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Housing, Feeding and Management of Calves and Replacement Heifers in Swedish Dairy Herds

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Pettersson K, Svensson C, Liberg P: Housing, feeding and management of calves and Replacement heifers in Swedish dairy herds. Acta vet. scand. 2001, 42, 465-478. – A questionnaire was sent to 1500 randomly selected dairy herds in Sweden, asking for general information about the herds, including routines from birth to first calving and also routines at breeding, calving and during the grazing period. Fifty-eight percent of the questionnaires were returned. The preweaned calves were kept in individual calf pens in 68% and in group housing systems in 28% of the herds. Pens with slatted floors were the main housing system for replacement heifers from weaning to breeding, and tie stalls from breeding to first calving. Whole milk was used in 44% and milk replacements in 42% of the herds. The calves received, as a median, 2.5 litres of milk per meal and 2 meals per day. The median age at weaning was 8 weeks. Age was the single most common criteria used for deciding both weaning and breeding time. The median age when the heifers were first turned out to pasture was 6 months. Prophylactic anthelmintic treatment was used by 65% of the herds. The most common diet for replacement heifers before calving was a combination of grain, hay and silage.

colostrum; wearing; rearing; breeding; feed plan; pasture.

Introduction

In modern milk production, calves are often overlooked. Increased knowledge about their situation is important for offering these animals rearing conditions in which they can maintain good health and adjust to milk production. A link between housing and health during the rearing period has been established by several authors; *Goodger & Theodore* (1986), *Curtis et al.* (1988), *Perez et al.* (1990), *Olsson et al.* (1994) and *Svensson et al.* (2000a) found group housing to be a risk factor for disease, while *Simensen* (1982) reported conflicting results. Furthermore, it has been shown that heifers suffering from a high incidence of disease as young calves have an increased risk of disease later in life, as well as a higher age at first calving (*Waltner-Toews et al.* 1986a). *Correa et al.* (1988) found that heifers that were healthy as calves were twice as likely to calve and calved 6 months earlier compared with calves that had suffered from respiratory disease during their first 90 days of life. Raising replacement heifers in such a manner that they will give birth for the first time around 24 months of age has been found to reduce production costs (*Radostits et al.* 1994). *Mourits et al.* (2000) estimated the optimal average age at first calving, from an economic point of view, to be 20.5 months in Holstein animals in Pennsylvania. None of these rearing aims are possible without optimal rearing conditions. It has been shown that management throughout the rearing period influences the longevity of the dairy cow and thereby the total herd economy *(Drew* 1998). In order for veterinarians and other advisors to be able to adapt their guidance to the situation on

the individual farm, it is important to know which routines are used for management of replacement heifers on that farm. The aim of this study was to provide a comprehensive view of the housing systems and the feeding and management routines used for replacement heifers in Swedish dairy herds.

Materials and methods

A questionnaire was sent to 1500 dairy herds, randomly selected among all herds in Sweden that had 28-94 cows and were registered in the official milk-recording programme. A cover letter explaining the purpose of the project was enclosed. The letter assured the farmers that they answered anonymously and that the answers were to be treated confidentially. To those not returning the questionnaire, a first reminder was sent after one month and a second and final reminder after another month.

The questionnaire comprised 71 questions, and dealt with 7 sections. All questions referred to the routines used in the herds during 1998. The first section gathered general information about the herd, sections 2 to 4 information about routines from birth to first calving, and the last 3 sections emphasised routines at breeding and calving, and during the grazing period. The questions were of multiple-choice type (46) or were semi-closed questions (25). Before the questionnaire was mailed it was examined by 5 veterinarians and one agronomist. The questionnaires returned were individually examined for aberrant results, and the answer was marginally excluded when a question seemed to have been misunderstood. Geometric means, standard deviation (SD) and range or median and 80% central range (CR, i.e. excluding 10% at each end of the distribution) were produced using Microsoft Office Excel 2000.

Results

Of the 1500 questionnaires mailed, 877 (58%) were returned. Despite all questionnaires not being completed by all farmers, most questions (79%) were answered by most of the responders (98%). The lowest answer rate to a single question was 79%.

General questions

Most of the farmers (98%) stated that milk production was the most important source of income on the farm. The mean number of cows (calculated as the sum of the number of days each cow stays in the herd between calving and slaughter divided by 365) in the herds during 1998 was 44.5 (SD: 15.3, range: 15.6-115.0). The mean production in kilograms energy corrected milk (ECM) was 8545 (SD: 965, range: 4500-11576), and the mean replacement percentage was 37.5 (SD: 11.0, range: 10.0-100.0). In most herds (95%) the heifers were kept in the same production unit as the cows. Sixty-four percent of the herds housed their calves together with the cows and/or the young stock. In 16% of the herds the calves were kept separately. Twenty percent of the answers to the question about how the calves were kept were excluded because they could not be interpreted.

Routines at calving

Forty percent of the herds used special maternity pens for calving, and among these, 18% utilised a group pen. In 57% of the herds the calves were immediately removed from their dams. In the other herds, calf and dam were allowed to stay together for some time (median: 2 days, 80% central range (CR): 1-4 days); 37% of the herds let the calf stay this period together with the dam in the maternity pen, while 6% allowed the calf to roam freely in the cowshed.

Housing

The period from birth to weaning. The calves were kept in individual pens in 68% of the herds after being removed from their dams.

Table 1. The distribution of housing systems for dairy replacement heifers in Sweden from weaning to first calving.

Housing system	Weaning to breeding % of herds (n=877)	Breeding to calving % of herds (n=877)
Pen with slatted floors	25	13
Pen with slatted floors and litter pen; combinations over time	15	2
Pen with slatted floors and tie stall; combinations over time	13	9
Litter pen	18*	21**
Litter pen and tie stall stanchion; combinations over time	11	6
Tie stall	7	36
Others	11	13

* of which 5% had a walkway with concrete or slatted floor
** of which 8% had a walkway with concrete or slatted floor

Fifteen percent of the herds used group pens with bucket feeding, 13% used group pens with automatic milk feeding, only 3 herds (0.3%) used calf hutches, and the remainder used other systems. For calves moved from an individual pen to a group pen with automatic milk feeding, the median age at transfer was 1 week (CR: 1-3). For calves moved from an individual pen to a group pen with bucket feeding of milk, the median age at transfer was 4 weeks (CR: 1-6). Half the herds (51%) moved their calves from one housing system to another within a week before or after weaning. Most of the herds (93%) kept their calves in an insulated building until weaning.

The period from weaning to first calving. The distribution of housing systems for replacement heifers from weaning to first calving is shown in Table 1. The median age at which calves were transferred to pens with a slatted floor (in herds that used such a system) was 2 months (CR: 2-4). Replacement heifers that were tied up sometime during the period from birth to calving had a median age of 12 months (CR: 3-23) when they first were tied up in a stanchion barn.

In the period from weaning to breeding, the replacement heifers in 68% of the herds were housed in insulated buildings, in 13% in uninsulated buildings and in 19% in various combinations of these over time. The corresponding percentages for the period from breeding to first calving were 67%, 24% and 9%, respectively.

Feeding

The pre-weaning period. The median number of days the calves received milk from the dam was 4 (CR: 3-7). The calves generally received two meals of 2.5 litres per day (CR: 2.0-3.0) during their first days of life. The calves' first two meals of colostrum originated in 39% of the herds from milk of the first milking occasion after calving, in 54% of the herds from the first two milkings, while in 7% of the herds also milk from later milkings than the second one was used.

After the colostrum period there were almost as many herds that used whole milk (44%), as there were herds that fed their calves milk replacements (42%). Combinations of the two alternatives were used in the other herds. After the colostrum period the calves generally received two meals per day and in each meal 2.5 litres (CR: 2.0-3.5). Almost all farmers (98%) stated that they heated the milk before feeding.

For heating, 56% of the herds used a water bath, 20% added hot water to the milk, 12% used an immersion heater and 12% used combinations of these alternatives.

Most of the herds (77%) used bucket feeding of milk. The rest used automatic milk feeding systems (13%), teat buckets (4%), nursing cows (1%) or other methods (5%). Of the 111 herds that used automatic milk feeding systems, 74% used a transponder system while 26% gave the calves milk *ad libitum.*

The calves were, as a median, 5 days old (CR: 1-10) when they were first offered hay, 14 days old (CR: 7-28) when they were offered concentrates, and 60 days old (CR: 30-120) when they were offered silage. Water was first offered to the calves at, as a median, 14 days of age (CR: 7-56). Concentrates fed to calves before weaning were usually (in 60% of the herds) given *ad libitum.* They were given as pelletted calf concentrate in 49% of the herds, as crushed grain in combination with special protein feed for cows (28%), as crushed grain in combination with special protein feed for calves (7%), as crushed grain solely (6%), or as other combinations (10%).

The weaning period. The median age at weaning was 8 weeks (CR: 7-11). Almost half the herds (46%) used the 'age' of the calf as a criterion for time of weaning. In 18% of the herds 'concentrate consumption' was used as criterion to decide when to wean a calf; these farmers aimed that their calves had a median concentrate consumption at weaning of 1 kg (CR: 1-2). Seven percent of the herds used the calf's 'body weight' as criterion; in those herds the farmers aimed at a median weight at weaning of 70 kg (CR: 60-97). Combinations of these alternatives were used to determine the appropriate weaning time in 29% of the herds.

In 32% of the herds the weaning procedure was to dilute the milk with successively increasing volumes of water during, as a median, 7 days (CR: 3-14). In 21% of the herds the weaning procedure was 'simply to stop giving milk'. Another 21% gave their calves just one meal of milk per day for, as a median, 5 days (CR: 3-10) before the total removal of milk. In 19% of the herds the calves received a smaller volume of milk per meal during, as a median, 7 days (CR: 3-14), and the remaining herds used combinations of the alternative weaning procedures.

The period from weaning to first calving. The distribution of the most common diets used for calves and replacement heifers after weaning are shown in Table 2. In 47% of the herds the replacement heifers were fed the concentrates in predetermined amounts and the roughage *ad libitum.* In 26% of the herds the replacement heifers were fed both concentrates and roughage in predetermined amounts, whereas in only 2% of the herds both concentrates and roughage were fed *ad libitum*. The most common diet for replacement heifers before calving was a combination of grain, hay and silage which was given to the six months old replacement heifers in 24% of the herds, to the replacement heifers at insemination in 16% of the herds and to the heifers four months pregnant in 17% of the herds. The most common diet (given by 36% of the herds) at calving was a combination of grain, protein feed, hay and silage. The median amount of grain given varied between 1.5 and 2.0 kilograms for the six months old replacement heifers and between 2.0 and 2.6 at calving. The median amount of grain given to the replacement heifers at insemination or at four months pregnancy was 2.0 kilograms regardless of the kind of roughage that was used or if the replacement heifers also were served protein feed. A mineral feed was given to the heifers from 6 months of age to first calving in 77% of the herds. The length of the time period in which the replacement heifers

Table 2. The most common diets fed to Swedish dairy replacement heifers at 6 months of age, at insemination/covering, at 4 months pregnancy and at calving and the median (10th - 90th percentiles) amounts of the feedstuffs given in herds offering these in predetermined amounts.

		% of herds		Kilograms/% of herds offering the feedstuff in predetermined amounts					
Feeding strategy	Animal category	In total	Using straw	G	P	C	S (dry matter)	H	TMR (Dry matter)
G+S	6 months old	12	39	2.0(1.0-2.8)/97			3.0(2.2-4.0)/16		
	at insemination	17	53	2.0(1.0-3.0)/95			5.0(3.0-6.0)/28		
	4 months pregn.	17	54	2.0(1.0-3.0)/93			5.0(2.0-6.0)/29		
	at calving	4	52	2.0(1.0-6.2)/93			6.0(4.0-11.0)/33		
G+H	6 months old	9	11	2.0(1.0-3.0)/88				4.0(2.4-4.6)/20	
	at insemination	3	38	2.0(1.3-3.9)/92				7.0(3.6-8.8)/27	
	4 months pregn.	3	24	2.0(1.4-3.3)/96				4.0(1.0-7.2)/31	
	at calving	-	-	-				-	
G+S+H	6 months old	24	34	2.0(1.0-3.0)/90			2.0(1.0-4.2)/28	2.0(1.0-3.0)/38	
	at insemination	16	43	2.0(1.0-4.0)/90			4.0(2.5-6.0)/26	2.0(1.0-3.0)/51	
	4 months pregn.	17	37	2.0(1.0-4.0)/91			4.0(2.0-7.6)/31	2.0(1.0-3.0)/47	
	at calving	6	41	2.6(1.0-5.5)/94			6.0(3.0-10.0)/14	2.0(1.0-3.0)/63	
G+P+S	6 months old	6	39	1.5(1.0-2.4)/96	0.5(0.3-1.0)/94		2.5(2.0-4.2)/26		
	at insemination	12	38	2.0(1.0-3.0)/92	0.5(0.3-1.0)/95		4.5(3.3-6.2)/29		
	4 months pregn.	9	46	2.0(1.0-3.5)/92	0.5(0.2-1.0)/91		5.0(4.0-7.0)/27		
	at calving	14	21	2.0(1.0-4.0)/94	1.5(0.5-3.0)/96		6.0(4.9-7.2)/28		
G+P+H	6 months old	4	20	1.5(1.0-2.0)/95	0.5(0.3-1.0)/97			3.0(1.0-5.0)/41	
	at insemination	4	43	2.0(1.1-4.0)/96	0.6(0.2-1.7)/93			5.0(2.0-6.0)/46	
	4 months pregn.	2	48	2.0(1.9-4.0)/95	0.5(0.4-1.0)/90			5.0(3.0-8.0)/52	
	at calving	-	-	-	-			-	
G+P+S+H	6 months old	10	25	1.5(0.8-3.0)/93	0.5(0.3-1.0)/95		2.5(1.0-4.0)/10	2.0(1.0-3.0)/39	
	at insemination	11	33	2.0(1.0-4.0)/94	0.5(0.2-1.5)/97		4.0(2.0-5.4)/41	2.0(1.0-4.0)/50	
	4 months pregn.	11	39	2.0(1.0-3.9)/89	0.5(0.2-1.4)/90		4.5(1.7-5.3)/19	2.0(1.0-4.0)/46	
	at calving	36	16	2.5(1.0-4.0)/94	2.0(0.8-3.0)/94		6.0(4.0-8.0)/42	2.0(1.0-3.0)/71	
C+S	6 months old	7	39			1.5(1.0-2.5)/100	3.5(2.0-5.3)/12		
	at insemination	5	40			2.0(1.0-3.0)/95	6.5(3.0-8.0)/17		
	4 months pregn.	6	36			1.5(0.8-2.5)/92	5.0(4.0-8.0)/26		
	at calving	5	20			3.0(2.0-5.0)/95	8.0(5.8-10.5)/26		
C+S+H	6 months old	4	29			1.9(1.0-2.0)/97	2.0(1.0-5.0)/37	2.0(1.0-2.3)/51	
	at insemination	2	50			1.8(1.0-3.0)/100	4.0(1.4-5.0)/70	1.5(1.0-2.6)/70	
	4 months pregn.	3	32			2.0(1.0-3.1)/91	4.5(3.0-7.5)/27	2.0(1.0-3.0)/50	
	at calving	6	20			4.0(2.5-6.0)/98	6.0(4.7-10.6)/23	1.5(1.0-2.6)/66	
TMR	6 months old	5							4.0(2.5-6.9)/32
	at insemination	4							7.0(5.0-15.4)/38
	4 months pregn.	3							6.0(4.0-10.0)/41
	at calving	6							12(8.4-14.7)/27
Only roughage	6 months old	6					-	-	
	at insemination	12					-	-	
	4 months pregn.	16					-	-	
	at calving	6					-	-	

C=complete feed (commercial ready-mixed concentrate), G=grain feed, H= hay, P=protein feed, S= silage, TMR=Total Mixed Ration (total mixture of concentrate and roughage)

Table 3. Period of adjustment for Swedish dairy replacement heifers to lactation feed ration and housing before first calving

Weeks before calving	Adjustment to	
	feed ration % of herds (n=877)	housing % of herds (n=877)
>8	0	12
>4,<=8	14	22
>2,<=4	57	45
>1,<=2	20	15
=<1	4	6
0	5	0

near parturition could adjust to the feed ratio and the housing system used for the cows is shown in Table 3.

Routines at insemination/covering

Altogether 37% of the herds used 'age' as criterion for determining the time for first insemination or covering. The median age used in these herds was 16 months (CR: 15-18). In 18% of the herds 'heart girth' was instead used to determine the time for first insemination or covering. In these herds, the median heart girth used for this purpose was 160 cm (CR: 155-170). 'Time of the year' was used as the most important criterion in 8% of the herds and 'presence of two preceding heats with a normal interval' was used in 3% of the herds. One-third of the herds (34%) used combinations of these alternatives and/or other factors for determining the time for the first insemination/covering. The mean age at first calving was 27.9 months (SD: 2.6, range: 20.0-40.5).

Grazing routines

The median age of the group of youngest calves first turned out to pasture in each of the herds was 6 months (CR: 4-10). The median length of the first grazing season was 4 months (CR: 3-6). In 38% of the herds the calves were turned out to pasture at different time points and therefore several groups of first-season grazing calves were out on pasture on these farms during the grazing period. Fifty-five percent of the groups of first-season grazing calves were turned out to pasture in May, 38% of the groups were turned out in June, and 7% were turned out later than June.

The first-season grazing calves were supplemented with mineral feed in 70% of the herds and with concentrate and/or roughage in 65% of the herds and the second grazing-season replacement heifers in 70% of the herds and 31% of the herds, respectively (Table 4).

Sixty-six percent of the herds used meadow land for their first-season grazing replacement heifers, 55% used arable land that had been used as pasture for several years, 46% used arable land earlier used for harvesting roughage, and 5% of the herds used some other type of area. Meadowland and arable land used as pasture for several years were also the main types of pasture used for the second-season grazing of replacement heifers. The pasture area for the first-season grazers had earlier been used for grazing by both first-season grazers

Table 4. Supplementary feeding given to Swedish dairy replacement heifers during the grazing season.

	First grazing season % of herds (n=570)	Second grazing season % of herds (n=272)
Concentrate:		
Spring	22	4
Autumn	16	54
Spring + Autumn	7	5
Whole grazing period	55	37
Roughage:		
Spring	14	2
Autumn	49	78
Spring + Autumn	16	12
Whole period	21	8

and older cattle (44%), by first-season grazers only (42%), only by older cattle (4%), by other species (5%), for grain or hay (8%) or other purposes (1%). On some farms several paddocks were used for the first-season grazers.

The first-season grazing replacement heifers were treated prophylactically with anthelmintics in 66% of the herds; 72% used intraruminal devices (ivermectin, moranteltartrate or oxfendazole), 11% used pour-on preparations (eprinomectinum), 7% used powder/mixture preparations (albendazole, fenbendazole, febantel, ivermectin, metriphonate, pyrantel or pyranteltartrate), 6% used an injectable anthelmintic (doramectin, ivermectin or moxidectin) and 4% of the herds used combinations of these or other preparations.

The water supply for the second-grazing replacement heifers on pasture was from a well in 55% of the herds, from rivers, ponds or lakes in 32% of the herds and 13% of the herds used a combination of these water sources. In 37% of the herds the heifers were given water in a tub. Fourteen percent used water-bowls and 15% used a pump. The other herds used combinations of these or other methods.

Discussion

Increased knowledge about the rearing conditions of calves in dairy production is necessary for good extension advice and to serve as a basis for handling suboptimal conditions or special problems in individual herds.

The official milk recording programme in Sweden in 1998 covered a total of 10 362 herds, of which 56% had 28-94 cows. Of the herds with 28-94 cows, 877 (15%) were included in the present study. The fifty-eight percent of the questionnaires returned was not an optimal response rate. However, the average number of cows in the herds (44.5), the annual milk production (8545 kg ECM) and the age at first calving (27.9 months) in the present investigation did not differ significantly from those of all Swedish herds as scored by the official milk recording programme: 44.7, 8255 kg ECM and 29.2 months, respectively. We therefore have no reason to believe that the results were biased in any decisive way due to systematic differences in the procedures used by responders and non-responders, but believe the results are reasonably representative of Swedish herds with 28-94 cows.

Routines at calving

Forty percent of the herds used special maternity pens for calving and of these 18% used a group pen. According to Swedish legislation that came into force in 1993, dairy herds must have one maternity pen for every thirty cows. From previous studies it is known that the use of a calving pen has positive effects on the offspring. *Stott et al.* (1979) showed that the presence of the dam had a positive effect on the calf's absorption of immunoglobulins from the colostrum. However, one important factor to consider when using maternity pens is the difficulty for the calf to find the teats within the first important hours after birth. *Lidfors* (1996) reported that out of the 24 calves studied 32% did not succeed in suckling within four hours post partum. *Ventorp & Michanek* (1990) found that one reason for prolonged teat seeking was a short distance from the udder to the floor. In order to ensure that the calf receives adequate amounts of colostrum when kept in a calving pen, it should be fed manually. *Michanek & Ventorp* (1993) showed that calves born in group pens had a lower concentration of immunoglobulin G in serum 36 hours after birth compared with calves born in individual calving pens, due to the suckling of a non-puerperal cow with a minimal concentration of IgG in the milk. The use of group pens for calving may therefore be questioned.

Housing

In the present study, 68% of the farmers housed their calves in individual pens and 28% used group pens with or without an automatic milk feeding system. In earlier, small, surveys in Sweden (*Bernes et al.* 1986, *Norrman* 1990, *Stenebo* 1995) the individual pen was found to be the most commonly used housing system for preweaned calves. *Norrman,* who studied 155 herds in the county of Halland, reported that 92% used this system. *Stenebo* reported that 95% out of 143 herds used individual pens. The lower percentage in the present study may express a tendency in the last decade towards an increased usage of group pens in Sweden. *Curtis et al.* (1988) found group housing to be a risk factor for respiratory diseases. Similar results were found by *Svensson et al.* (2000a), who reported that calves kept in group pens with automatic milk feeding had a 2.8 times higher risk of developing respiratory diseases than calves kept in individual pens. Furthermore, *Goodger & Theodore* (1986), *Perez et al.* (1990) and *Olsson et al.* (1994) found that group pens represented a higher risk for outbreaks of diarrhoea than did individual housing. A positive effect of group housing was reported by *Warnick et al.* (1977); calves in group pens started eating concentrates earlier than calves in individual pens. The group housing systems have also been shown to have a positive effect on the social behaviour of calves; *Webster et al.* (1985) and *Jensen* (1999) found that the level of locomotor play in calves was significantly lower in individual pens compared with group pens. *Dellmeier et al.* (1985) found increased levels of locomotor behaviours during open-field tests in confined calves compared with calves housed in a more spacious housing system, and suggested this to be due to a build-up of motivation to perform these behaviours in the confined animals.

Calf hutches were used by only 0.3% of the herds in the present study. Despite them being rare, calf hutches are indeed widely discussed in Sweden, mainly on the basis of the positive experiences of this system in North America, where it is much more prevalent. In a survey from the US (*Heinrichs et al.* 1994) 44.7% out of 329 herds used calf hutches, and in Ontario, Canada, of 104 herds, 17.3% were reported to use hutches in the summer and 7.7% in the winter (*Waltner-Toews et al.* 1986b). *Waltner-Toews et al.* (1986c) found a decreased risk of developing both pneumonia as well as diarrhoea in calves housed in calf hutches compared with calves in indoor individual pens. *Blom et al.* (2000) found that calves were less exposed to respiratory diseases when kept in groups in calf hutches compared with indoor group housing. A negative effect of housing in calf hutches was noticed by *McKnight* (1978); during the wintertime calves in hutches had a slightly lower growth rate than calves in indoor individual pens.

Only 16% of the herds in the present investigation kept their calves separated from other age categories of cattle. In an investigation in 328 Norwegian dairy herds (*Bakken* 1981), 3.7% of the herds kept their calves separated from older cattle. *Virtala et al.* (1999) found housing mostly together with older cattle to be a risk factor for pneumonia. *Fourichon et al.* (1997) found that a housing design that allowed cross-contamination between calves and older cattle was a risk factor for calf morbidity. On the other hand, *Simensen* (1981) found that the highest level of ammonia, the lowest temperature and the highest air humidity were found when the calves were housed in a separate building. This was interpreted to be due to the often poor ventilation in separate calf stables.

In the present study, replacement heifers between breeding and first calving were kept on a slatted floor for at least part of this period in 26% of the herds and for part of the same period

in litter pens in 29% of the herds. This is a lower use of pens with a slatted floor than has been reported from Norway (33.8%) and from the county of Västerbotten in Sweden (54%) (*Bakken* 1981; *Bernes et al.*1986). There is also a lower usage of pens with a slatted floor but a higher usage of litter pens than reported from Denmark (44% and 8.1%, respectively) by *Alban & Agger* (1996). *Hannan & Murphy* (1983) found a higher incidence of diseases in cattle kept on a slatted floor compared with cattle in litter pens. *Frankena et al.* (1993) found that replacement heifers housed on litter had a 3.2-fold lower incidence of *dermatitis interdigitalis* when compared with replacement heifers housed on a slatted floor. Housing of the heifers in litter pens is not entirely positive with regard to claw health. *Vermunt & Greenough* (1995) reported that the claws of calves housed in litter pens became overgrown due to the modest wear of claw horn. A difference in the wear of claw horn can probably be found between replacement heifers housed in litter pens with and without access to an alley with a concrete or slatted floor. *Webster* (2000) reported that the heels of replacement heifers housed on litter frequently showed deep erosions, probably due to chemical effects. Unfortunately, there are no Swedish studies comparing claw health in replacement heifers housed on a slatted floor and in litter pens.

According to a preference study by *Bäckström* (1977), calves never choose to lie down on a slatted floor without straw if they have access to areas with litter. *Lidfors* (1992) showed that bulls kept on a slatted floor more often showed an abnormal rising behaviour compared with bulls in litter pens. On slatted floors, it also took the bulls longer to lie down. *Webster et al.* (1985) found that during their first weeks of life, veal calves showed discomfort while standing on slatted floor. The median age in the present study at which calves were transferred to pens with a slatted floor in herds using such pens was 2 months. According to *Groth* (1982), this is the earliest age at which a calf should be moved to a slatted floor and, from a health point of view; it would be preferable that the calves were allowed to stay even longer on straw. Quite contrary to what was thought in the past, the slatted floor pen is a housing system that has be found to be accompanied by many problems regarding animal welfare and health.

Fifty-one percent of the herds in the present study housed their replacement heifers in a tie stall during parts of the period between breeding and first calving. According to *Alban & Agger,* 37.2% of the investigated Danish herds housed their replacement heifers in tie stalls between 12 and 24 months. *Redbo* (1990) and *Jensen* (1995) both found an increased rate of stereotype behaviours in tied-up heifers. The average age for replacement heifers to be tied-up in the present study was 12 months. According to Swedish welfare legislation from 1997, calves must be kept loose up to at least 6 months of age.

Feeding

In the present study, the source of the calves' first two meals of colostrum was milk from the first milking of the cow in 39% of the herds, while 54% of the herds used milk from the first and second milkings. According to *Liberg & Carlsson* (1998), milk from the second milking of the cow contains on average only 55% of the level of immunoglobulin G found in milk from the first milking. They therefore stated that when speaking of the capacity to build up a passive immunity in the new-born calf it is only the milk from the very first milking occasion that should be called colostrum. Milk from later milkings should be referred to as transitional milk. This means that the risk that the calf is given colostrum with an insufficient level of immunoglobulins increases when the farmer

does not routinely utilise colostrum from the first milking only. Another important aspect of the colostrum routines is the time period from birth to the first intake of colostrum, it has been shown in several studies that the absorption of immunoglobulins is highly reduced six to twelve hours after birth (*Mc Guire & Adams* 1982, *Cortese et al.* 1994, *Gay et al.* 1994 and *Arthington* 1997). The time period between birth and first intake of colostrum was not investigated in the present study, but *Liberg & Carlsson* (1998) showed that most Swedish dairy farmers (76%) fed the calves the first colostrum within four hours after the calves are born. The mean time to first colostrum intake was 3.5 hours. The colostrum routines have been shown to also have an effect on the further development of the replacement heifer. *Odde* (1988) and *Robison et al.* (1988) showed a positive effect of the immunoglobulin status in the young calf and the growth up to 180 days of age. *Denise et al.* (1989) showed that calves with a lower immunoglobulin level at one day of age had a lower milk production and a higher mortality rate during the first lactation period.

The feeding of whole milk to Swedish dairy calves throughout the entire pre-weaning period was more abundant in the present study than previously reported by *Stenebo* (44% versus 35%), which in turn may be due to differences in the payment system for the whole milk and the price of the milk replacements. *Waltner-Toews et al.* (1986c) found an increased risk of diarrhoea when milk replacements were used, which at least partly could be due to poor preparation routines. In contrast, *Perez et al.* did not find any association between the type of milk and diarrhoea. Ninety-eight percent of the herds in the present study heated the whole milk before giving it to the calves. As many as 20% of the herds heated the milk by adding hot water despite this routine long having been known to affect the coagulation process of the milk in the abomasum *(Roy* 1970).

In the present study, the median age of the calves when introduced to hay was 5 days and to grain feed 14 days. This is similar to what was reported in Sweden by *Norrman* about ten years ago. *Perez et al.* found roughage fed in addition to milk, was a protective factor against diarrhoea.

The criteria for, and time of, weaning found in the present study were similar to those described by *Heinrichs et al.* from the USA. Systems with an early weaning may add nutritional stress to the young calf and have been shown to accentuate the effects of internal parasites and trigger outbreaks of coccidiosis (*Schillhorn van Veen* 1986).

The amounts of feedstuffs given in the different diets (see Table 2) should be interpreted with caution, since there is a risk that they may reflect what the farmers wish to give their animals, rather than what they actually give them. Nevertheless, we believe the data are worth presenting as examples of the most common feeding strategies used for Swedish dairy replacement heifers. The choice of grain, hay and silage as most common combination of feed stuffs to replacement heifers is probably heavily influenced by tradition. The use of a commercial ready-mixed concentrate (Complete feed) is a typical Swedish phenomenon. In this survey Complete feeds were fed to the six months old replacement heifers in 11% of the herds, to the replacement heifers at insemination in 7% of the herds, to the replacement heifers four months pregnant in 9% of the herds and to the heifers at calving in 11% of the herds. On the other hand, the use of Total Mixed Ration (TMR) to replacement heifers is very rare in Sweden, in this survey the percentage of herds using TMR varied between 3 and 6% in the different age categories. The amount of grain given did not differ between animals of different age or between animals given different

combinations of other feed stuffs in the diet. A more directed advisory service for the feeding of replacement heifers might be needed for the farmers to better adjust the amount of concentrates to be given to the needs for energy and protein of heifers of different age, as well as to the different energy and protein content of the roughage.

Grazing routines

The median age in the present study of the youngest calves at turn-out to pasture was 6 months. *Norrman* reported that the average age of heifers turned out to pasture for the first time was 6 months. According to the Swedish animal welfare legislation, replacement heifers aimed for milk production older than six months of age must be turned out to pasture.

Forty-two percent of the groups of first-season grazers were turned out onto a pasture that had been used only for first-season grazing heifers during previous seasons. *Eysker et al.* (1998) found that repeated moves to a clean pasture decreased the build up of gastrointestinal nematode infections in calves. According to *Svensson et al.* (1994), grazing a permanent calf pasture is a risk factor for developing *Eimeria alabamensis* coccidiosis. In the present study, 66% of the herds treated their first-season grazing replacement heifers prophylactically with anthelmintics. *Norrman* reported that 80% and *Svensson et al.* (2000b) 58% of the herd used prophylactic anthelmintic treatment. *Svensson et al.* (2000b) also reported supplementary feeding on the pasture to be the most commonly used parasite control method. In the present study, 65% of the herds fed their first-season grazing replacement heifers additional roughage and/or concentrates on pasture. *Höglund et al.* (2001) found supplementary feeding to be associated with reduced levels of serum pepsinogen in calves on organic farms using different methods of grazing management to control parasite infections. Well nourished hosts can better withstand the effect of parasites and this may explain the beneficial effects of supplementary feeding (*Coop & Kyriakis* 1999), but the reduced time spent grazing could also be of some importance (*Bransby* 1990). Forty-two percent of the herds kept their calves on pastures during 1998 that only first-season grazing heifers had grazed the two earlier seasons. This was found by *Svensson* (1995) to be a risk factor for the infection of *Eimeria alabamensis.* Seven percent of the herds turned out their first-season grazing replacement heifers to pasture later than June and 5% of the herds used pastures for the first-season grazing replacement heifers that in previous years have been grazed by other species. In order to be able to create an effective parasite control it is necessary to combine a sensible use of anthelmintics with grazing management, additional roughage feeding, rotational grazing with other species, and a delayed turn-out (*Nansen* 1993, *Thamsborg et al.* 1999).

The water supply for the second season grazers in the present study came in 45% of the herds partly or solely from surface water, whereas *Norrman* reported such a water source to be used in 66% of the herds. According to *Schukken et al.* (1990), drinking water from other sources than public water increases the risk of mastitis.

This paper has presented the first extensive survey of housing, feeding and management routines practised on Swedish dairy farms. It identifies several areas where advisory inputs are urgently needed and where this new knowledge could be useful for improvement of herd health control. The increased use of group pens for young calves demands an intensive advisory input to avoid the health problems associated with this type of housing. The widespread use of pens with slatted floors, despite the well-known disadvantages especially on animal behaviour,

must also be discussed. Furthermore, the farmers need to be informed that the routine of saving colostrum from the first milking occasion to more than the calves' first meal is an easy and cheap way to increase the level of immunoglobulins fed to the calves for the improvement of the health status. In this questionnaire, we did not find any evidence that the grazing period is a critical period during the rearing period, but from practical experience the difficulties of maintaining the growth on pasture are well known.

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Sammanfattning

Inhysning, utfodring och skötsel av rekryteringsdjur inom mjölkproduktionen i Sverige.

En enkät skickades ut till 1500 slumpvis utvalda mjölkkobesättningar. Enkäten innehöll frågor om rutiner mellan födelse och inkalvning, rutiner vid inseminering/betäckning, rutiner under betessäsongen samt generella frågor om besättningarna. Svarsfrekvensen var 58%. I 68% av besättningarna hölls kalvarna i ensambox under mjölkperioden, 15% använde traditionella gruppboxar med hinkutfodring och 13% inhyste sina kalvar i gruppboxar med sk kalvamma. Trettionio procent av besättningarna sparade mjölk från första urmjölkningen efter kalvningen även till kalvens andra mål. Helmjölk användes i 44% och mjölkersättning i 42% av besättningarna. Medianåldern vid avvänjning var 8 veckor. I över hälften av besättningarna (53%) gick kvigorna under någon del av perioden avvänjning till inseminering/betäckning på spaltgolv medan 51% av besättningarna hade sina kvigor uppbundna någon del av perioden, inseminering/ betäckning till inkalvning. Den vanligaste foderstaten under uppfödningsperioden innan inkalvning var spannmål, hö och ensilage. Drygt två tredjedelar av besättningarna avmaskade sina kvigor i förebyggande syfte före eller under första betessommaren.

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