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Needs and welfare of housed calves

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Summary

The concept of welfare is introduced and basic biological functions are described in relation to the needs of calves. These form mechanisms that have evolved in the species and persist in domestic cattle today. Indicators of poor welfare in calves are reviewed. Current systems for rearing calves in crates result in poor welfare but welfare is much better in a well managed group-housing system. Public attitudes are starting to affect the veal industry considerably and a solution to the problem involving a change to group-housing systems with a diet including adequate roughage and iron is necessary if the industry is to survive.
Descriptors: welfare; needs; behaviour; physiology; calf rearing.

Welfare

Animals encounter a variety of difficulties during their lives and they use physiological and behavioral methods to try to cope with these. The extent to which coping methods, such as adrenal activity, are used can be measured, as can the consequences of failure to cope, for example reduced ability to grow or reproduce. The welfare of an individual is its state as regards its attempts to cope with its environment (Broom, 1986). Welfare can vary from very poor to very good, and can be measured. Measurements relevant to the assessment of welfare include those of injury level, disease incidence, pain responses, consequences of lack of control, especially frustration, and the effects of fear.

Situations or human actions that lead to poor calf welfare are direct abuse; neglect which is deliberate, accidental or due to lack of knowledge; provision of inadequate conditions during housing, transport or marketing; disease; failure to provide for emergencies and improper procedures during and before slaughter. Direct abuse includes hitting or frightening the animal and carrying out surgical operations. Neglect might involve failure to feed or clean out adequately, to treat if diseased, or to care for if injured, disturbed or likely to be harmed in some way. Emergencies which could arise on any animal unit are fire, power failure or extreme weather conditions. Welfare can be very poor in these emergency situations and provision should be made for early warning, back-up power supplies, preventing the freezing of water supplies, providing ventilation or showers in very hot conditions, fire prevention, firefighting, and rapid evacuation of all animals in case of fire. The welfare of most diseased animals is poor, sometimes very poor, so disease prevention, without general exacerbation of disease problems by too widespread a use of antibiotics, is desirable. Procedures that minimize pathogen contact with the calves and the treatment of diseased individuals is the best strategy here. Conditions and procedures when animals are handled, transported, marketed and slaughtered can often lead to very poor welfare but the topic that will be discussed in most detail in this paper is the housing and associated management of calves.

The factors affecting welfare outlined above fall into three somewhat overlapping categories in terms of human responsibility. The design of the housing and management system is largely the responsibility of the owner of the unit and the site manager. These people have a substantial affect on the welfare of large numbers of individual animals. The men and women who care directly for the animals in that they feed them, clean up after them, check them to see if they have problems, handle them for treatment or movement to another place, and load

them onto vehicles, have a very important effect on animal welfare. Contributions are also made by specialists such as veterinary surgeons, vehicle drivers and abattoir staff. None of these alone can insure that welfare is good. Each has a moral obligation towards the animals.

Needs

A need is a deficiency in an animal that can be remedied by obtaining a particular resource or responding to a particular environmental or bodily stimulus. Needs are dictated by the basic biology of the animal, for they relate to its various functional systems. Farm animals, including calves, have an array of needs similar to those of their wild ancestors. The mechanisms which evolved within the species are still present in our domestic animals although some responses, such as those associated with flight from man, are reduced. Various functions are described below with explanation of the need and what the animal must do in order to satisfy them.

1. In order to obtain adequate nutrients and to reduce disease incidence, the young calf must ingest and digest, first colostrum and then milk. The biological mechanisms that have evolved in order to achieve this are searching behaviour which should result in finding a teat and then the licking and sucking of a teatlike object. The behaviour of the calf is not just organized so that all such behaviour is terminated if the gut is filled with milk but the licking and sucking behaviour itself is of great importance to the calf. The calf needs both to rectify any nutrient or energy deficiency and to suck on a teat or teatlike object.
2. The functions of recuperation and avoiding danger during the time of day when feeding is less efficient in range conditions are served by resting and sleeping. Adequate rest and sleep require that the calf adopts a sleeping posture on a suitable surface for a period during which there is not too much disturbance.
3. The avoidance of danger also requires that animals explore their surroundings so as to find out about sources of danger, and to hide or show escape responses if necessary. Exploration is also of value in the efficient exploitation of resources. The need to explore exists for all animals whilst those to hide or to escape exist if the calf perceives that there is some danger. Man is often treated as a dangerous predator by young calves and many events in the life of a young calf elicit attempts to hide or escape.
4. In order that bone and muscle can develop normally, and that injury can be avoided, the calf needs to take sufficient exercise and to move or adopt postures that do not cause discomfort. If bones are not loaded by muscle action and body movement then osteopenia will develop. A small amount of exercise at frequent intervals may be sufficient to insure normal bone development. Extreme inactivity causes abnormal muscle development and may also cause joint problems. The biological mechanism to prevent or remedy these problems is for animals to want to take regular exercise and to avoid discomfort such as that which results from difficulty in making certain movements.
5. Important aspects of gut development in calves are the changes in the rumen etc., which result in efficient utilization of grass and other fibrous plants that are the staple food of cattle. Hence the calf needs to eat roughage and to ruminate. It has a very strong preference to eat fibrous material and to attempt to ruminate, even if no roughage has been ingested. Any inadequacies of nutrients, including iron, also make calves want to eat a variety of materials that might supply the missing nutrient.
6. Disease and parasitism levels are minimized by keeping the body clean. Grooming also helps in thermoregulation and other functions. Hence animals need to respond to stimuli which indicate that grooming is necessary, principally by licking themselves. These stimuli emanate from the whole body and if an animal initiates a grooming sequence, the whole body has to be groomed if it is to be satisfied with what it has done. Hence inability to groom the hind part of the body causes problems.

7. Cattle are social animals, and ability to deal with social situations is important and demanding to them. In order to develop social ability, each calf needs to approach and interact with other calves.

Whilst a general study of the biology of calves tells us that each of these needs is of importance to the animals, measurements of behaviour and physiology give more information about how important they are. In some cases, frequent and vigorous behaviour or attempted behaviour, such as sucking or grooming, indicates the strength of the need. It may be impossible for calves in certain farm conditions to show some kinds of behaviour because of the restrictions placed upon them by those conditions. Hence it is necessary for as wide as possible a range of signs of poor welfare, for example abnormalities of behaviour or physiology, to be used to recognize the importance of the need.

Indicators of poor welfare in relation to rearing conditions

High disease incidence

Calves are particularly susceptible to respiratory and gastro-intestinal disease. Van Putten (1987) quotes data from Postema showing that 67% of batches of veal calves in the Netherlands required treatment for respiratory disease by 10 weeks and 20% had enteric disorders after one week in a veal-production unit. Similarly, van der Mei (1987) found that 25% of veal calves had respiratory disease and 14–18% had severe diarrhoea before 10 weeks of age, the higher level referring to group-housed calves. Webster (1984) reported less disease in group-housed calves and it seems likely that disease might be lower in well managed group housing than in crates but higher in less well managed grouphousing. It is clear, however, that in both crate housing and group housing, these high incidences of disease in veal calves are a particularly serious welfare problem. Calves purchased and brought into a unit are five times more likely to require treatment for disease (Webster, 1984), so this is an important cause of the problem.

With the exception of a few suckler calves, veal calves are separated from their mothers at a very early age. This separation causes some problems for the calf and inevitably makes it rather more difficult for the farmer to keep it healthy. Calves left with their mothers stand earlier and are more active than those which are separated (le Neindre & Signoret, 1987). The reduced vigour and lack of interest in their environment shown by some calves after separation can result in failure to obtain adequate immunoglobulin and nutrients. Even if some time is spent with the mother, a variety of factors affect the likelihood that sufficient colostrum will be ingested and immunoglobulin absorbed from it (Broom, 1983). Much greater disease problems arise when young calves are transported, sometimes via a market, to another farm so that they encounter new pathogen challenges and often a new diet.

Stereotypies

Tongue-rolling or tongue-playing and other 'purposeless oral behaviour' (Webster et al., 1985) is abnormal behaviour that is not shown by calves that can cope well with their environment. These are examples of stereotypies, repeated relatively invariate sequences of movements that have no obvious purpose (Fraser & Broom, 1990), and just as in man, zoo animals or sows, stereotypies are indicators of poor welfare. Tongue-rolling is much more frequent amongst crate-reared calves than amongst those reared in groups (Andreae et al., 1980; Webster et al., 1985; Wierenga, 1987). There is individual variation in its occurrence but there is always much variation in the methods used for trying to cope with inadequate rearing conditions (Broom, 1986; 1988). A reduction in the occurrence of stereotyped licking, manipulation etc.

occurs when straw is provided (van Putten & Elshof, 1978; Webster, 1984) and higher levels are observed at low light level of 2 lux than at 20, 100 or 130 lux (Dannemann et al., 1984).

Table 1. Oral behaviour of calves at two weeks of age (%).

	Suckler calves	Crate-housed	Group-housed
Purposeless oral activity	1	14	3
Grooming	6	15	6
Ruminating	8	2	5

Table 2. Calf behaviour when fed from bucket or teat (after Hammell et al., 1988).

	Bucket	Teat
Duration of drinking (min)	18	44
Time sucking dummy teat (min)	13	1
Drinking interrupted by sucking dummy teat	yes	no

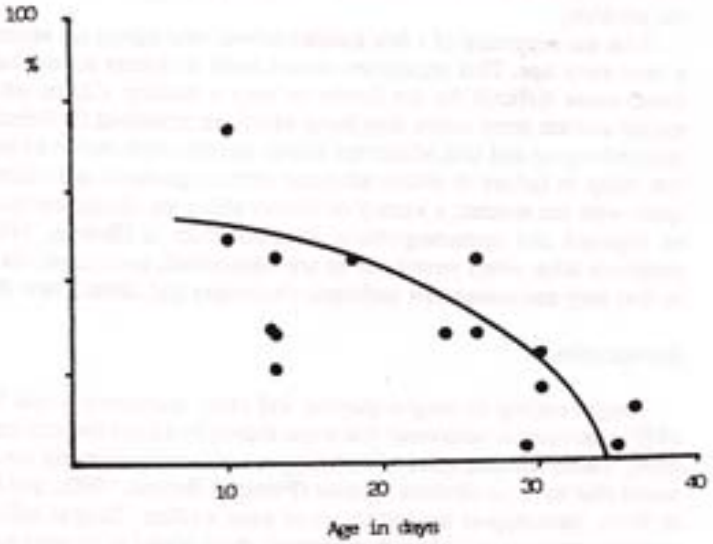

Figure 1. Percentage of time sucking or licking a novel non-nutritive teat or another calf during 10 min after drinking milk from a bucket (Broom & van Praag, in prep.).

Sucking and licking

Some sucking and licking is stereotyped but other behaviour of this kind, although too variable in form to be called a stereotypy, has a high enough frequency or duration to be abnormal. Data from Webster et al. (1985) is shown in Table 1. Similarly, Ketelaar-de Lauwere & Smits (1989) reported such oral activities for 20–30% of the time in crates ranging in size from 70 cm × 150 cm to 170 cm × 250 cm. It would seem from this result that absence of suitable stimuli for normal sucking, lack of social contact or inadequate diet are likely to be more important than lack of space in causing this behaviour.

Non-nutritive sucking is likely to arise in the first place if the calf's need to suck is not satisfied during feeding. Its occurrence depends upon what is available for the animal to suck. Calves may want very much to suck but have no object present so they may increase licking behaviour or show other signs of poor welfare. If in groups, calves that wish to suck may suck the penis, navel or ears of other calves and in doing so may cause problems to themselves by drinking urine, or to other calves by causing soreness. Individually housed calves that can reach one another may suck another calf and 'kissing' pairs are frequent in occurrence. The sucking of the pen or of other calves occurs most just after feeding and is much more frequent if the calf is fed from a bucket than if it is fed from a teat.

When a non-nutritive teat is provided in a calf's pen, the calves spend much time sucking it, especially after feeding (Waterhouse, 1978; Broom, 1982). Such sucking is reduced if milk is supplied more frequently (Metz, 1984). It is more prolonged and may interrupt drinking when milk is drunk from a bucket (Hammell et al., 1988; Table 2). In an experiment in which a novel non-nutritive teat was presented to individually housed calves at different ages, calves more than 30 days of age did not suck it within two minutes of finishing drinking from a bucket (Broom & van Praag, in prep.). Figure 1 shows the decline in interest in the novel non-nutritive teat with age. The desire of calves to suck a teat declines with age but animals which associate feeding with teat-sucking will continue sucking to a later age.

Excessive self-licking occurs frequently in crate-housed calves and results in ingestion of hair and formation of hair balls or bezoars. It could be that inability to groom the hind part of the body increases the desire to groom those parts of the body that can be reached. Self-licking was reduced by feeding 75g of straw per day and numbers of hair balls dropped from means of fifteen to less than one (van Putten & Elshof, 1978). In the same study, sham rumination occurred in crate-housed milk-fed calves for two hours per day. Provision of straw allowed normal rumination in that study and in that by Webster et al. (1985).

Adrenal and other physiological indicators

In a study of 8-week-old Friesian calves, Dantzer et al. (1983) assessed previous adrenal activity by means of challenge with adrenocorticotrophic hormone (ACTH). Tethered calves showed a significantly greater cortisol response to ACTH challenge than did group-housed calves, suggesting that the tethered calves had used their emergency adrenal cortex response more often during the rearing period. A similar result was obtained by Friend et al. (1985a), who also found significantly higher basal cortisol levels, thyroid hormone levels and neutrophil/lymphocyte ratios in tethered or individually housed calves than in group-housed calves (Table 3).

Response to disturbing stimuli

Calves are much more severely affected by contact with man if they have had little previous human contact. Frequent gentle contact is desirable for calves. Excessive fearfulness occurs when calves are kept in poorly lit buildings (Webster & Saville, 1981). The responses of calves to handling and transport are substantially greater if they have been kept in crates than if they

Table 3. Physiological 6-week-old calves after different housing. Data from Friend et al. (1985a).

Physiological indicator	Tether-stall 0.56 m × 1.2 m	Individual pen 1.2 m × 1.5 m	Group-housed
Tri-iodothyronine (ng dl^{-1})	106	78	58
Thyroxine (µg ml^{-1})	6.0	5.0	4.3
Basal cortisol (ng ml^{-1})	5.4	4.2	3.4
Cortisol after ACTH challenge (ng ml^{-1})	103	98	75
Neutrophil/lymphocyte ratio	0.69	0.37	0.36

have been kept in groups (Trunkfield et al., this book). So it would appear that crate-reared calves are less well able to cope with difficulties such as those presented by those procedures.

Difficulties of posture and locomotion

The postures adopted by most resting calves with no space restriction cannot be adopted by a calf in a narrow crate (de Wilt, 1985). The most preferred head position is difficult to adopt and hind-leg extension cannot occur. This study, and a subsequent detailed investigation by Ketelaar-de Lauwere & Smits (1989) has shown that calves try very hard to adopt postures that are comfortable and that result in good thermoregulation, particularly in hot conditions. Hind-leg stretching occurs for 2–8% of the time and the common lying posture in crates with one leg extended along the body does not occur if more space is available. Behaviours like leg stretching that are infrequent may still be of great importance to an individual. An example of another behaviour that is infrequent but important is defaecation. The minimum width that allowed comfortable lying for calves was found to be 90 cm. A further problem reported in small crates was that calves had difficulties standing up and lying down. Calves choose to walk at intervals if they are able to and crate-housed calves show much locomotor behaviour when released from the crate (Warnick et al., 1977; Friend et al., 1985b). After six months in a crate, many calves have severe locomotory problems (Trunkfield et al., this book).

Social and maternal inadequacy

Calves reared in isolation performed badly in competition with group-reared calves when mixed after 6–8 weeks (Warnick et al., 1977), 12 weeks (Waterhouse, 1979), and 6 months (Broom & Leaver, 1978). Some elements of social interaction are still shown after isolation but signals such as ear movements are abnormal and ability to compete effectively within a mixed herd is clearly impaired (Broom, 1982); the effects of isolation for 6 months were still apparent one year later. Some signs of maternal inadequacy were evident in calves reared in isolation for six months (Broom & Leaver, 1977) although le Neindre (pers. comm.) was not able to see impairment of maternal behaviour after shorter periods of isolation. Although crate-reared veal calves do not encounter other calves except for the period before slaughter, it is clear that their normal social development is impaired substantially by isolation. Waterhouse (1979) found that effects on social ability were much greater if the calves were in visual isolation than if they could see and touch other calves through a hurdle partition (also Broom, 1982). Calves in 'enriched' pens with independently moving objects in them were more normal in their social behaviour.

Group-housed calves show little competitive behaviour that might be considered harmful. There can be uneven growth rates but these problems can be solved by better provision of

food. Social facilitation aids weaker calves in group-housing as long as there are enough feeding places. Where milk was provided from teats to calves 0–5 weeks old, good results were obtained by putting five milk-supplying teats in a row 20 cm apart (Barton, 1983; Barton & Broom, 1985). Group-housed calves also learn readily to drink from responder-controlled feeders (Maatje, this book).

Injuries and anaemia

These topics are covered by Webster and others in this volume. Anaemia results in poor welfare. Severe ulceration does so too but there are doubts about the effects of small ulcers, which are frequent after feeding on milk and straw (Welchman & Baust, 1987). There may be links between behavioral responses to difficult conditions and abomasal ulceration (Wiepkema, 1985). Claw problems can be bad on inadequate or poorly drained floors and tail-tip necrosis can be very high on slats.

Conclusions

It is clear that the crate used for veal calf production does not meet the needs of the calves and results in a wide range of indicators of poor welfare in calves.

What change is necessary in order that the welfare of calves will be good? If the crate were larger, for example 90–120 cm wide, some of the problems would be solved. The calf would be able to turn round, stretch and adopt more comfortable lying postures. However it would still be unable to exercise normally by walking, interact socially, chew solid food, ruminate, carry out investigatory behaviour or respond appropriately if frightened. Hence calves housed individually in larger solid-sided pens still show clear signs of poor welfare. If the solid walls of individual crates are replaced by open sides, the environment of the calf is considerably improved because some social interaction can occur and the calf can move in a little more space. However social behaviour is still very much limited by the crate and the other deficiences listed above are not removed. The change that results in the removal of these deficiences is to keep the calves in a group in a larger pen.

A major problem in the veal industry is the demand for 'white' meat. The indications from a wide range of studies are that the diet composition which is necessary to produce 'white' veal will always cause some severe welfare problems. In order to avoid clinical anaemia in all the calves and to provide roughage that the calves can manipulate, chew and ruminate on, the meat must become a little pinker on average. Such an improved diet for veal calves should be cheaper, should result in better feed conversion and should lead to lower disease levels. With improved diet, including adequate roughage and iron, and a group-housing system with measures taken to minimize intersucking, veal can be produced humanely. Disease levels in group housing can be high but this does not occur in good group-housing systems, which have good care by stock persons, a good diet and usually materials such as straw for calves to manipulate and chew. Fully slatted floors are less likely to work well and disease is more often a problem in such systems, especially where adequate iron and roughage are not provided in the food. Individual crates that have open sides for social contact and that are large enough for calf comfort (more than 90 cm wide) are certainly better for calves than normal crates but are not as good as full group housing and it may well be cheaper to use a group-housing system.

The veal industry has to take note of the fact that veal consumption is dropping rapidly, even in countries like Italy where there is a strong tradition for veal dishes. The public perception of the poor welfare of the veal calf is a major factor in the accelerating decline in veal consumption. There is no reason, however, why this decline should not be stopped and reversed if changes in diet and housing result in improved welfare and the public is informed of this. There is a tendency for the public to associate white veal with poor welfare so a new improved

image of veal could include some change in colour together with explanation from the industry that new veal comes from better fed calves whose welfare is better because they live in groups and because their other biological needs are also met.

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