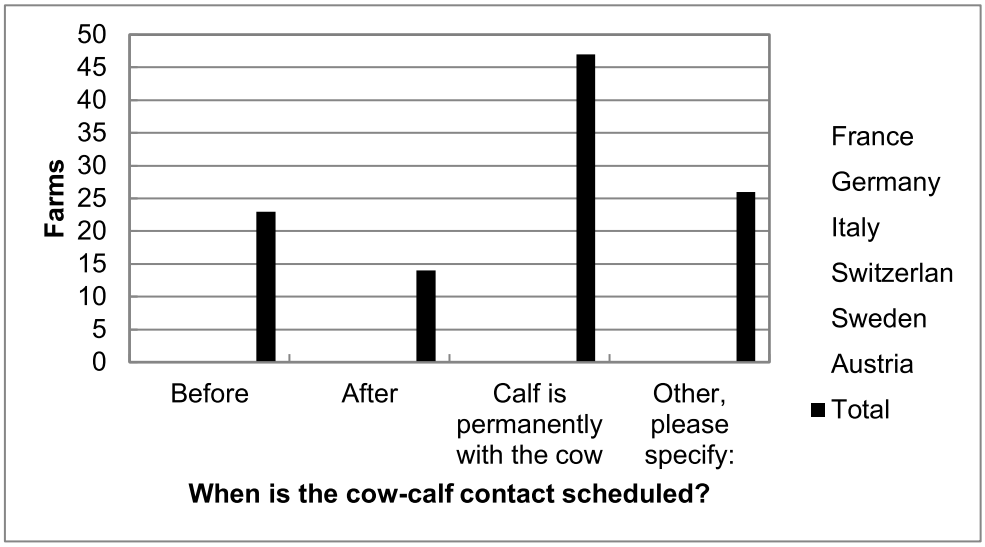

Figure 4. Scheduled cow-calf contact on participating farms. Before and after indicates time according to milking.

Figure 5 shows the different housing systems that the farmers used. The most used system was freestall with cubicles (43 %) and the second most used was freestall with e.g. deep straw bedding, compost bedding (33 %). Under "Other" farmers generally answered that they used an extensive system. In 73 % of the farms, the suckled cows were milked with a milking frequency of 1-2 times a day.

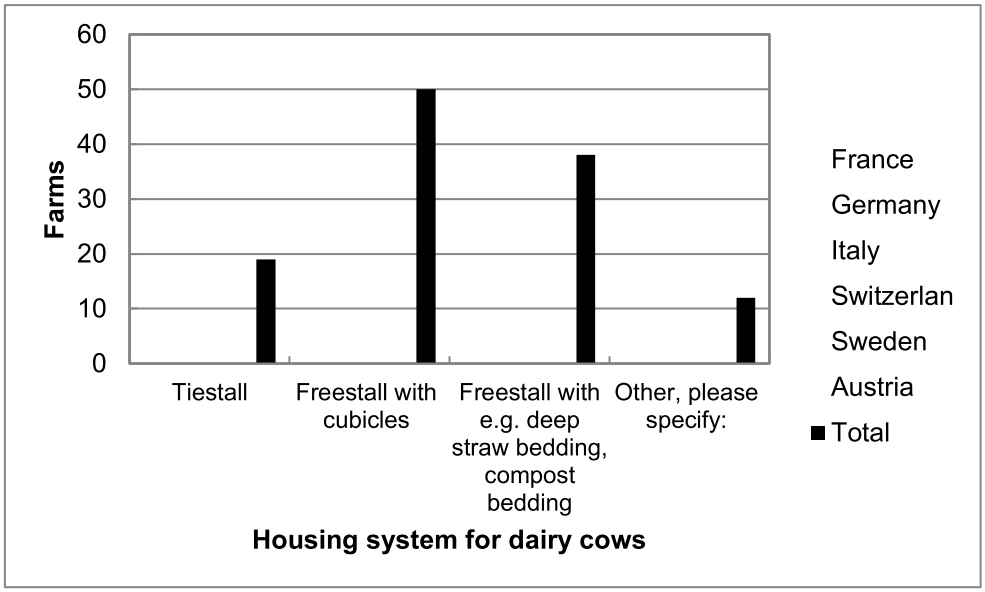

Figure 5. Farms different housing systems for dairy cows.

Perception of health

According to the interviewed farmers 51 % saw no difference in suckled cows' fertility compared to only milked cows, 19 % answered that it was better, 11 % that it was worse and 19 % did not know. Figure 6 shows the farmers' perceptions of their suckled cows' udder health compared to only milked cows and 36 % answered that the udder health was better and 42 % answered no difference. Farmers that let the calves suckle more than 90 days did not to a higher extent perceive that the udder health of suckled cows' was better (P = 0.176).
Three fourths (73 %) of the farmers perceives that the general health of calves that suckled were better than in calves that did not suckle. Of these farmers, 81 % said the calves had a higher weight gain and 62 % that the frequency of diarrhoea was lower. When it came to respiratory diseases 42 % answered that it was lower and 36 % that it was no difference compared to calves that did not suckle.

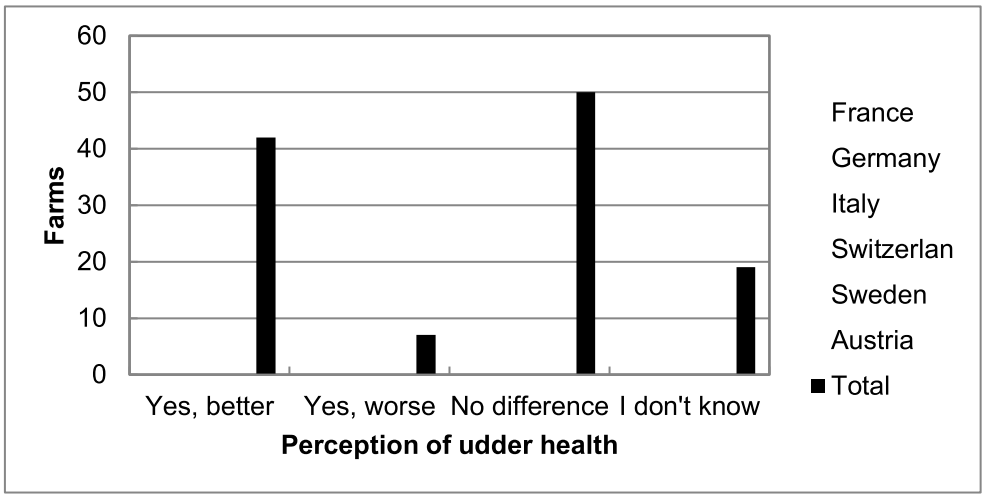

Figure 6. Farmers' perceptions of suckled cows' udder health compared to cows that were only milked.

Main drivers and barriers

On the question if the farmers thought that their system was more time consuming than traditional systems 77 % answered no. The main drivers (Figure 7) for having a system with cow-calf contact was that it was more natural and that calves were healthier. In the category "Other" farmers answered that it were better for animal welfare purposes, that it increased income and that they thought it was more fun to work like this. Only the French farmers and one farmer from Switzerland answered that it increased the income.

One of the last questions was if the farmers had any main barriers to using a cow-calf contact system before they started. The majority (53 %) stated that they did not think about it. Farmers that answered "Other" on that question said that one of their main concerns was that the housing was not adapted or optimal for a cow-calf contact system.

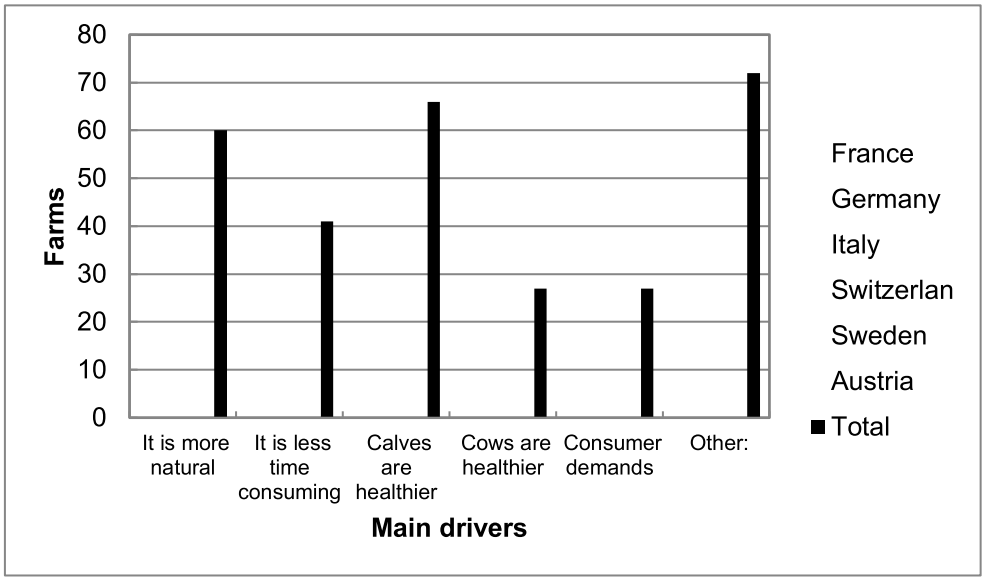

Figure 7. The main drivers for having a system with cow-calf contact.

Discussion

Cow-calf separation

The farmers in this survey said that vocalising from cow and calf was the most common problem after separation. Separating cow and calf causes stress and it is even more stressful when they have developed a stronger bond. A study by Lidfors (1996) found that cows that were separated from their calves at a later state vocalised more. That is one of the reasons why farmers might prefer early separation, they do not vocalise as much and are therefore not as stressed. Lidfors (1996) said that apart from stress, linked to separation, there are several benefits with more cow-calf contact connected to behaviour. Several studies showed that abnormal oral behaviours such as cross-suckling was significantly lower for calves that suckled than artificially reared calves (Fröberg, *et al*., 2007; Fröberg, *et al.*, 2008; Roth, *et al.*, 2009). The reason is probably that their suckling behaviour was being satisfied (Roth, *et al.*, 2009). The questionnaire used in this study did not have a question about cross-suckling but it would have been interesting if it would have. For further research a question about cross-suckling should be included. Other positive behaviour aspects of cow-calf contact demonstrated in the study by Buchli *et al.* (2017) are that calves showed more advanced social behaviours. They saw that in contact with an unfamiliar cow the calves had easier to show submissiveness and react to threatening behaviours from the cow. The calves that were reared by a cow also showed a lower cardiac stress response when being isolated and introduced to a novel object (Buchli, *et al*., 2017). One speculation is that reducing the stress in calves could possibly make them calmer as heifers and thereafter cows. This could be a benefit in terms of workplace security as it can makes the animal-contact management easier.

Health

The farmers in this survey answered that the suckled cows' udder health was better (36 %) or no difference (42 %) (Figure 5) compared to only milked cows. This is supported by studies that indicate that the udder health might be improved by being suckled (Fröberg, *et al*., 2007; Fröberg, *et al*., 2008). One of the hypothesis in this thesis was that farmers that let the calf suckle longer (> 90 days) had a better udder health, which was not possible to show in this study. The correlation between longer suckling period and udder health was not significant. Possible reasons why this was not possible to show could be because of the large variation between farms and that the results of udder health were based on the farmers own perception and not objectively.

The farmers' perceived that the general health of their calves was better (73 %) and that the frequency of diarrhoea was lower (62 %) than in non cow-calf contact calves. The literature was indecisive if bouts of diarrhoea increased (Svensson, *et al*., 2003; Roth, *et al*., 2009) or decreased (Weary & Chua, 2000; Wagenaar & Langhout, 2007) with suckling. Having the calf by its mother and other animals enhances the risk of the calf getting in contact with hostile bacteria or viruses which could cause illness such as diarrhoea (Svensson, *et al*., 2003). Letting the calf suckle might also lower the risk of diarrhoea because they have the possibility to a higher colostrum intake, which contains important immunoglobulins (Weary & Chua, 2000). There are on the other hand several factors that affect the pathogenesis of diarrhoea (Klein-Jöbstl, *et al.,* 2014). Examples of risk factors are management around birth, colostrum management, calf housing, feeding and hygiene. That suggest that it can be hard to draw a conclusion from the results that suckling alone decreases the risk of diarrhoea. The results in this study do not show the different management strategies the different farms have to prevent diseases.

Growth

According to 81 % of the participating farmers, the suckling calves' weight gain was higher than artificially reared calves. Several studies have showed the same results (Bar-Peled, *et al.*, 1997; Jasper & Weary, 2002; Roth, *et al.*, 2009; Fröberg, *et al.*, 2011). Bar-Peled *et al.* (1997), Roth *et al.* (2009) and Fröberg *et al.* (2011) also showed that suckling calves had a dip in weight gain after weaning. Artificially reared calves had a higher intake of concentrate and hay before weaning compared to suckling calves (Jasper & Weary, 2002). That might suggest that they were more adapted to a diet without milk and weaning was not as big of an adjustment as it was for suckling calves.

Farm economics

An important condition having a working dairy farm is that it is profitable in some way. The proportion of total income coming from the dairy production was varying from under 25 % to 100 % (Figure 2). In France all participating farmers stated that 76-100 % of their income came from dairy production, a result markedly higher than in other countries. It is unclear why this was the case. According to some studies having calves suckling cows might have a positive impact on farm economy (Juniqueria, *et al.,* 2005; Asheim, *et al.*, 2016). Asheim *et al*. (2016) gave reasons such as suckling for seven to thirteen weeks would potentially lower calf-associated work by five to ten hours, respectively. Calves had a better growth and there was lower disease incidence both in cows and calves. Having a cow-calf contact system demanded investments such as appropriate housing and an increased herd size to be profitable. Hence, these additional costs could be compensated by the positive welfare aspects. Participating farmers (77%) in this survey also said that their systems were less time consuming than traditional systems. Being able to save time by having a system there the calf management is more self-going without cutting down the animal welfare could save money. Juniqueria *et al*. (2005) argued that the reason for higher profit was that the suckled cows had a longer lactation period and therefore more saleable milk. Even if calves drank the cows' milk they still made more saleable milk than not suckled cows. Juniqueria *et al.* (2005) made their study in Brazil with F_1 Holstein × Gir crosses. Fröberg *et al.* (2007) said that the reason for more saleable milk for suckled cows might be an effect of higher frequency of udder emptying. That is another question that could have been interpreted in this thesis, if the farmers thought their cows milked more or less while giving milk to a calf. That might on the other hand be a hard question to answer because they would have to estimate how much the calves drank. For future research more studies about suckling's effect on milk yield would be of interest.

Herd size and management systems

The average dairy farm in EU had a herd size of 33 cows in 2016 (European Commission, 2018). The average farmer in this thesis had 53 dairy cows and the median was 36 dairy cows. That shows that the participating farms in this survey were of average size or slightly above.

Most farms (38 %) used a milking parlour (fishbone) which suggest that it is possible to have a cow-calf contact system with a modern milking system. A small portion of farms even had automatic milking systems. The review by Johnsen *et al.* (2016) presented several sources (Fröberg & Lidfors, 2009; Roth, *et al.*, 2009; Fröberg, *et al*., 2011; Wagner, *et al.,* 2013; Veisser, *et al*., 2013) there cow-calf

contact had been implemented in a modern milking system. Wagner *et al.* (2013) had a free cow-calf contact system with milking parlour, cubicle housing and a calf area with a selection gate accessing the cow barn. Fröberg and Lidfors (2009) had a free cow-calf contact system in an automatic milking system with cubicle housing and a calf creep. The other hypophysis in this thesis was that calf rearing systems would differ depending on farm size. This was probably true for this study. Larger farms (> 36 cows) had a tendency of using a system with foster cow or a mixed system with foster cow and dam.

Drivers

The main drivers to have a system with cow-calf contact for farmers in this study were that it was more natural, calves are healthier, better for animal welfare purposes and that it was more fun to work like this. Consumers seems to think rearing cow and calf together is a more natural way and therefore more preferable (Ventura, *et al*., 2013; Busch, *et al*., 2017). Having consumers being more and more involved and interested in food production can be both benificial and less benificial. Producers work to meet consumers demands but consumers are not always aware of food productions limitations. Drastic changes might not be possible when the farm are your livleyhood but historically have animal welfare improved and still are.

The questionnaire

The process of choosing relevant questions to analyse from the questionnaire was a matter of finding interesting information and connect it to the literature. The results would have to be of interest for people who thought of a system with cow-calf contact as an alternative in calf rearing. Showing possible advantages and disadvantages.

One or two interviewers were used in respective country, which could mean that the questions might be interpreted differently depending on the interviewer. The various farmers might also have understood the questions differently and some farmers did not answer all questions. The sample of farmers were targeted for this particular subject and the results are not representable for the general farming in each country.

An example for a question that might been interpreted wrong for some farmers are the question on describing the rearing system week by week. Some had answered that female calves were kept in group boxes all twelve weeks and at the same time said that calves were permanently with a cow. With no further explanation, it can be hard to figure out how the system looked like in reality. They might mean that

the female calves were kept in group boxes together with mother or foster cow. For farms that also gave a written answer describing their calf rearing system it was easy to understand how they did. On the question about the annual total milk production some answered the farms total and some the average production per cow. Making it harder to get a direct comparison. A distinct instruction at the question could have helped the interviewers on how the answer should be written. A question that were missing was a question on how long the calves had cow-calf contact. It might have been an error because there are two questions asking how long calves were allowed to suckle and one question on the proportion of female calves that had cow-calf contact for more than seven days. Because some farms never let the calves suckle a cow a question about only cow-calf contact would have been helpful in interpreting the results. It might on the other hand been better to change the meaning of cow-calf contact system to a system where the calf also are allowed to suckle. Giving it a more united target group. The definition of cow-calf contact should have been clear from the start. The questionnaire was not optimal and would have needed further work. Clear instructions at the more interpretative questions might have been helpful to the interviewers to get more united answers that are comparable to each other. A pilot-test on a number of dairy farmers in each country would have be a way to see how the questionnaire worked practically.

Study design

The purpose of this thesis was to identify and describe innovative strategies to allow cow-calf contact. The results do not really show any innovative strategies, but only how farms tend to do. The farm with only one dairy cow should have been excluded because it was not a dairy farm. There should also have been a better definition of cow-calf contact. Does it mean that the calf is allowed to suckle a cow or only that the calf have social interactions with a cow? If the definition was that the calf is allowed to suckle the three small farms from Sweden – that separated the calf to later reintroduce it to the cow again without suckling – should have been excluded from the data.

The method used to collect data was Snowball sampling. Benefits with using Snowball sampling is that it is a good way to find subjects within a small subgroup of a population with the same traits of interest. It is also a simple, cheap and cost-efficient way of obtaining information. Disadvantages of this method is that the researcher has little control over the sampling method and have to rely on previous subjects. There is a risk of sampling bias using this method. The subjects would most likely nominate people they know well and because of that the subjects might share the same traits and characteristics. That could contribute to a smaller range in

subjects and therefore not a liable representation of the targeted area of interest. It is not possible to create a randomized sampling.

Conclusion

This thesis showed that there are active dairy farms using systems where cow and calf are kept together and that it is possible to implement a cow-calf contact system on a farm with a modern milking system. There are several benefits for keeping cow and calf together (e.g. increased welfare and potentially better economy) but also constraints (e.g. stress when cow and calf are separated and lower amount of saleable milk). This thesis also showed that larger farms (> 36 cows) more frequently used a calf rearing system with foster cows or a mixed system (foster cow and dam), rather than only mother. Another conclusion is that that the length of the suckling period did not affect farmers' perception that their cows had a better udder health, according to this study.

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Popular scientific summary

Early cow-calf separation is a debatable topic in the dairy industry. The general practice on modern farms is to separate cow and calf within a couple of hours after birth. This is to ensure the calf drinks enough of the important colostrum and to easier observe its health. Consumers often oppose this practice and argues that it is unnatural. A system where cow and calf are together for a longer period of time does have several benefits.

Letting a calf suckle its mother or a foster cow can help with developing social behaviours, boost growth and prevent stereotypical behaviours such as cross-sucking there the calf suckles the interior or other calves. Having a cow being suckled can have a positive impact on udder health and could result in a longer lactation period. Some studies have even showed that it can be economically beneficial to have a system with cow-calf contact.

In this master's thesis the aim was to study innovative strategies for keeping cow and calf together in dairy production. A total of 119 farmers have been interviewed from six European countries on how they rear their calves. The participating countries were Austria, France, Germany, Italy, Sweden and Switzerland. The criteria for entering an interview was that the farmer had to keep cow and calf together for more than seven days.

The main milking system for participating farms was a fishbone milking parlour. Most farmers let the calf go with its mother and some had foster cows. The farmers said that their cows and calves were healthier now than if they would been kept apart. The main drivers for farmers to work with a system allowing longer cow-calf contact were that it was more natural, calves were healthier, better for welfare purposes and they enjoyed working like this.

This thesis showed that there are active dairy farms using systems where cow and calf are kept together and that it is possible to implement a cow-calf contact system on a farm with a modern milking system.

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Appendix 1

Inventory of innovative rearing systems

Questionnaire ProYoungStock WP1.1

DEFINITIONS
Separation = Separation of cow and calf
Weaning = The time point when milk feeding for the calf is terminated
Calf = 0-6 months of age

1. BASIC INFORMATION

Interviewer:

_____
_____
_____

Interviewer's institution:

_____
_____
_____

Date of interview (YYMMDD)

_____
_____
_____

Name of farmer:

_____
_____
_____

Farmer's contact details:

_____
_____
_____

Herd id:

_____
_____
_____

2.

How many days do calves suckle a cow (mother or foster cow)?

If less than 7 days end the interview. Ask whether he/she is aware of any other farmers that keep cow and calves together for more than 7 days.

Enter number of days

_____
_____
_____

3. FARM

- Which production labels apply to your herd?
- Organic label, specify: _____
- Welfare label, specify: _____
- Other label, specify: _____

4. What is the predominant cow breed in the dairy herd?

- Brown Swiss
- Fleckvieh
- Holstein
- Jersey
- Modicana
- Montbéliarde
- Normande
- Polish red
- Swedish polled
- Swedish red
- Other, please specify: _____

5. Other cow breeds in the dairy herd?

_____
_____
_____

6. Herd size - total number of dairy cows (including dry cows and foster cows):

_____
_____
_____

7. Farm size

Agricultural crop/forage surface (hectares):

_____
_____
_____

Permanent pasture (hectares)

_____
_____
_____

Temporary pasture (hectares)

_____
_____
_____

8. Total number of born calves during the last 12 months

_____
_____
_____

Number of weaned female calves during the last 12 months
(Weaning = The time point when milk feeding for the calf is terminated)

_____
_____
_____

Number of sold female calves (until the age of 6 months) during the last 12 months

_____
_____
_____

Number of raised female calves (kept for recruitment) during the last 12 months:

_____
_____
_____

Number of fattened female calves during the last 12 months (or raised for fattening beef/slaughter)

_____
_____
_____

9. Other production animals on the farm?

- o Beef cattle
- o Pigs
- o Poultry
- o Sheep
- o Goats
- o Other _____

10. Share of household income derived from milk production?

- o **%**
- o 0-25
- o 26-50
- o 51-75
- o 76-100

11. Housing system for the dairy cows?

- o Tiestall
- o Freestall with cubicles
- o Freestall with e.g. deep straw bedding, compost bedding
- o Other, please specify: _____

12. Which milking system is used?

- o Automatic Milking System
- o Rotary
- o Milking parlour - fishbone
- o Milking parlour - tandem
- o Tie-stall pipeline
- o Other, please specify: _____

13. REARING SYSTEM

Cows

Calves are reared by:

- o Mother (dam rearing)
- o Foster cow
- o A mix of mothers and foster cows
- o Other, please specify: _____

14. Are suckled cows milked?

- o Yes
- o No
- o Other, please specify: _____

If yes, how many times per day do they get milked?

_____
_____
_____

15. Estimate the herd's annual total milk production (kg ECM)

_____
_____
_____

16. Seasonal calving?

- Yes
- No
- Other, please specify: _____

17. How many days are cows (together with calves) in general kept on pasture per year?

_____
_____
_____

18. Pasture management for dairy cows?

- Production pasture (cows cover parts of their daily energy requirement from the pasture)
- Exercise pasture (access to a walking area without significant nutritional value. Cows are fed elsewhere)
- A mix of the above

19. If you use production pasture, what is the average proportion of pasture of the total feed ration during the grazing season?
%

- No production pasture
- 1-25
- 26-50
- 51-75
- 76-100

20. If using early lactation foster cows (possibly with own calf), what are the criteria for choosing foster cows?

- Not applicable
- High somatic cell count
- Low milk production
- Difficulties to milk the cow
- Other, please specify: _____

21. If using late-lactation foster cows (no own calf), what are the criteria for choosing foster cows?

- Not applicable
- High somatic cell count
- Low milk production
- Difficulties to milk the cow
- Other, please specify: _____

22. Any observed problems in connection with the permanent separation of cow and calf?

- o Cows are mooing for several days
- o Cows don't like to be milked anymore for several days
- o Cows don't eat enough for several days
- o Calves are mooing for several days
- o Calves lose weight
- o No observed problems
- o Other, please specify: _____

23. If there are problems, how do you solve them?

- o Separation is done slowly (in small steps)
- o Calves and cows are treated medically
- o Calves and cows are deviated with attractive feed
- o There are no problems
- o Other, please specify: _____

24. Do you use any special measures to care for the udders (especially foster cows)?

- o No
- o Yes

If yes, which?

_____
_____
_____

25. REARING SYSTEM

Calves

Proportion of calves that have cow contact more than 7 days:
(0-100%)

_____
_____
_____

26. If you have foster cows, how many calves per foster cow do you have on average?

_____
_____
_____

27. If you have foster cows, at what day is the calf moved to the foster cow?
(day)

_____
_____
_____

28. How is colostrum normally fed to the calf?

- o Suckling
- o Calf drencher
- o Bucket feeder
- o Other, please specify: _____

29. Do you rear your heifers on your own farm?

- o Yes
- o No

30. What proportion of female calves are allowed to suckle? %

_____
_____
_____

What proportion of male calves are allowed to suckle?
%

_____
_____
_____

31. Please describe how a female calf is kept from birth to weaning
Week 1

- Calves are kept with mother cow
- Calves are kept with foster cow
- Calves are kept in single pens
- Female calves are kept in group boxes
- In outdoor hutches
- Female calves get additional bucket feeding

Week 2

- Calves are kept with mother cow
- Calves are kept with foster cow
- Calves are kept in single pens
- Female calves are kept in group boxes
- In outdoor hutches
- Female calves get additional bucket feeding

Week 3

- Calves are kept with mother cow
- Calves are kept with foster cow
- Calves are kept in single pens
- Female calves are kept in group boxes
- In outdoor hutches
- Female calves get additional bucket feeding

Week 4

- Calves are kept with mother cow
- Calves are kept with foster cow
- Calves are kept in single pens
- Female calves are kept in group boxes
- In outdoor hutches
- Female calves get additional bucket feeding

Week 5

- Calves are kept with mother cow
- Calves are kept with foster cow
- Calves are kept in single pens
- Female calves are kept in group boxes
- In outdoor hutches
- Female calves get additional bucket feeding

Week 6

- Calves are kept with mother cow
- Calves are kept with foster cow
- Calves are kept in single pens
- Female calves are kept in group boxes

- In outdoor hutches
- Female calves get additional bucket feeding

Week 7
- Calves are kept with mother cow
- Calves are kept with foster cow
- Calves are kept in single pens
- Female calves are kept in group boxes
- In outdoor hutches
- Female calves get additional bucket feeding

Week 8
- Calves are kept with mother cow
- Calves are kept with foster cow
- Calves are kept in single pens
- Female calves are kept in group boxes
- In outdoor hutches
- Female calves get additional bucket feeding

Week 9
- Calves are kept with mother cow
- Calves are kept with foster cow
- Calves are kept in single pens
- Female calves are kept in group boxes
- In outdoor hutches
- Female calves get additional bucket feeding

Week 10
- Calves are kept with mother cow
- Calves are kept with foster cow
- Calves are kept in single pens
- Female calves are kept in group boxes
- In outdoor hutches
- Female calves get additional bucket feeding

Week 11
- Calves are kept with mother cow
- Calves are kept with foster cow
- Calves are kept in single pens
- Female calves are kept in group boxes
- In outdoor hutches
- Female calves get additional bucket feeding

Week 12
- Calves are kept with mother cow
- Calves are kept with foster cow
- Calves are kept in single pens
- Female calves are kept in group boxes
- In outdoor hutches
- Female calves get additional bucket feeding

Remember to focus on issues such as: single pen, group housing, separation from mother, additional feeding and time frame.
Additional comments:
_____
_____
_____

32. At what age do the calves get access to forage?
(week)

_____
_____
_____

33. At what age do the calves get access to concentrates?
(week)

_____
_____
_____

34. SUCKLING
How many days do the female suckler calves suckle?
(days)

_____
_____
_____

35. Do the female calves get additional bucket feeding?

- Yes
- No

If yes, how many liters per day?

_____
_____
_____

36. Frequency of cow-calf contact with suckling opportunity (for female calves)?

- Permanent
- Restricted

If cow-calf-contacts are restricted please describe the strategy:

_____
_____
_____

37. If restricted, how many cow-calf contacts per day (female calves)?

_____
_____
_____

38. If restricted, duration of cow-calf contact (female calves)?
hours per day

_____
_____
_____

39. Is the cow-calf contact scheduled before or after milking of the cow (female calves)?

- Before
- After
- Calf is permanently with the cow
- Other, please specify: _____

40. Do you control how much milk a female calf gets?

- Yes
- No
- Other, please specify: _____

If yes, how do you do that?

_____
_____
_____

41. For an average female calf, estimate age at weaning:
(Weaning = The time point when milk feeding for the calf is terminated)
(weeks)

_____
_____
_____

42. PERFORMANCE TESTING
Are the suckled cows included in performance testing/regular milk recording?

- Yes
- No
- Some
- Not enrolled in milk recording

43. To the best of your knowledge, are the results of the performance testing/ regular milk recordings affected by having suckled cows?

- Yes
- No
- Maybe
- I don't know
- Not applicable

If yes, in what way?

_____
_____
_____

44. PERCEPTIONS OF ANIMAL HEALTH
Cows

In your opinion, is the fertility different in suckled cows (compared to only milked cows)?

- Yes, better
- Yes, worse
- No difference
- I don't know

In your opinion, is the udder health different in suckled cows (compared to only milked cows)?

- Yes, better
- Yes, worse
- No difference
- I don't know

45. PERCEPTIONS OF ANIMAL HEALTH
Calves

In your opinion, is the general health different in suckler calves (compared to e.g. bucket fed calves)?
- o Yes, better
- o Yes, worse
- o No difference
- o I don't know

In your opinion, is the daily weight gain different in suckler calves (compared to others)?
- o Yes, higher
- o Yes, lower
- o No difference
- o I don't know

In your opinion, is the frequency of diarrhoea (with impaired general condition) different in suckler calves (compared to e.g. bucket fed calves)?
- o Yes, higher
- o Yes, lower
- o No difference
- o I don't know

In your opinion, is the frequency of respiratory diseases different in suckler calves (compared to e.g. bucket fed calves)?
- o Yes, higher
- o Yes, lower
- o No difference
- o I don't know

46. Have you used antibiotics for calves during the last 12 months?
- o Yes
- o No

47. Have you used anthelmintics for calves during the last 3 years?
- o Yes
- o No

If yes, please specify:
- o Conventional medicine
- o Homeopathy
- o Other alternative medicine (e.g. fytotherapy, herbal medicine)

48. On average, how many calves (0-3 months of age) die per year in your herd (stillbirths not included)?
_____
_____
_____

49. DRIVERS AND BARRIERS
When was the practice with keeping cow and calf together (for more than 7 days) implemented on your farm?
type the year (YYYY):
_____
_____
_____

50. Do you think that the cow-calf rearing system is more time consuming than conventional systems?

- o Yes
- o No

Comment:

_____
_____
_____

51. Please state the main drivers for using a system allowing cow-calf contact:

- o It is more natural
- o It is less time consuming
- o Calves are healthier
- o Cows are healthier
- o Consumer demands
- o Other: _____

52. Please state the main barriers (for yourself before you started) to using a system allowing cow-calf contact

- o I didn't think about it
- o I did not know how to do it
- o I thought it was too complicated
- o I thought it was not allowed
- o I thought it would be too time consuming
- o I wanted to avoid late separation of calves and cows, because of separation stress
- o Performance testing of cows is difficult if calves suckle
- o Other: _____

53. Do you want to modify anything in your present cow-calf rearing strategy?

- o Yes
- o No

If yes, what?

_____
_____
_____

54. Optional question: Do you know any other farmers with innovative rearing systems keeping calves and cows together?
If yes, who?

_____
_____
_____

55. Any final comments or important aspects that you want to tell us?

_____
_____
_____

Thank you for completing the questionnaire!