TECHNICAL GUIDE

Pair housing of dairy calves

An opportunity for calves, a solution for farmers

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DPFF : Danone Produits Frais France, a joint stock company with a capital of 16,950,497 euros, registered office 17, Rue des deux Gares, 92500 Rueil-Malmaison, registration number 672 039 971 RCS Bobigny

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Translated from French to English by Dr. Alison Foucault, DVM, MRCVS - **Cover photo credits:** Holm&Laue.

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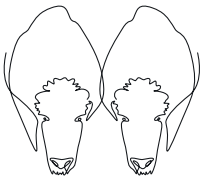

Pair housing as an alternative to individual housing for dairy calves

Individual housing: the majority practice

In France, the majority of dairy calves are housed in individual pens.

This type of housing is allowed for up to 8 weeks of age in conventional farming [1] and up to 1 week in organic farming [2].

The main reasons for adopting this practice are to limit the risk of disease transmission between calves, whose immune systems are immature, and to facilitate food intake and calf monitoring.

Reconciling welfare and performance...

The main goals in dairy calf rearing are to limit mortality and morbidity (for both males and females), to optimise the growth of the females so they can be at an ideal age for their first calving, and for a good start to lactation. An important challenge is to meet these performance objectives while still providing the animals with a rich environment, allowing them to express their natural behaviours (especially social) and to develop their cognitive abilities. Indeed, animal welfare is only achieved if the animal is in a "positive mental and physical state, relating to its physiological and behavioural needs being met, as well as its expectations"[3]. Taking into consideration the mental, cognitive and individual components of animal welfare is a recent development, and as of yet, is often not well integrated into farming practices.

When it comes to rearing dairy calves, the two main points of criticism relate to the early separation from the mother, which deprives the calf of its privileged social partner in its first weeks of life, and the social isolation of being housed in individual huts.

The dairy industry has therefore taken steps to integrate calves into a social group as early as possible (with other calves and/or cows).

Having an alternative to individual housing for calves can also allow farms to meet certain technical specifications when required.

...with housing calves in groups?

Housing calves in groups can also have a number of benefits on the farm. First of all, when carried out in good conditions, group housing helps convey a positive image of calf rearing. In a recent survey [4], farmers who reared their calves in groups reported better work satisfaction with calves that seemed to «feel better» in groups. Some farmers see group rearing as a way of streamlining and optimising the time spent on calf care. Group rearing calves also has beneficial effects on their welfare (mental, emotional) and learning abilities, allowing them to become more adaptable to the different situations they will encounter, including less stress and potentially better growth during sensitive periods such as weaning.

What is pair housing?

Pair housing consists of grouping two calves together as soon as they are separated from their mothers (usually within 12 to 24 hours of birth) in a pen of at least 1.5 m2/calf [1].

Pair rearing of calves appears to be an interesting compromise allowing for easier monitoring of the calves and a limited risk of pathogen transmission compared to larger groups. It can also be a comfortable solution for farmers who may not wish to make radical changes to their herd management or to their premises. In addition, the potential health risks associated with pairing calves can be easily mitigated by adjusting feeding and hygiene practices.

Why this guide?

This guide is intended for anyone (farmer, technical advisor, veterinarian, teacher) who wants to know more about this practice.

It reports on the scientific data currently available and offers practical advice for implementation on the farm.

This guide comprises 5 factsheets presenting the benefits and points of caution of housing calves in pairs, the recommended feeding and hygiene practices, and a practical guide to implement this type of housing on the farm.

Finally, other alternative methods of rearing calves will be briefly presented.

FACTSHEET 1

INDIVIDUAL HOUSING VS. GROUP HOUSING: benefits and risks

Pair housing of calves is still a minority practice in farming. This being said, data from pilot field stations allow us to identify some advantages as well as points of caution attached to this practice.

MORE SOCIABLE CALVES

Cows are gregarious social animals, living in stable social groups. The newly born calf's preferred social partner is its mother, and it then extends its social interactions to the rest of the group (other calves, mothers).
In individual housing, regulations ensure that calves have visual contact with other calves [1] but their other interactions are very limited (tactile and olfactory contact, group rest, play, etc.). Housing calves in pairs allows contact between the two calves, and therefore the possibility of expressing natural behaviours such as resting together, grooming and social play.
Experiments comparing the behaviour of calves reared in individual vs. group pens from birth show that:

> Calves raised in groups develop better social skills. They are more likely to approach an unfamiliar calf [5] [6] [7], play with each other more [8] [9], sleep in groups, and fight less when they are grouped together [10].
> Group-reared calves are less fearful of new situations, whether it is a new environment [11] [5] or a new type of feed [12]. They have better learning abilities [13] [14] and adapt better to a change of situation during a learning task.
> The effects of housing calves in pairs can be seen particularly at the time of weaning, which is a stressful time for the animals. The number of vocalisations at weaning, a sign of calf stress, is reduced in pair-reared animals and the time spent lying down is greater [15] [16].
> However, studies have also shown that calves reared in pairs (for 7 to 10 weeks) were shyer and more wary of humans. They took longer to interact with a human entering their pen [17] [18], were less contact-seeking than individually reared calves [18] and were more difficult to move [17]. The effects of this practice on the human-animal relationship for short periods of paired housing (2-3 weeks) or over the long term are not currently known.
> One study found that calves in pairs generally displayed less non-nutritive sucking (directed at items in the pen or the bucket) but did cross suck on the other calf [19].

FAVOURABLE EFFECTS ON GROWTH PERFORMANCE AND HEALTH

> There is, to date, no proven effect of small group housing on calf health when compared to individual housing. In trials, the conclusions were very variable from one farm to another (ranging from no difference to increased or decreased risk) [20] [21] [22] [23] [24] [25] [26]. Calf-rearing in large groups (> 6 calves), however, presents an increased risk to health (disease spread, difficulty of monitoring) [27] [28] [29].
> Calves reared in pairs were found to have equivalent or better growth performance before and just after weaning [15] [30] [31] [32] [33] [12]. This is mainly due to increased feeding frequency (via automatic milk feeders) and increased intake of concentrate compared to calves housed alone [15], both during, before and after weaning (up to 58% more concentrate consumed before weaning and 48% after weaning).
> Paired calves cope better with the disruption of weaning (see behaviour section), they feed more quickly which favours weight gain after this transition.

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SOME POINTS OF CAUTION REGARDING MILK COMPETITION AND CROSS SUCKING

> The risk of milk competition during feeding and cross sucking on another calf can become an issue in group rearing. However, the frequency of occurrence and intensity of these phenomena fluctuate greatly [34] [35] [36] [37], indicating that they can be avoided by creating the most homogeneous pair possible, good management of feed distribution (see Factsheet 2 "Feeding") and enriching the calves' environment (toys, brushes, etc.).

> Since the individual handling of calves can be more complicated when housed in groups, it is all the more important in pair housing to handle the calves and have positive contact with them (scratching, petting) to get them used to being around people.

SOME QUESTIONS REMAIN

> The effects of paired housing on the ease of milk distribution and labour strenuousness have not yet been assessed.

> The effects of pair housing on a cow's milk-producing career, social skills (among cattle), the human-animal relationship or cognitive abilities (memory, learning) into adulthood have not, to date, been evaluated. However, given the better social skills observed at weaning, it can be hypothesised that these extend into later life, with various studies suggesting that the effects of the calves' social environment persist over time [30].

Table 1 summarises the main benefits and points of caution of pair-rearing calves, compared to calves reared in individual pens [4].

Table 1: benefits and points of caution of rearing calves in pairs

Benefits	Points of caution
Promotes social behaviour (contact between the 2 calves)	Risk of cross sucking
Calves more adaptable to new situations	Risk of competition between calves
Improved learning skills	Monitoring or restraining calves during feeding to limit competition and cross sucking
Higher concentrate consumption	
Calves less stressed at weaning	
No increase in health risks for the calves if the proper hygiene and biotechnical steps are taken	

TO LEARN MORE

ON PAIR HOUSING DAIRY CALVES

- Summary of the results of pair housing trials in Canada:
Brocard V. 2020.
Housing dairy calves in pairs to improve their welfare: the experience of pair housing in Canada. Available in French at: https://idele.fr/detail-article/loger-les-veaux-laitiers-a-deux-pour-ameliorer-leur-bien-etre-lexperience-du-pair-housing- au-canada.

- Invited review:
Effects of group housing of dairy calves on behavior, cognition, performance, and health, Journal of Dairy Science, 99(4), pp. 2453–2467. doi:10.3168/jds.2015-10144

- A starter guide to pairing dairy calves, published by the University of Wisconsin (7 articles to download):
University of Wisconsin-Madison (UW-Madison) Pair or group housing of dairy calves Version 1 February 2021.
Downloadable from: https://animalwelfare.cals.wisc.edu/calf_pairing/

FEEDING YOUNG CALVES
housed in pairs

Common feeding principles prior to weaning apply to young calves reared in pairs.

5 POINTS OF CAUTION ON FEEDING CALVE IN PAIRS

> **Rigorous management of the colostrum period:** regardless of the housing setup (individual, small or large group), calves need solid passive immunity in order to stave off the risk of infection. This immunity is usually transferred via the mother's colostrum, but specific conditions have to be fulfilled.

> **Providing enough milk:** to avoid cross sucking, it is essential that both calves are fed enough milk to feel satiated. Indeed, hungry calves are more likely to cross suck on each other. After the colostrum period, dairy calves consume milk ad lib at a rate of 20% of their body weight. It is therefore important to quickly reach 8 litres of milk distributed per day, in at least 2 daily distributions. Contrary to popular belief, calves are able to take in large volumes of milk without developing diarrhoea.

> **The use of a nipple (with a slow flow rate) is a good way of meeting a calf's natural sucking need.** Combined with dispensing a large volume of milk, this significantly reduces the risk of cross sucking [38] [12].

> **Particular care should be taken to ensure the hygiene of the milk and dry feed:** this promotes good digestive health and limits the calf's risk of developing neonatal diarrhoea, particularly in relation to the high volumes of milk distributed.

> **Precautions to avoid competition at the time of joint feeding:** distancing of the teats, or even installing a temporary physical barrier [12] [39].

PRACTICAL FOOD MANAGEMENT

> **Colostrum management:** see factsheet 3 "Hygiene management". Colostrum should be given as soon as possible after birth, ideally within the first 2 hours of life. The calf should receive at least 200 grams of immunoglobulins in the first 6 hours of life (e.g. for colostrum with 50 g/l immunoglobulins, at least 4 litres).

> **Milk diet**

After receiving colostrum on the first day of life, the calf should be given its mother's "transitional milk" on D2 and D3.
Ideally, it is then fed milk from D4 until weaning.

> **Milk reconstituted from milk replacer powder is recommended in conventional agriculture for several reasons:**
- Consistent composition
- Composition adapted to a calf's physiology (leading to better digestion and growth)
- Superior microbiological quality
- Convenient to prepare

Figure 1a

Figure 1b

Ad lib water and pellets in clean buckets

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> **If cow's milk is used** (especially in organic farming where calf milk replacer is prohibited):
- No "mastitic" milk or milk with antibiotic residues
- Supplement with a protein balancer to bring the Protein / Fat ratio to around 1.3.

> **Concerning calf milk replacer (MR):**
- Choose a protein-rich powder, ideally 27 or 28% (and not under 24%). Precise amino acid content is rarely provided by the manufacturer; if known, a min. of 2.3% lysine and 0.75% methionine (based on dry matter) is recommended
- Aim for a protein to fat ratio close to 1.3 (e.g. a 27/21 formula)
- The 1st component of the MR must be skimmed milk powder, and represent at least 50% of the formula
- How much MR? *(see Figure 1)*:
  - At peak feeding around 1 month of age: at least 1kg/day (i.e. at least 8 litres of feed in total)
  - Gradually reduce the volume in the 10 to 15 days prior to weaning
  - Over the whole period until weaning: about 45 kg.

Suggested feeding programme for optimised growth until weaning (early weaning, in a twice daily manual feeding system)

Week	Day	Type of feed	L/feed	Feed/day	L/day	Quantity of milk replacer (gr/day)	Quantity of milk replacer over the period (in gr)
1	1	Colostrum	4 + 2	2	6		
	2 to 3	Transitional milk	3	2	6		
	4 to 7	MR	3,5	2	7	875	3500
2		MR	4	2	8	1000	7000
3		MR	4,5	2	9	1125	7875
4		MR	4,5	2	9	1125	7875
5		MR	4	2	8	1000	7000
6		MR	4	2	8	1000	7000
7		MR	2	2	4	500	3500
8		MR	2	1	2	250	1750
9		MR	0	0	0	0	0

Total up to weaning: **45.5 kg**

FEEDING YOUNG CALVES
housed in pairs (cont.)

> **Preparation and distribution of reconstituted milk**

- Use clean water of good physicochemical quality (hardness: 70-150 ppm)
- Make sure the mixture is homogeneous (add the MR gradually if preparing manually with a whisk)
- Prepare at approx. 55°C (follow the manufacturer's recommendations)
- Feed at a temperature of 37-40°C
- Feed with a teat, positioned up high so that the calf drinks with its head up (allowing the oesophageal groove to close and the milk to pass into the abomasum)
- Hygiene of milk preparation and distribution equipment: *see factsheet 3 "Hygiene management"*

> **Non-milk food**

Water, straw and solids (starter feed) should be provided from the first few days and refreshed daily *(Figure 1)*.

Two bucket holders are therefore required.
A salt lick is also recommended (for vitamin and mineral intake + salt).

Main characteristics of the solid feed:

- Appetizing, muesli-like texture, daily removal of leftovers.
- Composition: 0.95 to 1 Milk Forage Units, 18 to 20% Crude Protein, ≥ 12% Crude fibre
- Favour a cereal with low acidity in its composition (corn rather than straw cereal)
- Aim for an intake of at least 2 kg at the time of weaning

CALF-REARING IN PAIRS REQUIRES CAREFUL MANAGEMENT OF THE COLOSTRUM PERIOD, AS WELL AS STRICT HYGIENE OF THE MILK AND FEED PROVIDED. CROSS SUCKING BEHAVIOURS SHOULD BE ACTIVELY MITIGATED, SPECIFICALLY BY PROVIDING CALVES WITH ENOUGH MILK.

FACTSHEET 3

HYGIENE MANAGEMENT OF YOUNG CALVES
housed in pairs

Although shared housing increases the risk of disease transmission between calves, controlled trials show that pair housing is not necessarily associated with an increase in early life illnesses (diarrhoea in particular), provided there are strict sanitary practices in place.

HYGIENE PRACTICES AROUND CALVING

> Calves should be born in a dedicated calving area, cleaned and disinfected after each calving (or at least every day during peak calving periods), with thick bedding provided (20 to 30 kg of straw for a surface area of 15 m^2). The umbilical cord should be emptied of its contents and disinfected (e.g. with iodine).

> The successful transfer of passive immunity, as well as being reared in an environment with low infectious pressure, are critical aspects of calves' health and even survival. Keeping the calf with its mother may, in some cases, be associated with increased health risks for the calf, but this risk is not systematic [40]. Thus, recommendations on whether to separate the mother and the calf will vary depending on a farm's particular conditions (building sanitation, health status of the herd, etc.).

It may be advisable either to leave the calf with its mother for a minimum of 6 hours, ensuring good colostrum intake by suckling, or to separate the calf from its mother as soon as possible, ideally within 2 hours, in order to give it enough good quality colostrum, and to limit its contact with adult pathogens.

COLOSTRUM MANAGEMENT: RESPECTING THE 5Q RULE

Colostrum should be distributed as soon as possible. It should be harvested under the same hygienic conditions as for conventional milking. For adequate protection against early life infections, the calf should receive at least 200 grams of immunoglobulins in the first 2-6 hours of life, under appropriate sanitary conditions.

a. **Colostrum Quality:** all colostrum must be refractometer-tested and contain at least 50 grams/litre of immunoglobulins (Ig) (i.e. at least 23% on the Brix scale). This concentration is consistent with the target of 200 grams of immunoglobulins distributed in the first few hours of life (a 4-litre colostrum feed). For colostrum of lower quality (< 50 g/l Ig), it will be necessary to supplement or replace it with good quality colostrum (from a colostrum bank, or with a commercial colostrum powder).

b. **Quantity:** ideally, the first intake should be 10% of the calf's weight, i.e. about 4 litres, possibly supplemented by a 2-litre drink after 12 hours.

c. **Quickness:** ideally, colostrum intake should be within 2 hours of birth (and no more than 6 hours after). Indeed, a calf's intestinal permeability to colostral immunoglobulins (the antibodies responsible for immunity) decreases very rapidly in the first few hours of life. To allow for maximum passage of immunoglobulins into the calf's systemic circulation, colostrum should therefore be given very early, allowing for high blood concentrations and thus protection against neonatal infections.

d. **SQueaky clean:** the colostrum distributed must contain < 100,000 germs/ml, and specifically < 10,000 *Escherichia coli* /ml.

e. **Control and Quantification of passive immunity transfer in calves:** the goal is to have > 85% of calves with > 55 g/l serum protein (i.e. > 8.3% on the Brix scale, which corresponds to at least 15 g/l IgG). And no more than 10% (ideally 5%) of calves with a Brix reading of < 8.1% (< 10 g/l IgG).

Figure 2a

Figure 2b

Examples of teat buckets for two calves, clean and drying, between two feeds

MILK AND SOLID FEED: HERE TOO, HYGIENE IS PARAMOUNT

> **Hygiene in the preparation and distribution of (reconstituted) milk**. Large volumes of milk need to be distributed in order for calves to be satiated, so particular attention must be paid to the hygiene of the milk itself, as well as the sanitation of the equipment used for its preparation and distribution.

- The area must be clean
- The water must be free of pathogens
- Particular attention should be paid to the cleanliness of the equipment used for milk preparation and distribution:
  - Individual buckets: rinse with warm water, clean with a brush and detergent soap, disinfect, and flip over on a clean surface to drain and dry *(Figure 2)*
  - Teats: immerse for 24 hours in a suitable disinfectant solution (a set of nipples is therefore required), such as hydrogen peroxide / acetic acid at 1 or 2%.

> Non-milk food

Water, straw and dry feed should be refreshed daily.

Figure 3 - Example of generous bedding with clean straw

CLEAN AND COMFORTABLE HOUSING

> Calves housed in pairs should have clean and comfortable accommodations *(Figure 3)*. Pairs should be made up of calves born less than 1 week apart.

> Main technical housing requirements:

- Regulatory area: 1.5 m^2/calf; recommended: min 2 m^2/calf and ideally 2.5m^2/calf; Volume: 7 to 9 m^3 per calf [1] [41]
- Bedding: 1 kg/m^2 daily; when the calf is lying down, its legs should not be visible
- Bedding: regularly check the temperature at a 10 cm depth — it should be < 36°C. Clean regularly after each pair is moved on, and as soon as the bedding "heats up":
  - Remove manure
  - Clean at high pressure (with boiling water or detergent)
  - Disinfect floors and walls up to 1.5 m

> General husbandry norms:

- Temperature: between 7 and 25°C (for calves up to 15 days old); provide heat lamps or calf jackets in case of extreme cold (and increase the volume of milk provided)
- Air speed < 0.25 m/s in winter
- Air inlet volume 0.04 m^2, outlet volume 0.02 m^2 (up to 60 kg; multiply by 1.5 between 60 and 120kg)
- Ammonia should not be noticeable (< 5 ppm)
- Humidity: between 50 and 70% at 20°C
- Sufficient brightness: 200 lux

HYGIENE MANAGEMENT OF YOUNG CALVES
housed in pairs (cont.)

BIOSECURITY: BASIC MEASURES TO PROTECT THE CALVES

> Biosecurity recommendations are the same for farms housing calves in pairs vs. otherwise:

- Visitor access: provide a footbath with clean disinfectant solution, or at least use specific clothing and boots.
- Care for young calves before older cattle; use clean clothing.
- Sick calves should be isolated and cared for / fed after healthy calves.
- Pest control should be in place for rodents and insects (+ bird control if necessary).
- Vaccination can be introduced to reduce the incidence of digestive and respiratory diseases in young calves, depending on the context of the farm and veterinary advice.

HYGIENE MANAGEMENT OF CALVES IN PAIRS MUST BE METICULOUS, AND IS ESSENTIAL TO LIMIT THE SPREAD OF INFECTIOUS AGENTS BETWEEN ANIMALS.

FACTSHEET 4

SETTING UP pair housing

DOES MY CURRENT SYSTEM ALLOW FOR HOUSING CALVES IN PAIRS?

To assess the feasibility of pair housing, one must consider the number of births and their distribution throughout the year.
Indeed, for sanitary reasons, pairs must be made up of calves born within a week of each other.
Table 2 shows the number of nursery spaces required (for calves less than 3 weeks old) [41] depending on farm size and calving management.
From this table, it can be seen that the first condition to facilitate paired housing is to group calving in one or two blocks.
Mathematically, it is easier to form pairs in farms with more than 100 cows.
Thus, for smaller farms, it will be essential to have tight calving blocks.

Table 2: Minimum number of spaces required for calves under 3 weeks of age, by farm size and calving management (adapted from IDELE 2014)

Herd size	Year-round calving	Autumn calving	2 calving blocks: autumn and spring
50 DC	3*	5 *	3 *
100 DC	4*	10*	12*
150 DC	6**	15**	19*

** based on keeping 70% of females and selling 100% of males at 8 days*
*** based on keeping 80% of females and selling 100% of males at 8 days*

These conditions are of course not exclusive and it is up to the farmer to assess whether this housing adjustment is feasible or not. For this purpose, one should calculate the exact number of calves < 3 weeks old that will be present in the nursery simultaneously. This can be done by using a calculating tool to establish the number of places required, taking into account the following elements: herd size, calving block(s), calf mortality, renewal rate (% of females to be kept), % of males kept, number of weeks in a two-calf pen.

HOW ARE THE PAIRS MADE UP?

Pairs should be formed as homogeneously as possible (age and size of the calves). An age difference of less than 7 days [41] or even 5 days [41] between the calves is strongly recommended.
Once formed, the pairs should be stable (no swaps) to limit health risks and calf stress.
In some situations, it may be worthwhile to house calves in mixed-gender pairs (male/female) — if it is possible to keep the male calves long enough (e.g. 3 weeks).

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HOW LONG SHOULD CALVES BE HOUSED IN PAIRS?

A minimum of 15 days of pair housing is recommended, as the calves usually need an adaptation phase of a few days to a week to get used to feeding properly. One can adapt the duration to suit the farm's calf management, in particular the desired age of calves being moved into group pens (age of the calves, size of the group).
Similarly, one's strategy may differ depending on the time of year: if calving is tightly grouped and places in two-calf pens are quickly filled, the move to group pens can be made more quickly. Here too, taking calving planning into account will help optimise the practice of pair housing.

SETTING UP
pair housing (cont.)

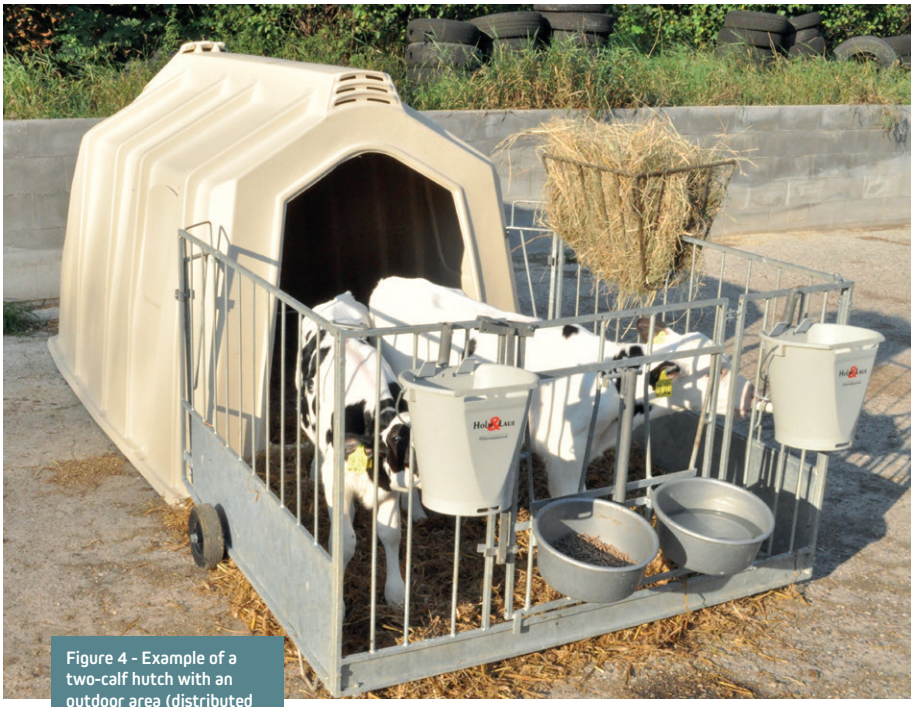
WHAT TYPE OF HOUSING CAN ONE USE FOR PAIR REARING?

Two main options are generally used to house calves in pairs:

OPTION 1: IGLOO/HUTCH SYSTEM WITH COMMON OUTDOOR AREA

> **Pairing of two individual hutches:** in this case, particular care must be given to bedding maintenance and hygiene, as calves tend to prefer to lie together in the same hutch [42]. The cost of the hutches should also be considered.

> **Purchasing or building "super hutches" *(Figure 4)*:** in this case, one must be mindful of the greater challenge of handling individual calves, and make sure that the hutch (which has a larger opening) still protects the calves from the weather (UW-Madison, 2021).



© Holm&Laue

Figure 4 - Example of a two-calf hutch with an outdoor area (distributed by Holm&Laue)

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Figure 5 - Example of removing a partition to create a pen for 2 calves

OPTION 2: PEN SETUP FOR 2 CALVES

> **One can remove the panel between 2 individual pens *(Figure 5)* or design pens specifically *(Figure 6)*.** In this case, the planning of the pen area should take into account the size the calves will reach at the end of the paired housing period. If desired, a system to separate the calves at the time of feeding can also be factored in, to facilitate their getting used to drinking and limit competition (especially in the case of heterogeneous pairs).

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Figure 6 - Example of a pen design for two calves in the USA (note here that the area available for the pair is greater than 2 x 1.5 m²)

> Purchasing pens suitable for housing 2 calves:

Some manufacturers offer housing systems designed for 2 calves *(Figures 7 and 8)*:

© TopCalf

Figure 7a

© Beiser

Figure 7b

Figure 7a and 7b
Examples of outdoor pens for two calves (marketed by TopCalf on the left and Beiser on the right)

Indoor pen for two calves:

Figure 8a

Many manufacturers offer group housing solutions which, although not specifically designed for a pair, may be suitable for two calves due to their size (minimum 3 m²) and equipment. This list is not exhaustive and farmers can choose the setup that suits them best.

Figure 8b

© VDB CalfOTel

Figure 8a and 8b
Example of two-calf indoor pens (marketed by VDB CalfOTel) which come with a removable partition to separate the calves if needed.

FACTSHEET 4

SETTING UP
pair housing (cont.)

FEEDING AND HYGIENE MANAGEMENT

> The feeding and hygiene management of calves housed in pairs should follow the same good practices as for calves reared in individual huts (as mentioned in factsheets 2 "Feeding" and 3 "Hygiene management"). However, certain critical points require particular attention:

> Good practice common to all types of housing:

- Ensure good immune protection: Each calf should receive a minimum of 4 litres of good quality colostrum (minimum Brix reading of 23%) within 6 hours of birth, and a further 2 litres within 12 hours
- Milk, water and starter feed should be dispensed in clean buckets (washed and dried between meals)
- The volume of air in the nursery should be 7 to 9 m^3 per calf
- Bedding: 1 kg of straw/m^2 should be laid out every day; when the calf is lying down, its legs should not be visible, and the bedding should be clean and dry
- Biosecurity rules: outside visitors should be limited, specific clothing should be worn in the nursery, boots should be washed and a clean footbath should ideally be used, calves should be handled before adults, sick calves should be handled after healthy ones.

> Additional recommendations for housing calves in pairs:

- Increase the area available per calf to ideally 2.5 m^2/calf instead of 1.5 m^2
- Mitigate cross sucking: calves should receive large volumes of drink, i.e. at least 8 litres in total at the peak of intake at 1 month (i.e. 1 kg of powder when using milk replacer)
- Mitigate cross sucking: the use of slow-flow teat buckets is recommended
- Dispense good quality feed: calves should not be fed with unmarketable milk (mastitic or with antibiotic residues), and the use of calf milk replacer should be preferred when possible
- Dispense good quality feed: using a milk taxi is recommended, as it ensures that the milk is distributed quickly and synchronously at the right temperature, limiting the risks of cross sucking, competition, and rumen drinking
- Increase calf monitoring to detect health or behavioural problems as early as possible
- Handle calves to promote docility
- Each hutch, pen, or ideally the entire barn, should have at least a 1-week sanitary rest period before new calves are moved in.

TO LEARN MORE

ABOUT THE PRACTICAL IMPLEMENTATION OF PAIR HOUSING OF DAIRY CALVES

- Article listing points to consider when switching to pairs (USA): https://www.progressivedairy.com/topics/calves-heifers/effectively-raising-pair-housed-calves-common-questions-from-transitioning-farmers

- A starter guide to pairing dairy calves published by the University of Wisconsin (7 articles to download): University of Wisconsin-Madison (UW-Madison) Pair or group housing of dairy calves. Version 1 February 2021.
Downloadable at: https://animalwelfare.cals.wisc.edu/calf_pairing/

TWO EXAMPLES OF FARMS HAVING IMPLEMENTED PAIR HOUSING OF CALVES

ON A CONVENTIONAL DAIRY FARM, WITH 100% OF CALVES HOUSED IN PAIRS (PAS-DE-CALAIS REGION, FRANCE)

WHY THIS CHOICE?

A desire to maintain or even improve performance and welfare by encouraging calves' social behaviour.

CALF REARING SYSTEM

- 90 dairy cows, mainly Prim'Holsteins + a few Flemish Reds
- Milk production: 8,000 litres over 305 days
- 90 births/year, exceptionally grouped in 2 blocks
- Goal: early calving at 24 months
- 2 partners take care of the calves

HOUSING

- Large nursery (95m2) with wind effect ventilation (air intake 0.3m^2) with a high roof height (7-9 m^3/calf), bright with translucent windows facing north-east *(Figures 9 and 10)*
- 4 pens (bought second hand) for two calves *(Figure 11)*

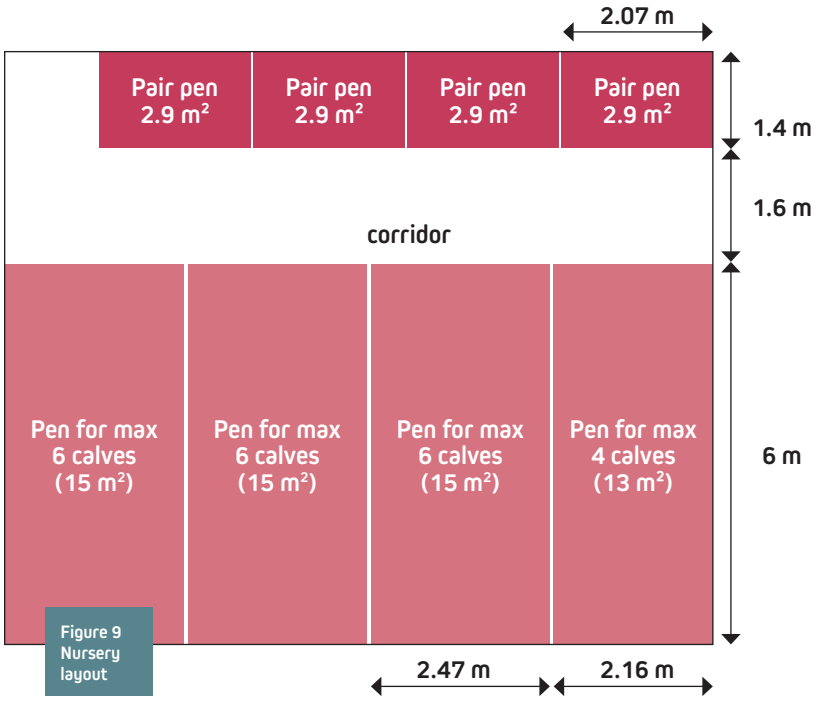

Figure 9
Nursery layout

Figure 10
Collective pens for 4-6 calves

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Figure 11
Pen and equipment for the housing of two calves

3 WOODEN PARTITIONS

SEPARATION WALL
from the dairy
(less cold than an external wall)

BEDDING
straw-bedded grating on concrete floor

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MILK
bucket with two slow-flow teats, placed up high, cleaned and dried between each feed

PELLETS
2 buckets for pellets at will

WATER
2 buckets for water at will

(D 1.4 x W 2.07 = 2.9 m^2)

SETTING UP
pair housing (cont.)

MANAGEMENT OF THE PAIRED CALVES

The calves, ideally of the same age and gender when possible, are paired within 12 hours of calving. They remain in pairs from a few hours to 15 days, depending on the number of births in a given period.

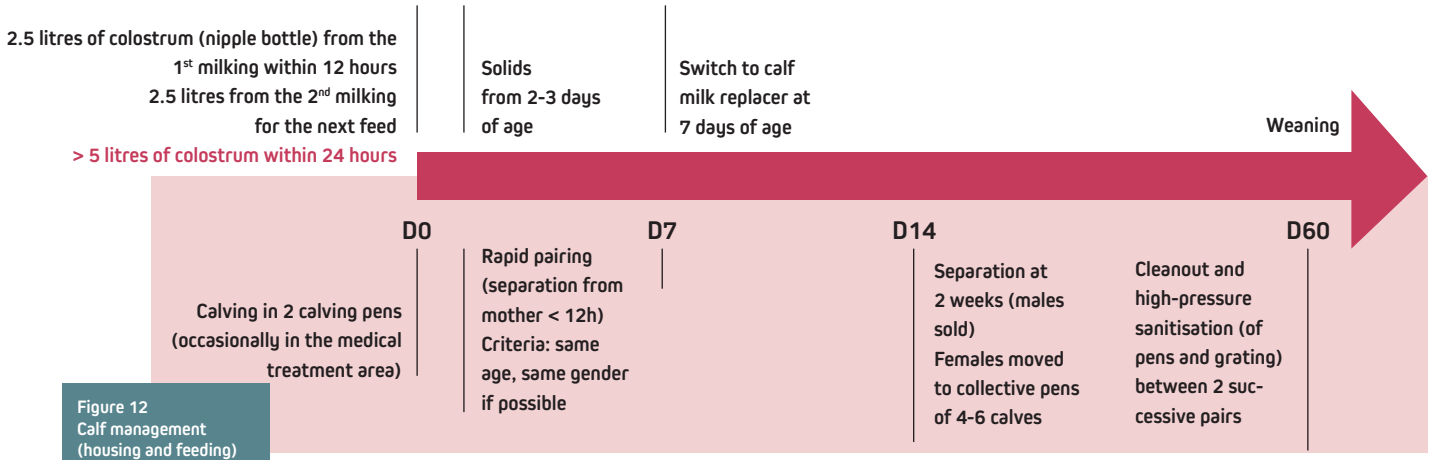

Figure 12
Calf management (housing and feeding) before weaning

FEEDING (FIGURE 12):

- Colostrum: 5 litres within 12-24 hours (including 2.5 litres from the 1st milking), quality checked via refractometer
- Post-calving transitional milk
- Calf milk replacer from 7 days of age: 26.5% TP, 20.5% Fat, 2 meals of 2.5 litres then 2 meals of 4 litres at 1 month, then reduction during the last 2 weeks before weaning to 2 x 2 litres then 2 x 1 litre
- Use of double teat buckets that have been washed (hot water tank) and systematically dried/turned over between feedings *(Figures 2a and 2b)*
- Solid feed distributed from 2-3 days of age, water and pellets made available in 4 buckets, which are only washed when the calf pair is changed
- Weaning at 2 months, calves and heifers are not weighed

FROM THE FARMERS' PERSPECTIVE:

- Overall satisfaction with this system, which allows for enhanced social behaviour and improved growth due to intake stimulation between calves (motivation to drink)
- Overall, no recurring health problems are noted in the herd. The main health issue seen in calves is respiratory. Good quality colostrum (Brix reading average of 23.1%) and large volumes of colostrum (4-5 litres in the first 24 hours) allow the young calves to have good immunity. The veterinarian's monthly visits (health checks, AI and reproductive monitoring) allow for good preventative care.
- Main issue: risk of cross sucking. When this happens, the calves can be separated and then re-paired (preferred to placing a nose flap, although this still remains an option)
- Farmers' advice: keep a close eye on the calves when drinking, and focus on good management of the drying off and colostrum periods.

ON AN ORGANIC DAIRY FARM, A MIXED SYSTEM OF CALVES HOUSED IN PAIRS AND FOSTERED CALVES (CALVADOS REGION, FRANCE)

WHY THIS CHOICE?

To meet organic label specifications which do not allow for calves to be housed individually.

CALF REARING SYSTEM

- Organic farm since 2017.
- 130 dairy cows, 3-way crossbreeds of Prim'Holstein / Jersey / Red.
- Milk production: 5500-6000 litres over 305 days.
- 130 births/year in 2 calving blocks (February and August). Sexed semen used on cows whose female offspring are to be kept. These female calves will be reared by a foster cow. AI with Belgian Blue semen used on cows whose offspring will not be kept.
- These calves (male or female) are housed in pairs until they are sold.
- Large workforce (6 people).

HOUSING

- The calf enclosures are located in an outbuilding *(Figure 13)* to respect the organic label requirement of buildings having 3 open sides.
- 7 hutches (branded La Gée) for 2 calves (D = 1.6 m, W = 0.9 m, H = 1.35 m) with outdoor space (area: 2.04 m^2) on concrete flooring *(Figure 14)*.
- Bedding is refreshed daily, and a full cleanout and systematic disinfection are performed between 2 pairs of calves.
- If space is needed, the calves are moved to a group pen of 6 calves, measuring 9 m^2.
- Replacement heifers are reared under unmilked foster cows (docile cull cows) *(Figure 15)* in their calving pen for the adaptation phase (7-10 days), then moved to a collective pen (7 foster cows and 14 calves) with pasture access (3 rotating plots).

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Figure 13a
Enclosures in the outbuilding
Figure 13b

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SETTING UP
pair housing (cont.)

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Figure 14 :
Pens used for the housing of two crossbred calves

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Figure 15
Foster cow with 2 female calves in the adoption pen, before transfer to the collective foster pen

MANAGEMENT OF THE PAIRED CALVES:

Thanks to block calving (75 births in 2.5 months for the winter period), calves are often born less than 24 hours apart.

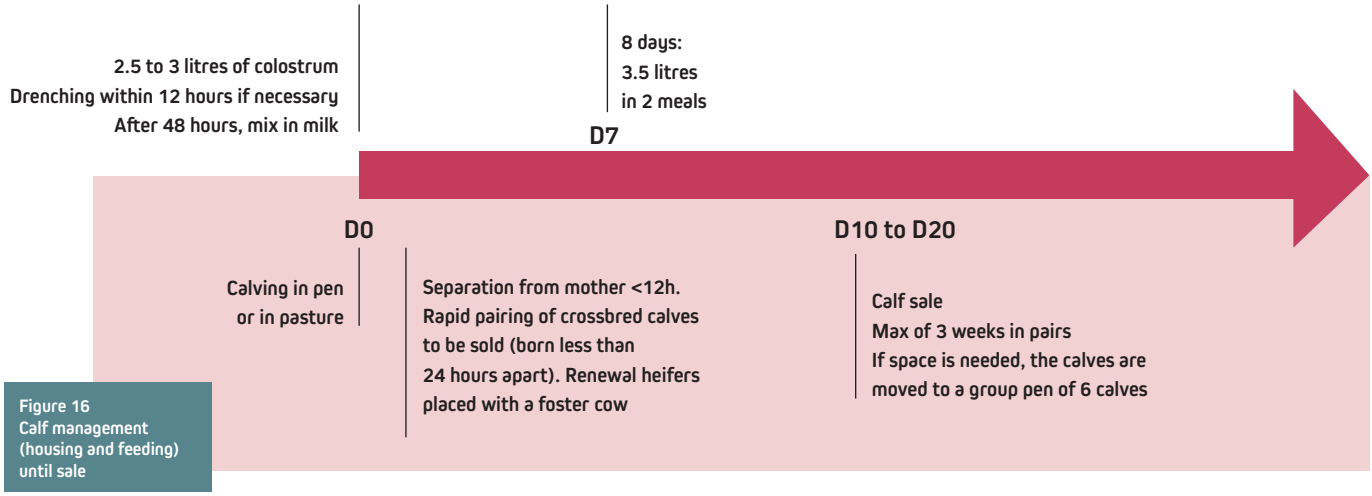

Figure 16
Calf management (housing and feeding) until sale

FEEDING (FIGURE 16):

- The quality of the colostrum is checked visually (colour) as a matter of routine, or with a colostrometer if in doubt. Good quality colostrum is frozen.
- Teat buckets are systematically washed and dried / turned over between two feeds. Younger calves are given teats that are not new, as they are softer.
- The solid feed provided has 20% protein (40% alfalfa, 40% mix of triticale, faba bean and pea).

FROM THE FARMERS' PERSPECTIVE:

- Overall satisfied with this system, which allows the farm to comply with organic label requirements.
- The 2 critical success factors they have identified are hygiene conditions and good calf matching.
- The outdoor hutches save space in the nursery whilst limiting health problems.
- Block calving streamlines the work, allows for a sanitary rest period of the premises, and enables the calves to reach a higher value.

CONCLUSION/PERSPECTIVES

By and large, public opinion is not in favour of the individual housing of calves [43]. This has prompted the dairy industry to encourage farmers to house calves in groups, which is why pair housing has become an interesting alternative. Pilot trials on farms pioneering this approach, or on farms having always kept calves in groups, have demonstrated that this practice can be applicable and beneficial to calf welfare as well as herd performance.

Moving calves into groups (of two or more) should be done in a considered manner and with the following precautions:

- Careful sanitary management (healthy calves, effective transfer of passive immunity, strict hygiene of the premises and of feeding practices)
- Creating homogeneous pairs and ensuring that calf management (milk distribution, feed volume, and environment enrichment if necessary) allows for harmonious behavioural development and mitigates the risk of competition or cross sucking

In addition to pair rearing, other alternatives to individual housing are possible, in particular:

- housing in larger groups (collective pens): this consists of grouping 3 or more calves in shared enclosures from birth
- group housing of calves with foster cows: two to three calves are adopted by one cow in the herd until weaning
- keeping the calf with its mother: this consists of raising the calf with its mother until weaning while maintaining (reduced) milk production through milking

Farmers wishing to stop housing their calves individually can choose the system that best suits their expectations, their current management and their herd.

TO LEARN MORE

ABOUT THE DIFFERENT GROUP HOUSING OPTIONS FOR CALVES, THEIR ADVANTAGES AND DISADVANTAGES, AND TO ACCESS TECHNICAL ARTICLES:

- Chambers of Agriculture of Brittany. Foster Cows. 2021.
Available in French at: http://www.chambres-agriculture-bretagne.fr/synagri/les-vaches-nourrices (Accessed on 12 August 2021).

- Chambers of Agriculture of Brittany and Terra.
Project: Fostered calf rearing: a system to discover. 2020.
Available in French at https://opera-connaissances.chambres-agriculture.fr/doc_num.php?explnum_id=160816

- VOLAME INRAE/Oniris project (INRAE Marcenac and Mirecourt farms and network of farms) Rethinking dairy calf rearing to re-establish the mother-calf bond.
Webinar on 19 October 2021 (2h).
Available in French at https://www.youtube.com/watch?v=ErFTEYQd2LE

- FIBL, Demeter and Bio Suisse.
Technical guide on mother-bonded and fostered calf rearing in dairy farming. 2020.
ISBN :PDF978-3-03736-144-3.
- Available in French at https://www.fibl.org/en/info-centre/news/technical-guide-on-mother-bonded-and-fostered-calf-rearing-in-dairy-farming.

ACKNOWLEDGEMENTS

The publication of this guide is part of Danone's Animal Welfare programme, coordinated by IDELE, to which the Danone Ecosystem Fund contributes by providing its support and expertise for the creation of an inclusive and sustainable agricultural model.

This guide was created as a continuation of the monitoring of pilot farms studying calf housing in pairs, thanks to the participation of JUNIA, welfare advisor MSD, health and zootechnical advisor and Phylum, coordinator of the approach.

The authors would like to thank those who contributed to this guide.

M Marie, M Le Gal, Mr and Miss Bachelet, dairy farmers, and Quentin Blond, veterinarian, for welcoming the authors, explaining their calf management system, providing access to data and information and agreeing for them to be shared in this paper.

Cyrielle Corbier, veterinarian, in charge of welfare issues at Littoral Normand, for her proofreading of this document and her help in collecting information.

Rémi Coulon, health and building expert at MSD and Céline Cotrel, veterinary expert on neonatal issues, for their support of the veterinarians and farmers of the "paired calves" pilot farms.

Lucille Bellegarde from CIWF, Valérie David and Béatrice Mounaix from IDELE for their careful review of this document.

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