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**Horns in cattle –
implications of keeping horned cattle or not**



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Summary

Dehorning is a frequently applied procedure that eases the management of cattle, but is also critical in terms of animal welfare as it violates the integrity of the animals and causes stress and pain.

The literature review in chapter 2 discusses different common disbudding and dehorning methods including the use of drugs during the procedure and its benefits for stress- and pain alleviation. It also outlines arguments for and against dehorning/disbudding. These relate mainly to human safety, animal welfare, ethics, economics, cultural aspects and product quality. It further summarises information on the significance of horns for the behaviour and physiology of cattle. In terms of the development of alternatives to dehorning it provides an overview over the state of knowledge concerning requirements for the successful keeping of fully horned cattle.

The quantitative survey in chapter 3, conducted as an internet based questionnaire, estimates to which extent horned and dehorned cattle are actually kept in Germany, what methods of disbudding or dehorning are used and which medications for pain alleviation are applied in practise. From the 226 dairy farmers answering to the internet based questionnaire, 90 % kept their cows without horns. Reasons given were a lower risk for the stockperson's on the jobs safety (92 %), fewer injuries amongst the cows (91 %) and an easier handling of the cattle (86 %). Most farmers used to disbud the calves below the age of 6 weeks with hot iron (88 %) or caustic paste (4 %), conducting the procedure themselves (88 %). The only medical treatment effectively inhibiting the pain of hot iron disbudding (local anaesthesia & analgesia) was reported to be used in 0.7 % of all cases. Sedation alone was used by 49 %, and local anaesthesia with or without sedation by 6 % of disbudders.

Qualitative information about motivations, habits and conditions influencing the decision for or against dehorning are provided in chapter 4 based on three focus group discussions in three different regions of Germany, targeting three different common practices of managing cattle: participants of one focus group mainly kept horned dairy cows, of another practised disbudding in dairy calves and of the third kept polled suckler cattle. The majority of farmers keeping horned cows stated that it requires more caution to handle the animals. The main motivations mentioned to keep the horns were avoiding the pain of disbudding, that horns belong to the nature of cattle

and they therefore need them for different reasons. Whereas participants of the group keeping horned cows could not see any higher risk for stockman's safety while working with horned animals, this point was stated in the first place from the groups practicing disbudding or keeping polled cattle. One major reason for breeding for polledness was to save the work of disbudding. For farmers practising disbudding, the procedure itself was regarded as routine not worthy of discussion.

To amend the existing recommendations for farmers willing to keep horned cattle, chapters 5 and 6 deal with selected questions, how to minimize stress and agonistic interactions in horned cattle. Firstly, it was examined to what extent different space allowances (4 m²/2.5 m²/1.7 m² per cow) in the waiting area before the milking parlour influence heart rate and the occurrence of agonistic interactions in horned cows. It was found that the different space allowances had a significant influence on heart rate ($p = 0.000$, $F = 9.74$) and the number of pushes every focal cow received ($p = 0.002$, $F = 7.72$) during the waiting period. The medium size waiting area (2.5 m²/cow) altogether provoked the lowest stress reaction.

In the second study it was evaluated whether different amounts of pasture access (0, 4 or 8 hours) affect heart rate, heart rate variability, lying behaviour and the number of agonistic interactions during or after feeding in the stable. Cows had significantly lower heart rates ($p = 0.000$, $F = 9.37$) with 8 hours pasture access compared to 4 and 0 hour pasture access and a significantly higher heart rate variability with 4 hours pasture access than with no pasture access ($p = 0.035$, $F = 3.66$). With 4 and 8 hours pasture access compared to no pasture access, the cows lied down significantly quicker after afternoon feeding ($p = 0.000$, $F = 24.95$), had significantly longer evening lying times during the 2 h observation period ($p = 0.000$, $F = 30.15$) and showed significantly less agonistic interaction during morning feeding ($p = 0.000$, $F = 23.72$). The measured data hint that the cows were more relaxed in the stable when they had time limited access to pasture.

Results of the two studies show exemplarily that improved housing and management taking into account species-specific needs can help to minimize stress and risks for horn inflicted injuries in horned dairy cows in loose housing. This underlines statements of the interviewed farmers keeping horned cattle that good welfare in horned herds is possible when sufficient caution is put to the management and handling of the animals.

Nevertheless most farmers practising disbudding could not see any reason to change their practice. Since the application of effective anaesthesia and analgesia is not common, about 99% of the disbudded calves suffer considerable stress and pain during the procedure, which, however, is mostly not perceived as such by the farmers. Regarding the potential costs of appropriate medication, it is questionable, if more information about animals' pain alone will change the practice of the farmers.

Zusammenfassung

Enthornung ist eine häufig angewendete Maßnahme zur Erleichterung des Managements bei Rindern. Aus Tierschutzsicht ist die jedoch kritisch zu betrachten, da sie die Integrität des Tieres verletzt und die Prozedur an sich auch mit erheblichen Schmerzen für das Tier verbunden ist.

Die Literaturübersicht in Kapitel 2 stellt verschiedene Enthornungsmethoden und Möglichkeiten der Schmerzbehandlung vor und diskutiert Argumente, die für und gegen die Enthornung sprechen. Diese beziehen sich vor allem auf die Aspekte Arbeitssicherheit, Tierschutz, Ethik, Tradition, Wirtschaftlichkeit der Tierhaltung sowie Produktqualität. Weiterhin wird die Bedeutung der Hörner für das Verhalten und die Physiologie von Rindern besprochen. In Bezug auf die Entwicklung von Alternativen zur Enthornung wird ein Überblick über den Stand des Wissens zu den Anforderungen an eine erfolgreiche Haltung von behornten Rindern gegeben.

Die quantitative Untersuchung in Kapitel 3, die als Internetumfrage durchgeführt wurde, soll abschätzen zu welchem Prozentsatz enthornte und behornnte Rinder in Deutschland gehalten werden, mit welchen Methoden sie enthornt werden und welche Schmerzbehandlungen dabei durchgeführt werden. Von den 226 Milchbauern, die geantwortet haben, enthornten 90% ihre Kälber. Die angegebenen Gründe waren Arbeitssicherheit (92%), Vermeidung von Verletzungen unter den Tieren (91%) und ein einfacherer Umgang mit den Tieren. Meist wurden die Kälber im Alter von unter 6 Wochen mit dem Brennstab (88%) oder Ätztift (4%) enthornt. Die einzige Medikation, die effektiv die Schmerzen der Enthornung mindert (Lokalanästhesie kombiniert mit einem Analgetikum) wurde in 0,7 % von allen Enthornungen bei Jungtieren angewendet. Sedation wurde in 49% und Lokalanästhesie mit oder ohne Sedation in 6% der Enthornungen bei Jungtieren angewendet.

Die qualitative Erhebung (Kapitel 4) zu den Gründen, Gewohnheiten und Umständen, die die Entscheidung für oder gegen eine Enthornung beeinflussen, basiert auf drei Fokusgruppendifkussionen, die in drei verschiedenen Regionen Deutschland durchgeführt wurden. Die erste Gruppe (Allgäu) bestand aus Milchbauern, die größtenteils behornnte Tiere hielten, die zweite Gruppe (Sachsen) aus Mutterkuhhaltern, die alle zumindest teilweise genetisch hornlose Bestände hatten (und enthornten). Die dritte Gruppe (Nordrhein-Westfalen, „NRW“) repräsentierte Milchbauern, die ihre Kälber enthornten. Die meisten Landwirte, die behornnte Tiere hielten waren überzeugt, dass die Herde mit größerer Vorsicht geführt werden muss, als eine enthornte Herde. Ein Hauptgrund für den Verzicht auf die Enthornung war die Ansicht, dass die Hörner zur Kuh gehören und sie diese auch aus den verschiedensten Gründen (siehe Kapitel 2) braucht. Weiterhin wurde auch berichtet, dass es für diese Landwirte eine Erleichterung darstellte, die „verhasste“ Arbeit des Enthornens zu vermeiden. Während die Bauern, die behornnte Tiere hielten mehrheitlich keine erhöhte Gefahr für ihre eigene Arbeitssicherheit sahen, wurde dieser Punkt von Landwirten, die enthornten oder genetisch hornlose Tiere hielten an erster Stelle genannt. Für die Mutterkuhhalter (Gruppe Sachsen) war ein Hauptaspekt für den Einsatz hornloser Genetik die Einsparung des Arbeitsgangs „Enthornung“, welcher für die Milchbauern der Gruppe NRW kein großes Problem darstellte, da sie die Kälber immer am Stall für anstehende Arbeiten verfügbar hatten. Deshalb sahen Letztere die Enthornung auch als unproblematische Routine, die keinerlei Diskussion wert wäre.

Um die existierenden Empfehlungen für die Haltung behornnter Milchkühe zu ergänzen, wurden in zwei ausgewählten Fragen untersucht, wie Stress und Auseinandersetzungen unter behornnten Rindern in Laufstallhaltung minimiert werden können (Kapitel 5 und 6). Die erste Frage (Kapitel 5) beschäftigte sich mit der Auswirkung des Platzangebots ($4\text{m}^2/\text{Kuh}$, $2,5\text{ m}^2/\text{Kuh}$ und $1,7\text{m}^2/\text{Kuh}$) im Vorwartebereich auf die Herzfrequenzen und die Auseinandersetzungshäufigkeit von eher rangniedereren und eher ranghohen horntragenden Milchkühen. Es zeigte sich, dass das Platzangebot die Herzfrequenzen unabhängig vom Rangstatus signifikant beeinflusste ($p = 0,000$; $F = 9,74$). Bei $1,7\text{ m}^2/\text{Kuh}$ wurden die signifikant höchsten Herzfrequenzen gemessen und auch die Anzahl der Hornstöße, die eine Kuh während der Wartezeit erhielt ($p = 0,002$; $F = 7,72$) erhöhte sich bei geringstem Platzangebot

(1,7m²) signifikant. Weniger Stressreaktionen wurden bei 2,5m² pro Kuh und 4,0m²/Kuh festgestellt.

Die zweite Studie (Kapitel 6) behandelte die Frage, ob verschieden lange Weidezeit pro Tag (kein Weidegang, 4 Stunden und 8 Stunden Weidegang) die Herzfrequenz, die Herzratenvariabilität, das Liegeverhalten und das Auftreten von agonistischem Verhalten im Laufstall beeinflusst. Es zeigte sich, dass die Kühe mit 8 Stunden Weidegang im Stall signifikant niedrigere Herzfrequenz ($p = 0,000$; $F = 9,37$) im Vergleich zu 4 Stunden oder gar keinem Weidegang hatten. Bei 4 Stunden Weidegang zeigte sich eine signifikant erhöhte Herzratenvariabilität im Vergleich zu ausschließlicher Stallhaltung ($p = 0,035$; $F = 3,66$). Sowohl bei 4 als auch bei 8 Stunden Weidezugang pro Tag im Vergleich zur Stallhaltungsperiode legten sich die Kühe nach der Abendfütterung signifikant schneller ab ($p = 0,000$; $F = 24,95$), lagen innerhalb der zweistündigen Beobachtungsphase signifikant längere Zeit ($p = 0,000$; $F = 30,15$) und zeigten weniger Auseinandersetzungen bei der Morgenfütterung ($p = 0,000$; $F = 23,72$). Die gemessenen Parameter weisen darauf hin, dass die Kühe an Tagen mit zeitlich begrenztem Weidegang auch während des Stallaufenthaltes entspannter waren.

Die Ergebnisse der beiden Studien zeigen exemplarisch, dass bestimmte Verbesserungen in Haltungseinrichtungen und Management die Stressbelastung und das Risiko für hornbedingte Verletzungen in horntragenden Herden im Laufstall senken können. Dass eine gute Tierschutzsituation auch in behornten Herden möglich ist, wenn der Stall als auch das Management und das Handling der Herde den arteigenen Bedürfnissen von Rindern angepasst ist, wurde auch von Landwirten, die horntragende Milchkühe hielten (Fokusgruppe Allgäu) bestätigt.

Nichtsdestotrotz sahen Landwirte, die die Enthornung routinemäßig durchführen keinerlei Gründe ihre Praxis zu ändern. Da die Anwendung von wirksamer Medikation (Lokalanästhesie kombiniert mit Analgetika) nicht gebräuchlich ist, finden rund 99% der Enthornungen in Deutschland unter erheblicher Schmerzbelastung der Tiere statt, welche aber von den Landwirten nicht als solche wahrgenommen wird. Besonders vor dem Hintergrund potentieller finanzieller Einbußen durch angepasste Schmerzbehandlung während und nach der Enthornung, ist es sehr fraglich, ob allein eine Aufklärung der Landwirte über die Schmerzbelastung der Tiere eine Änderung der Situation erwarten lässt.

1. General Introduction

Disbudding calves is a routine procedure in the whole EU (Cozzi et al., 2009). It is supposed to be necessary because standard space allowances in loose housings are not geared to the dimensions cows would need to perpetually keep appropriate social distances according to their dominance relationships to avoid horn inflicted skin injuries (Schneider, 2010).

Organic agriculture in contrast claims to offer housing facilities that conform to high welfare standards and routinely performed mutilations to adjust the animals to poor housing conditions are in fact unwanted (EU Regulation on Organic Agriculture, 2008).

However, as standard space allowances and housing equipment in organic agriculture are not necessarily well matched to horned cows, just keeping the horns without adapted stables and management practises, might be critical in terms of animal welfare as well, as it may lead to high levels of injuries and stress amongst the animals (Menke, 1996).

Therefore, according to the EU Regulation on Organic Agriculture (2008), dehorning is allowed with special permission in calves of appropriate age, using adequate analgesia or/and anaesthesia.

However, since only 3.2 % of all German dairy cows (AMI, 2010) are kept organically, the vast majority of the treated calves in Germany does not benefit from this standard. For calves born on conventional dairy farms, regulations stated in the German Animal Welfare Act (Tierschutzgesetz, 2006) allow dehorning without any medication until the age of 6 weeks. Regarding this, it should be motivation to highlight needs and possibilities to improve the welfare situation of the treated calves as well of horned cows not only in organic agriculture, but also on conventional farms.

Aim of this dissertation is to provide an overview over the significance of horns for cattle in general, arguments for and against dehorning/disbudding and over different common disbudding and dehorning methods including the use of drugs during the procedure and its benefits for stress- and pain alleviation as well as the state of knowledge regarding requirements for the successful keeping of horned dairy cows

(chapter 2). As no census data exists about the extent and manner of dehorning in Germany and about the attitudes of farmers to the procedure and possible alternatives, it will further give quantitative and qualitative information on common practices, attitudes and practical experiences of German farmers in relation to disbudding/dehorning, breeding for polledness and keeping of horned cattle (chapter 3 and 4). On this basis and taking into account two studies on horned dairy cows regarding agonistic interactions and cardiac response of space allowance in the waiting area of the milking parlour (chapter 5) and of amount of pasture access per day (chapter 6), it is the final ambition to discuss possible future directions in research and practice in relation to the keeping of horned cattle with a minimum risk for lesions and stress (chapter 7).

2. Literature review

2.1. The horn - development and anatomy

Horns are the pairs of hard, bonelike, permanent growths projecting from the heads of cattle. The horn itself consists of dense keratin and elongates from its base. Variations in level of nutrition of the animal are reflected in variations in rapidity of horn growth, resulting in a series of rings on the horn, which may reflect seasonal stress, notably the stress of calving in cows. The age of the animal may be estimated by counting the rings of the horns (Gottschalk et al., 1992).

The horn bud starts to form during the first two months of life. The horn is produced at the corium, the area of cells located at the junction of the horn and skin. If the horn but not the corium is removed, the horn will resume growing. In calves up to about 2 months of age, the horn bud is free-floating in the skin layer above the skull. As the calf grows older, the horn bud attaches to the skull, more precisely to the periosteum of the frontal bone overlying the frontal sinus. A small horn then starts to grow. Once the horn bud attaches to the skull, the horn core becomes a bony extension of the skull, and around the age of 7 - 8 months the hollow centre of the horn core opens directly into the frontal sinuses of the skull (Parsons and Jensen, 2006).

2.2. Significance of horns for cattle

2.2.1. Functions of horns

In cattle, both males and females of horned breeds have horns. Polledness did not occur naturally during evolution (Epstein, 1971, cited from Menke, 1996), at least all nowadays living populations of wild cattle, never subjected to human breeding efforts, are horned (Porter, 2008). Göpel (2010) hypothesises that the hornless *Archaeomeryx* living in the Eocene (about 56 to 34 million years ago) in present-day Mongolia, possessing front teeth and the small size as well as the appearance of a greater mouse deer (Colbert, 1941), is origin of the polledness of modern cattle breeds. However, as all domesticated taurine cattle descends from near eastern local wild ox (Bollongino, 2012), which was horned, polledness in cattle developed in the course of human breeding selection.

Hypotheses on the evolutionary function of horns in female ungulates were reviewed by Roberts (1996). They include that horns may provide advantages concerning predator defence or in resource competition. Estes (1991) formulated the hypothesis that male mimicry in female bovids serves the mother to protect their male offspring against the aggression of dominant males, which leads to a prolonged presence of the sons in the natal herd and home range. This is adaptive because the survival and reproductive success of male offspring and the mother's own genetic fitness are all enhanced. Additionally, for male ungulates there are indications that horns serve as honest signals of genetic quality in female choice of mating partners (Estes, 1991).

In terms of behaviour, the presence of horns will likely affect quality and quantity of social interactions as well as social relationships in a herd which will be discussed in more detail below. Additionally, horns may be used during self-grooming of body regions which were otherwise out of reach. Taschke (1995) found in mature cows observed 24 hours before dehorning that about 28 % of all self-grooming occurrences were carried out with the help of the horns. In the first 3 hours after dehorning the cows showed an “imaginary horn rubbing”, but after a short period they stopped that and repeatedly showed standing with lowered head.

Cows appear to be well aware of their horns. For example, Menke (1996) reports that horned cows can access even very narrow feeding racks without colliding by tilting

their heads. According to oral reports of some farmers some horned cows are even able to deliberately open closed feeding racks with the tips of their horns.

In terms of functions for human purposes, farmers in earlier times favoured cattle with horns over hornless cattle because they were used as draught animals and the horns served to attach the harness (Rosenberger and Robeis, 2005).

2.2.2. Relevance of horns for social behaviour within the herd

In general, literature explicitly dealing with horned animals is relatively scarce which even more applies to comparisons between horned and dehorned herds. Often, it is not even stated in social behaviour studies whether animals were horned or not. It had, therefore, to be assumed that animals were dehorned, if not stated otherwise.

In general, presence or absence of horns will affect the way of cattle fighting. During head to head pushing horns have the function of hooking the animals together, thereby allowing a pushing force contest. In hornless cattle, due to the permanent slipping of foreheads, pushing force can only be exerted by neck/shoulder and the head is frequently used for hitting (Sambraus, 1978).

Contrary to frequent expectations that horned cattle would be more aggressive than dehorned ones (Sambraus, 1978), Menke (1996) argues that due to the more aversive experience when e.g. butted by a horned cow, in fact threats without physical interaction were likely more effective and physical agonistic interactions less frequent in horned than in hornless herds. Also Graf (1974) noticed that agonistic interactions on pasture were not only more frequent, but also more often with physical contact in dehorned cows compared to horned cows. He concluded that horned animals are receiving more respect from their conspecifics than hornless. The maintenance of dominance relationships largely by threat signals and withdrawal and only seldomly by physical interactions reflects the typical situation in well established groups on pasture (Bouissou, 1972; Reinhardt et al., 1986). To which degree this is obtained under housing conditions presumably will not only depend on the presence of horns, but also on a multitude of animal related as well as housing and management related factors (see Table 2.1).

Tab. 2.1: Factors influencing the quality and quantity of agonistic behaviour in dairy cows

Factor	References
Presence or absence of horns	Graf, 1974
Herd composition, frequency of regrouping, mixing unfamiliar animals	Boe & Farevik, 2003; Menke, 1996
Group rearing of calves (early social environment & social experience)	Boe & Farevik, 2003
Method of integration of new cows into the herd	Menke, 1996; Boe & Farevik, 2003
Separation time of dry/calving cows from the herd	Waiblinger, 1996
Measures to avoid disturbances by cows in oestrus	Menke, 1996
Locking the feeding rack during feeding	Waiblinger, 1996
Problem solving management	Waiblinger, 1996
Human-animal-relationship (frequency and quality of contact)	Waiblinger, 1996
Stockperson personality and attitude towards the cows via behaviour and management	Waiblinger, 1996
Frequency of personnel change	Menke, 1996
Frequency of brushing the cows	Waiblinger, 1996
Number of different milkers	Menke, 1996
Herd size	Boe & Farevik, 2003
Design of housing facilities (structured versus unstructured lying area, feeding rack)	Menke, 1996
Space allowance per cow	Wierenga, 1990; Metz & Mekking, 1984; Menke, 1996, Menke et al., 1999, Schneider, 2010
Provision of an outdoor run	Menke, 1996; Menke et al., 2000; Schneider et al., 2008
Animal characteristics (breed, temperament, breeding line)	Le Neindre & Sourd, 1984; Boivin et al., 1994; Plusquellec & Bouissou, 2001

Many farmers state that different breeds and also different breeding lines within one breed imply different potentials for intraspecific aggression (and also for aggression against humans, Boivin et al., 1994). For instance, Saler groups showed more non-agonistic interactions than Friesian groups (Le Neindre and Sourd, 1984), and Plusquellec and Bouissou (2001) found the breed Ehringer, selected for fight and dominance ability, less aggressive in undisturbed groups as well as more tolerant in a

food competition test than the breed Swiss Brown (Brune des Alpes). Unfortunately, no comparative studies on horned and dehorned herds under comparable conditions regarding proportions of physical and non-physical agonistic interactions are available. In any case, they would be difficult to implement as threats may be very subtle signals that are difficult to observe reliably on group level (Winckler et al., 2002). Moreover, sufficient control of the possibly confounding factors displayed in Table 2.1 would be needed.

To compare horned and dehorned herds with respect to frequencies of physical agonistic interactions is similarly difficult. Such a comparison is only available from Graf (1974) for horned and dehorned cows at pasture. His results confirm the hypothesis of lower frequencies of physical agonistic interactions in horned cows (0.17 pushes/animal/hour versus 0.66 pushes in dehorned cows). Menke et al. (1999), though acknowledging the limitations due to confounding factors and differences in timing and methods of observations, tried to evaluate their results of observations in 35 horned dairy cow herds in relation to other studies with dehorned herds. They found that the average level of 0.25 physical interactions per animal and hour in the horned herds was lower throughout than the results from dehorned herds that ranged from 0.33 to 4.6 interactions/animal and hour (Collis et al., 1979; Jonasen, 1991; Menke, 1996).

Menke et al. (1999) further hypothesized that lower frequencies of physical agonistic behaviour in horned herds will have positive effects on the stability of the social structure of the herd. For example, older horned cows might be able to stay high in rank despite losing weight and physical strength. Reinhardt (1980) reported from a semi-wild herd of Zebu cattle that older high-ranking cows had lower body weight, but longer horns than younger low-ranking cows. Kimstedt (1974), on the other hand, observed in one commercial dairy herd after dehorning no consistent shift in ranks. However, observation time was probably too short to detect real long-term effects on the social order of the herd. Nevertheless, also Bouissou (1964 cited from Bouissou, 1972) found that dehorning does not necessarily change the hierarchy in an established group, since the dominance relationships are maintained largely by long range threatening signals. Thus, effects of dehorning depend on whether the cows concerned get involved in fighting or not. If it comes to fighting with horned animals, they will most probably lose (Sambraus, 1978). Therefore, horns are found to be of

major importance in the determination of dominance relationships in newly constituted social groups of heifers (Bouissou, 1972). In general, conclusions regarding influencing factors on social rank in horned and dehorned cows from different studies are rather contradictory (Schein and Fohrman, 1955; Wagnon et al., 1966; Bouissou, 1972; Collis, 1976; Stricklin et al., 1980; Beilharz and Zeeb, 1982), due to the complex interactions of aspects listed in Table 2.1 as well as cattle age, weight, size, and so on. However, for mixed herds with horned and dehorned cows it can be expected that the presence of horns will often (though not always) overrule other influencing factors and put horned cattle at an advantage (Bouissou, 1972; Beilharz and Zeeb, 1982).

Largely independent from rank or other influencing factors it is expected that horned animals attempt to maintain greater inter-individual distances than dehorned ones which makes the keeping of horned cattle under restricted space conditions more difficult (Sambraus, 1978). However, scientific studies on spacing behaviour comparing horned and hornless cattle are lacking. In goats, Aschwanden et al. (2008) in an experimental study could not detect any influence of the presence of horns on social distances. It would be worthwhile to undertake similar studies in cattle.

When it comes to physical agonistic interactions in horned herds, the risk for injuries is higher than in hornless herds. Menke et al. (1999) found a mean of 13.6 supposedly horn-inflicted lesions per cow in the 35 investigated dairy farms. Though the majority of these lesions were superficial scratches or hairless areas, the large variation from 1 to 63.5 injuries per average cow may indicate distinct problems on certain farms. The welfare evaluation of injury levels is difficult because injuries (bruises) in hornless cattle due to agonistic interactions may exist as well, but will mostly not be visible. The only studies investigating bruises in horned and hornless cattle were related to the situation during transport and at the abattoir. Here Shaw et al. (1976) and Meischke et al. (1974) found that groups of horned animals or groups of horned and hornless animals had a higher mean weight of bruised tissue trimmed from the carcass than hornless. The studies allowed no distinction between bruises caused during housing and afterwards, and varying transport conditions (e.g. durations between 1 and 10 days) were not controlled for. Furthermore, bruising during transport and lairage can occur due to fighting as well as to falling or collisions with equipment or other animals (Tarrant, 1990). It remains that injury risks are higher in horned cattle.

However, there is insufficient knowledge about the pain associated with the different lesions. Similarly, it is not known if the decreased risk of injury also decreases social stress in hornless cattle. The opposite hypothesis would be that the improved housing and management conditions are not only necessary to successfully keep horned cattle, but are additionally beneficial by decreasing the social stress which is imposed on hornless cattle under standard housing and management conditions. These questions deserve further investigation in the future.

2.2.3. Potential physiological effects of horns or absence of horns

In the ancient world Goddesses and Gods representing fertility and vitality were often associated with horns or horned cows or bulls (Cooper, 1998). Also among cattle breeders the relation of superior production traits to the presence of horns appears to be a regular perception (Koots and Crow, 1989). It was for instance reported that a Swedish polled breed exhibited more fertility related problems than horned breeds (Venge, 1959). Although this is more a reservation towards polled cattle rather than towards dehorning, some breeders also appreciate the presence of horns in breeding animals for selection purposes. Indeed, in wild bovids, here African buffalo, Ezenwa and Jolles (2008) showed that horn size in males and females is an indicator of health, especially with regard to parasitic burden and immune function. They concluded that in sexual selection horns may serve as honest signals of individual health and genetic quality.

Some farmers claim that dehorned and polled cows tend to have more digestive problems (Stranzinger, 1984, cited from Menke, 1996) and more lameness problems (Pilz, 2006). Often these farmers have an anthroposophic background. Rudolf Steiner, the founder of the anthroposophic movement, postulated that horns and digestion are closely related (Spengler Neff, 1997). Arguments commonly put forward in favour of this connection are based on several empirical observations, which have not been scientifically investigated yet. For instance, it is claimed that horns get warm during rumination. Furthermore, it appears that cattle breeds or bovids living in environments providing low energy forage (e.g. in the savannah or steppe) tend to have larger horns than those having rich diets available (e.g. in middle or northern European flat areas). However, another possible function of horns, thermoregulation, may also play a role, as cattle breeds originating from hot climates often have especially large horns.

Because the core of the horn is part of the sinus, horns may contribute to nasal heat exchange, which is found in a range of large mammals. This is a mechanism to considerably reduce water loss through cooling of the air during exhalation in giraffes, waterbucks, goats and cows (Langman et al., 1979).

It is further hypothesised that the presence of horns affects milk quality. Using qualitative methods such as copper chloride biocrystallization or the capillary dynamolysis method (Steigbildmethode) differences between milk from horned and dehorned have been described (Wohlers, 2003; Baars et al., 2005), and it was claimed that these differences indicate a lack of vitality of dehorned cows (Anon., 2009). However, the methods applied are still in the process of scientific validation (e.g. Wohlers et al., 2007, Wohlers, 2011). Another aspect of milk quality currently under investigation is based on reports of some consumers that milk from horned cows show hypoallergic effects (Kusche and Baars, 2007).

2.3. Requirements for the keeping of fully horned cattle

If it is decided to leave cattle horned, it is commonly supposed that they can only successfully be kept in loose housing under improved housing and management conditions. In an epidemiological study, 84 % of 62 farmer keeping horned cows had adjusted the stable to the horns of their cows with at least one - mostly even two or more- structural modifications (Schneider, 2010).

Although according to the Council of Europe Recommendation Concerning Cattle (1988) “space allowances for cattle housed in groups should be calculated ... taking into account the presence or absence of horns ...” minimum standards commonly do not differentiate between horned and hornless cattle. That applies for the numerous official or unofficial welfare recommendations on housing and management conditions for cattle with some exceptions e.g. the recommendations of the Lower Saxonian Rural Ministry (2007). Detailed recommendations concerning improved housing and management conditions for horned cattle (Menke and Waiblinger, 1999; Rist, 2002; Fürschuss et al., 2004; Eilers et al., 2005; Schneider, 2008, 2010) are mainly based on practical experiences and opinions, and only to a very small degree on results from experimental or epidemiological studies.

An overview over the different minimum recommendations in relation to legal minimum standards or official recommendations and differentiations regarding horned and dehorned dairy cows is provided in Table 2.2.

There is a general agreement (Menke and Waiblinger, 1999; Baars and Brands, 2000; Eilers et al., 2005; Schneider, 2008, 2010) that with respect to housing conditions, the design and dimensions of feeding places, of passageways, space allowances in general and availability of cubicles, if applicable, are of special importance. A generous general space allowance per cow reduces agonistic behaviours and skin injuries caused by horns (Menke et al., 1999).

To avoid or reduce competitive situations, Menke and Waiblinger (1999) recommend that population density should be 10 - 20 % under the allowed maximum. Bottleneck and dead-end situations should be avoided (Menke and Waiblinger, 1999; Baars and Brands, 2000; Rist, 2002; Eilers et al., 2005; Schneider, 2008, 2010) and the cows should always have a clear view in all directions in order to allow adequate responses to other cows (Schneider, 2008). Drinking troughs, salt blocks, concentrate feeders or brushes should be placed in such a way that there is a minimum free space of 3 m from at least three sides (Schneider, 2008). Schneider (2010) found less skin injuries on farms where drinking troughs were clean and fixed at least 60 cm above the ground.

Most farmers (73%) from 61 farms keeping horned herds estimated a proper feeding rack crucial for the successful cow management in loose housing (Schneider, 2010). Feeding racks opening to the top are rather recommended because horned cows can enter and leave them faster than feeding racks with a bar on the top (Menke and Waiblinger, 1999; Waiblinger et al. 2001; Schneider, 2008). A self-locking mechanism allows the fixation of the cows to ensure undisturbed feeding for low and high ranking animals (Menke and Waiblinger, 1999; Eilers et al., 2005; Schneider, 2008). A fixation of the cows during the main feeding periods is recommended in order to reduce agonistic interactions during feeding (Menke, 1996). Schneider (2010) found this management practise in 82% of 62 horned herds. However fixation time should not be too long to avoid later competitions at drinkers Schneider (2008).

Minimum space recommendations concerning feeding places are also presented in Table 2.2., requirements for bulls, however, might be even higher, because horns in male cattle often grow outwards/vertically (Schneider, 2008).

In order to avoid frequent regroupings of the herd according to performance level which lead to increased agonistic interactions, Menke and Waiblinger (1999) suggest to use selection gates towards different feeding areas where different energy levels are fed. Scheider (2010) found the majority (57%) of 61 farmers keeping dry cows within the herd to avoid separation and reintroduction.

Generally, concentrate feeders are seen as a potentially problematic resource regarding increased risks for horn-related injuries, especially at udder and vulva. The advice is to provide enhanced protection for the cows in the feeding station by prolonged walls at the rear or, better, an enclosing mechanism (Menke and Waiblinger, 1999; Eilers et al., 2005; Schneider, 2008) and minimum dimensions of 80 cm wide and 240 cm long (Menke and Waiblinger, 1999).

An outdoor run provides supplemental withdrawal space (Menke and Waiblinger, 1999; Schneider, 2008) which is beneficial to reduce the frequency of agonistic interactions (Menke et al., 2000). Schneider (2010) found in tendency less agonistic interactions and injuries when a larger outdoor run ($9\text{m}^2/\text{cow}$) was accessible in comparison to a smaller (4.5 m^2) or no outdoor run.

An unstructured lying area provides the possibility to flee fast, but at the same time lying animals can easier be attacked (Schneider, 2008). In structured lying areas, i.e. cubicles, the cows are better protected, but when attacked, usually have to retreat in direction of the attacking cow, that is to the rear of the cubicle. Therefore, Eilers et al. (2005) and Schneider (2008) recommend provision of cubicles with the possibility to flee forward. At the same time, it is assumed that horned cows need a larger front head lunge area (get-up-zone) of up to 100 cm (Fürschuss et al., 2004; Schneider, 2008). This explains the higher cubicle lengths recommended for horned cows of 2.85 m to 3.00 m (Table 2.2). Additionally, Menke and Waiblinger (1999) advise against cubicles on a raised base because they assume a higher risk for pushes against the udder of the lying cow. Regarding the unstructured lying area, Schneider et al. (2008) found in tendency less interactions and less injuries with larger space allowances in the lying area ($8\text{ m}^2/\text{cow}$ vs. 4.5 m^2).

Tandem und butterfly milking parlours are recommended because they protect the cows from threats and pushes of other cows (Menke and Waiblinger, 1999; Schneider, 2008). It is also advised against the feeding of concentrate in the milking parlour

because it might increase agitation in the waiting area (Menke and Waiblinger, 1999; Schneider, 2008).

Square shaped waiting areas are supposed to provide more withdrawal space than tubular shapes (Schneider, 2008). A good view over the whole waiting area that allows the stockperson to take appropriate action in case of aggressive behaviour is also considered useful (Schneider, 2008).

However, the key factor of successful keeping horned cows in loose housing systems is the feeding- and social herd management as well as the problem solving ability of the farmer (e.g. immediate repair of defective feeding racks, solutions to problems from single aggressive cows) (Menke and Waiblinger, 1999; Schneider, 2008).

Regarding the herd management and the problem solving ability of the farmer, Menke et al. (1999) found in their epidemiological study significant effects on the frequency of aggressive behaviour and injuries caused by horns.

One aspect of the herd management is the introduction of new herd members, which needs special attention (Menke and Waiblinger 1999; Schneider, 2008). A high average age and a low replacement rate is associated with reduced agonistic interactions in the herd as it means reduced introductions of young animals into the herd (Baars and Brands, 2000; Schneider, 2008). Fewer injuries are expected in herds where the farmer habituated new animals gradually to the herd and paid attention to the social behaviour during integration (Menke et al., 1999). It is also beneficial to introduce new herd members on pasture where there is ample space available (Menke and Waiblinger, 1999; Schneider, 2008). In a small experimental study including horned commercial herds Menke et al. (2000) further observed that the integration of one new herd member compared to a group of three new members led to significantly fewer agonistic interactions in herd members and integrated animals. However, this was only a very small study and Schneider (2008) on the contrary recommends to introduce small groups instead of single animals based on reports of farmers (Schneider et al. 2009).

Cows in oestrus may be a further source of considerable disturbances and increased agonistic interactions in the herd. Menke et al. (1999) showed that removing cows in oestrus for a short time from the herd was significantly related to less agonistic behaviour. In this connection Schneider (2008) suggests that a bull running with the

herd has calming effects on the cows. However, this may depend on the individual behaviour of the bull. Scientific studies that analysed the effect of a bull in the herd are missing.

Finally, it is recommended to remove aggressive animals from the herd that are responsible for a considerable amount of injuries and to use aggressiveness as a negative breeding criterion (Menke and Waiblinger, 1999; Schneider, 2008). A further possibility to cope with single aggressive animals is to cut or grind off the tips of their horns or to cover them with protectors (Menke and Waiblinger, 1999; Schneider, 2008), which was found to be very effective in order to reduce the risk of injuries (Schneider, 2010).

With regard to human safety, i.e. as a way to reduce risks of accidents, stockpeople should be assertive and calm in all situations, maintain a clear communication with the animals and be predictable in order to reduce fear-related behaviour (Menke and Waiblinger, 1999; Schneider, 2008). In general, a good human-animal relationship, preferably from birth on, should be aimed at (Menke and Waiblinger, 1999; Eilers et al., 2005; Schneider, 2008). On this line Menke et al. (1999) found in their epidemiological study a significant negative relation between the frequency of agonistic behaviours and the ability of the stockperson to identify individual cows and the frequency of personnel changes. Schneider (2010) also found fewer injuries on farms with fewer employees. Therefore, it is recommended to have as little personnel changes as possible (Menke and Waiblinger, 1999; Schneider, 2008).

Tab. 2.2: Overview over minimum standards or recommendations regarding crucial aspects for the keeping of (horned) dairy cattle

	Legal minimum standards		Official minimum recommendations		Specific minimum recommendations for horned dairy cows						
	Austrian animal husbandry regulation (2004)	Swiss animal welfare regulation (2008) ¹	Danish Agricultural Advisory Center (2002) ²	Germany: Lower Saxonian Rural Ministry (2007) ³	Germany: Lower Saxonian Rural Ministry (2007) ³	Menke & Waiblinger (1999)	Baars & Brands (2000)	Rist (2002) ⁴	Fürschuss et al. (2004) ⁵	Eilers et al. (2005)	Schneider (2008)
Feeding place width (per animal) [cm]	40-75 (body weight 150 - over 650 kg)	65-78	70	70-75		75	75	80-90	80-90	80-90	85-100
Alley width behind feeding place [m]	3.20 ³	2.90-3.30	3.20	3.50 (4.00 recommended)		3.50	3.50		4.00	4.50	5.00
Animal/feeding-place ratio	2.5:1 if food provision is ad libitum			1:1 (in larger groups 1.2-1.5:1)		1:1	1:1	1:1.1-1.2		1:1.1-1.2	1:1-1.1
Concentrate feeder				1 station/25 cows		Width: 0.80 m, length: 2.40 m	1 station/25 cows				
Animal/water troughs ratio			6:1				20:1			10:1	10:1
Alley width between cubicles [m]	2.50	2.20-2.60	2.40 (1.80 for crossovers)	2.50 (3.00 recommended; one-way: 1.0-1.2 m)	3.50	2.50 (one-way-alleys: 0.8-1.0 m)	2.50	4.00	4.00 (one-way-alleys: 1.0 m)	4.00	4.00, (crossovers: 3.00, one-way-alleys: 1.00)
Cubicle length (wall-facing) [m]	1.90-2.60 (body weight 300 – over 700 kg)	2.30-2.60	2.60	2.50-2.80 (incl. 80 cm get-up-zone)			2.40	3.00 (incl. 60 cm get-up-zone)	2.85 (incl. 80-100 cm get-up-zone)	3.00	3.00 (incl. 100 cm get-up-zone)

¹ for cows with height at withers of 125 – 145 ± 5 cm; ² for cows of 700 kg body weight/large breeds; ³ for new buildings; ⁴ for cows of 500-650 kg body weight; ⁵ for cows with height at withers 135 ± 5 cm resp. 650 kg body weight

Tab. 2.2: (continued): Overview over minimum standards or recommendations regarding crucial aspects for the keeping of (horned) dairy cattle

	Legal minimum standards		Official minimum recommendations		Specific minimum recommendations for horned dairy cows						
	Austrian animal husbandry regulation (2004)	Swiss animal welfare regulation (2008) ¹	Danish Agricultural Advisory Center (2002) ²	Germany: Germany: Lower Saxonian Rural Ministry (2007) ³	Germany: Germany: Lower Saxonian Rural Ministry (2007) ³	Menke & Waiblinger (1999)	Baars & Brands (2000)	Rist (2002) ⁴	Fürschuss et al. (2004) ⁵	Eilers et al. (2005)	Schneider (2008)
Cubicle length (double rows) [m]	1.70-2.40 (body weight 300 – over 700 kg)	2.00-2.35	2.45	2.40-2.70			2.40	2.40	2.85 (incl. 80-100 cm get-up-zone)	2.70	2.50
Animal/cubicle ratio		1:1		1:1		1:1	1:1	1:1.1-1.2		1:1.1-1.2	1:1.1-1.2
Lying area per animal (unstructured area) [m ²]		4.00-5.00	6.50	One floor deep litter: 6.00-8.00 two floor deep litter: 4.50-5.00; one floor straw flow: 5.00, two floor straw flow: 4.00-4.50	One floor deep litter: 12.00; two floor deep litter: 7.00-9.00; one floor straw flow: 5.00, two floor straw flow: 4.00-4.50		7.00	8.00	7.00	8.00	8.00
Outdoor run: area per animal [m ²]			5.00	3.00				15.00	12.00-15.00	12.00	4.50

¹ for cows with height at withers of 125 – 145 ± 5 cm; ² for cows of 700 kg body weight/large breeds; ³ for new buildings; ⁴ for cows of 500-650 kg body weight; ⁵ for cows with height at withers 135 ± 5 cm resp. 650 kg body weight

2.4. Discussion and conclusions

The specific recommendations for the housing and management of horned dairy cows indeed include quite a number of higher minimum standards than usually to be found for hornless cows (for housing see the comparison in Table 2.2). However, the risk areas identified are of similar relevance for horned and hornless cattle. For example, high competition, particularly in the feeding area, frequent social change or lack of withdrawal space impairs welfare in dehorned cattle as well (e.g. reviewed in EFSA, 2009). It is not known yet, if horned cows truly show higher inter-individual distances than hornless cows and, therefore, have higher space requirements. Alternatively, the difference may mainly lie in the more visible consequences of agonistic interactions, namely horn-inflicted scratches and wounds, whereas possible bruises in hornless cattle are difficult to detect. No studies that may answer these questions are available yet. Additional to the risks of injury due to social interactions, there are clear risks of injuring the horns themselves due to inadequate equipment (e.g. the feeding rack) that need to be avoided. Especially regarding certain dimensions of the housing environment there is variation in the recommendations for horned dairy cows. Partly, they may be time related, as 9 years lie between the oldest and youngest recommendation, and cows have grown larger in the meantime. However, due to the very limited scientific evidence on the effects of different dimensions on the welfare of horned dairy cows, future research in this area is needed. The same is true for certain management measures such as a welfare-friendly introduction of new herd members.

2.5. Disbudding and dehorning

Disbudding means the removal of the horn buds of the calf at an early age (up to 2 or 3 months) when the horn itself is not yet developed (Rosenberger, 1970). It is carried out using a hot iron, caustic paste or by surgical removal with tube, scoop or curved knife.

Dehorning is used in animals older than 2 or 3 month and implies the removal of the horns by means of cup and scoop type dehorner, electrical or wire saw or shears.

While it seems logical to speak of disbudding only as long as the horn bud is free-floating, and of dehorning from the moment on when the bud attaches to the skull, in the literature and everyday language the distinction is not made that precisely. Often dehorning is more related to adult cattle and disbudding to calves of sometimes older age than 2 months. Additionally, dehorning is used as a generic term that includes disbudding and dehorning.

2.5.1. Reasons for and against the dehorning of cattle

2.5.1.1. Human safety and ease of management

Dehorned cattle are considered less dangerous for stockpeople's on-the-job safety. Normal head movements of the animal, e.g. to chase away flies, could hurt unwary stockpersons accidentally and purposefully conducted attacks of horned animals may cause more harm than from hornless animals. However, according to Menke et al. (2004), accidents with horns mainly occur in tie stalls in connection with tying and untying the animals, while he does not see a largely increased risk in loose housing. Stockpeople of 35 loose housed herds with horned cows did not report any serious hurt in sometimes more than 20 years practice (Menke et al., 1999). Statistical information about actual accidents with horned cattle compared to dehorned cattle is largely lacking. The only more recent source available is an Austrian study on documented work accidents with cattle including horned and dehorned cows mainly over the years 1995 to 2002 (Hackl, 2004). Kind and seriousness of accidents depended partly on the housing system, with higher proportions of 'medium heavy injuries' in loose housing and 'less heavy injuries' dominating in tie stalls. In tie stalls, about 72 % of accidents, in loose housing, about 38 % of cases concerned horned cattle. It is difficult to interpret these figures as they are not related to the proportion of farms or cattle with and without horns. About 86 % of all accidents had other causes than horn trusts. Accidents resulting in heavy injuries were mainly caused by pushing with the whole body (34 %) and leg kicking (30 %). Less frequent reasons were pushing/butting with the head (19 %) and pushing/butting with the horns (13 %) (Hackl, 2004). Deadly accidents were only in one case due to pushing/butting with the horns, in 7 cases due to pushing/butting with the head in hornless cows and in 6 cases due to pushing with the whole body or leg kicking. Also Waiblinger and

Menke (2002) conclude from a survey of accident records without statistical analysis that accidents resulting in heavy injuries or even death are generally caused by pressing against the wall or overrunning.

Hornless cattle (polled and dehorned) are, furthermore, considered to have a calmer temperament (Sambraus, 1978; Goonewardene et al., 1999). According to farmers' reports horned cattle seem to be more self-confident and ready to defend themselves in unpleasant situation, e.g. when they have to be restraint for injections or other treatments. For these reasons veterinarians as well as cattle dealers and cattle drivers might also prefer to handle dehorned cattle. However, almost no scientific evidence on behavioural differences between horned and hornless cattle during handling is available. Tulloh (1961) assessed temperament of horned, dehorned and polled beef cattle during handling, although partly there was a confounding between breeds, sex and horn status. Nevertheless, he concluded that there were no significant differences in temperament scores between horned and hornless animals.

2.5.1.2. Potential effects of dehorning on the human-animal relationship

Waiblinger (1996) found in 35 horned herds that the proportion of dehorned animals in the herd correlated with the avoidance distance towards humans, i.e. the more cows of a herd were dehorned, the shyer the animals were. One of the possible explanations is dehorned cattle becoming more fearful of humans due to the possibly traumatic experience of disbudding/dehorning. This hypothesis has not further been investigated yet. Enhanced fearfulness of humans enhances the likelihood of attacks as has been shown under free range conditions (Boivin et al., 1994; Le Neindre et al., 1996). Therefore, this aspect deserves more investigation in the future.

2.5.1.3. Animal social stress and injuries

Oester (1977) assumed that dehorning reduces social stress, bruises and injuries caused by horn thrusts amongst the animals, which can occur especially when kept in loose housing, during transport and lairage. However, in his study he compared the social behaviour of horned with freshly dehorned cows. It is very likely that the dehorned animals avoided head pushing due to the pain of the still healing wounds and therefore were hindered in their normal behaviour.

The range of horn inflicted damage in cattle may vary from abraded hair or minor skin lesions to serious injuries (Menke, 1996) which are especially problematic when udder or vulva are affected. Horn thrusts in the udder can result in the occurrence of visible blood in the milk, which also has economical implications, because the milk cannot be sold before it is free of blood again, and the affected cow may need medical treatment. Forceful thrusts in the trunk can even result in a rupture of the abdominal wall or abortion (Rosenberger, 1970). However, the extent of horn inflicted damage depends largely on housing conditions and management as will be discussed in chapter 2.4 in detail.

2.5.1.4. Economics

In terms of economics, it is commonly assumed that the adjustment of the housing system and management to the special needs of horned cattle implies higher investment and labour costs. Additionally, in regions with specialised leather goods industry even smaller skin lesions can reduce the sale value of the leather (Buchner et al., no year). Scratches on the skin can occur especially during crowding, e.g. on transport (Shaw et al., 1976; Wythes et al., 1979). Farmers may also suffer financial penalties on sale of horned cattle (Rosenberger and Robeis, 2005).

2.5.1.5. Culture

In some regions it is tradition to keep horned cattle (Anonymous, 2005), in some to keep dehorned cattle. Furthermore, for some breeds, especially in touristic areas, the keeping of horned cattle might also have the aspect of being more attractive for tourists and consumers. The role of the horns concerning culture and the self-appraisal of the farmers will be further investigated in chapter 4.

2.5.1.6. Ethics

Dehorning is a mutilation that subjects the animals to distress and pain as will be discussed in detail below. If a biocentric ethical view is adopted, integrity of the animal is an 'inherent worth' to be respected, additional to the responsibility to minimize animal suffering in the animals used by humans (Verhoog et al., 2004). In this view horns can be regarded a crucial part of the cow's nature (Menke et al.,

2004). Dehorning does not only change the cow's appearance, but also her behaviour, especially the social behaviour (see chapter 2.3). A further criticism of dehorning is that it is a means of adjusting the animals to the husbandry system rather than offering them an adequate environment to perform their species-specific behaviour (Menke et al., 2004).

2.5.2. Methods of disbudding

The objective of all methods of disbudding is to destroy the small ring of skin encircling the horn bud. Horn tissue is formed from specialized cells located in this area. To be successful, these methods should be used before significant horn growth occurs (Parsons and Jensen, 2006). Chemical and hot-iron disbudding methods destroy the horn-producing cells, whereas physical methods excise them (Vickers et al., 2005).

In the following, it will be described how to apply these methods according to text books, scientific papers or farmer's information sources in the internet. Nearly no information is available from practice how the disbudding is actually implemented and to which degree complications may occur. Only for hot iron disbudding some limited information can be given from one study. To get more information about the use of different disbudding/dehorning methods including medical treatment in practise, a survey was conducted (see chapter 3).

2.5.2.1. Disbudding with hot iron - cautery

Various hot iron dehorning tools are available. They may be heated by butane gas, 12- or 24-volt electric current. However, from farmers' discussion forums in the internet it appears that also less adequate tools such as soldering-irons are used. According to Stafford and Mellor (2005) hot iron disbudding can be applied up to an age of 2 months, but Rosenberger (1970) recommends it only up to an age of six weeks in order to achieve satisfactory results, namely to avoid the growth of scurs (little crippled horns). For the disbudding procedure the calf should be restrained firmly in a feeding rack or a "restraint box". The free ending of the iron burning device has a little cavity (cup shaped) which fits around the bud. The iron should be heated to a dull red, pressed onto the area around the bud, and slowly rotated with moderate

pressure for about 10 seconds up to 3 minutes to destroy the horn-forming tissue (Rosenberger, 1970; Laden et al., 1985; Gottschalk et al., 1992; Wohlt et al., 1994; McMeekan et al., 1998b; Parsons and Jensen, 2006; Stilwell et al., 2007). If the burning device is not hot enough, the burning time can last much longer. The iron should burn through the full thickness of the skin and the core of the bud has to turn brown (Gottschalk et al., 1992). By destroying the vessels which surround the bud, further growth of the horns is inhibited.

The electric buddex® dehorner with rechargeable battery designed for younger calves up to an age of 21 days, is handled as described above, but due to the high temperatures at the cauterising ring of the device, the burning process lasts only up to 7 seconds (DLG, 2003). According to Kahrer et al. (2008) however, one burning process is not sufficient and the buddex® has to be applied at least two times to ensure an entire interception of the blood supply of the horn buds.

While Gottschalk et al. (1992) do not give an exact age limit, they point out that in younger calves the burning of the surrounding vessels is sufficient, whereas the whole bud should be removed by levering it out from the side when the horn is further developed. The heat of the burning device is supposed to close the damaged blood vessels and, thus, no bleeding should occur if properly done (Parsons and Jensen, 2006). The cauterization also minimizes the risk of infection (Parsons and Jensen, 2006).

Taschke (1995) observed hot iron disbudding on a research farm in 73 calves and found that 8 % of the calves showed major bleeding of the wound directly after disbudding. One week afterwards 46 % of the wounds suppurated, after 3 weeks it were 5 %. It took 4-6 weeks until the wounds had healed completely; according to Kahrer et al. (2008) the healing process lasted even between 6 and 8 weeks. Taschke (1995) also noticed that a black tinged necrosis of the bone was often visible in the centre of the wound.

2.5.2.2. Disbudding with caustic paste

Various chemicals are used for the procedure such as potassium hydroxide, sodium hydroxide, or fluids or pastes that contain nitric acid, trichloroacetic acid, antimony

trichloride or zinc oxide. A common mixture is composed of 28 % antimony trichloride, 7 % salicylic acid and 65 % collodion (Rosenberger, 1970).

The optimal age to ensure success of disbudding with caustic paste is between 8 and 14 days, but sometimes it is used up to an age of 3 to 4 weeks, especially in female calves (Gottschalk et al., 1992). If applied on calves over 14 days scurs may grow, because the effect of the caustics might be insufficient (Rosenberger, 1970).

Before application, the area around the buds should be shaved. Then the buds are moistened with some drops of water. The buds and the areas around them get rubbed in under only little pressure with the caustic paste until the skin turns reddish and the dabbed area becomes scarified and wrinkled, which can need about 1 to 1.5 minutes depending on the development of the calf (Gottschalk et al., 1992). The caustic paste remains on the bud until the destroyed tissue gets rejected, which takes 4 to 6 weeks. As long as the active chemical is in contact with the tissue, damage continues (Yano et al., 1993). Calves treated with caustic paste must be protected from rain for a few days after the treatment to prevent the caustic from washing onto the face area and causing chemical burns e.g. on the eyes. Overdosage of the caustics can lead to necroses affecting even the frontal bones of the skull (Rosenberger, 1970). There is also a risk in suckling calves to rub the caustic paste on the udders of their dams during suckling or other herd-mates and causing chemical burns on them as well (Parsons and Jensen, 2006).

2.5.2.3. Disbudding with scoop, tube or knife - surgical removal of the horn producing area

This method surgically removes the horn and a small ring of skin encircling it. The surgical removal of the bud can be carried out up to an age of 2 to 3 month. There are different devices to conduct the procedure, e.g. tube, scoop, Roberts' device or curved knife.

The area around the buds should be shaved and disinfected. Application of antiseptics to the calf's skin before dehorning is of little benefit unless the hair is shaved and the area washed with soap before the antiseptic is applied (Parsons and Jensen, 2006). The sharp end of the scoop or tube is placed over the bud and rotated to isolate the central core of the buds. The cutting edge is then used as a gouge to get the punched

part completely loose by abrasing the underside (Rosenberger, 1970). Possibly occurring bleeding can be stopped by cauterisation or ligature. The remaining wound should be disinfected and should heal within 3 to 4 weeks (Gottschalk et al., 1992). Another method is the use of a curved knife similar to a furrier's knife (but without a hook on the end). The knife is drawn through the skin towards and through the horn, slicing off the horn. This will remove an elliptical piece of skin with the horn in the centre. To ensure that no horn-forming tissue is left, the ring of hair around the bud has to be removed completely. The most common mistake when disbudding with a knife is to remove an incomplete ring of hair around the horn bud. To prevent scurs, a second cut will be needed to remove all horn-forming tissue (Parsons and Jensen, 2006).

2.5.3. Dehorning

In calves where horn growth already started, shears, tube or scoop are used to remove the horns and to inhibit their further growth by cutting off a ring of skin of at least 1 cm around the base of the horns. Cup and scoop type dehorner are operating with a scissor-like movement. The scoop type dehorner is consisting of two interlocking semicircular blades attached to leverage handles. It amputates the horn, adjacent skin and some underlying bone by closing the blades whilst pressing them down vertically on the horn as the operator spreads the leverage arms (Parsons and Jensen, 2006).

In adult cattle or cattle older than 6 months, the bony horn core has to be cut. Various special tools for the amputation of the grown horn are available, e.g. the keystone dehorner (a guillotine type instrument with detachable blades, which has long handles and is capable of chopping off the largest cow horns and most bull horns); electrical saw or wire saw. The bone tissue should be cut and not just crushed or cracked. To avoid crushing or cracking the bones of the skull, wire saws should usually be used when mature animals are dehorned. If crushing or cracking of bone occurs, e.g. caused by a sudden defence reaction of the animal during dehorning with electrical saw with stiff blade, infection is more likely to occur (Parsons and Jensen, 2006). From the 7th or 8th month onwards, pneumatization of the bony horn core (development of the cornual sinus) begins, which implies that the sinus gets opened during the amputation. Dehorning then leaves an open hole that reaches down into the sinuses of the head. On the residual wound surface sulfonamid paste or antibiotic

ointment should be applied (Rosenberger, 1970). Hay or other food particles should be prevented from being thrown on the head of freshly dehorned cattle at feeding time. Therefore, the open hole into the head should be covered with gauze or cotton to keep out debris (e.g. dust, hay or insects). Recently dehorned cattle should also be protected from rain and dust storms until the open sinus has completely healed, which will take about 4 to 8 weeks. If a sinusitis occurs, the sinus must be flushed with disinfectants (Rosenberger, 1970). To avoid infections caused by flies and maggots in the wound, dehorning should be done under cool and dry weather conditions. In wet weather the healing rate is decreased, and the risk of infections is increased. Once an infection is established, it may result in a serious, long-term sinus infection (Parsons and Jensen, 2006). Chronic sinusitis is a frequent complication of dehorning (Ward and Rebhun, 1992). Also haemorrhage can become a concern. If not controlled, it can result in severe weight loss or death. Bleeding of the two or three main arteries that supply the horn area should be stopped. Arteries can be pulled and twisted until they break under the subcutaneous tissues, which will then provide pressure and a base for clot formation. Other possibilities to stop bleeding are cauterization with a hot iron, or a string can be tied around the horn base to apply pressure for 24 hours. Blood stopper chemicals should not be placed down into an open sinus as that may result in serious complications (Parsons and Jensen, 2006).

2.5.4. Pain and distress during disbudding and dehorning

Disbudding and dehorning cause tissue damage which results in activation and release of intracellular contents from damaged cells, inflammatory cells and nerve fibres (Anderson and Muir, 2005, cited from American Veterinary Medical Association, 2007). Most probably these processes will lead to similar experiences of pain as they would in human beings. Not only the anatomy of the nervous system and physiological response are similar (Weary et al., 2006), but also information processing in the brain appears comparable as has been shown in chickens by Gentle (2001). Therefore, the various kinds of tissue damage and their possible consequences on pain experience will briefly be discussed. Additionally, studies on physiological and behavioural responses towards different disbudding or dehorning procedures that indicate pain and distress will be reviewed.

Physiological indicators include responses of the sympathetic-adrenomedullary system, such as changes in heart rate or in plasma catecholamine concentrations, and responses of the hypothalamic-pituitary-adrenocortical system, namely changes in concentrations of cortisol, adrenocorticotrophic hormone (ACTH) and corticotrophin releasing factor. Indicators relating to the sympathetic-adrenomedullary system may be useful for comparing the experience of cattle immediately after dehorning. Changes in plasma cortisol concentrations over time have been used more frequently than any other single parameter to measure pain-induced distress. Generally the cortisol response can be divided in 2 major phases. The first peak in plasma cortisol concentrations is probably due to the nociceptor impulse barrage caused by horn amputation and the plateau and decline to pre-treatment levels may represent a phase where inflammation-related pain and its resolution dominate the response (McMeekan et al., 1998b).

Behavioural indicators of the calf's pain during the disbudding procedure are struggling behaviours like scurrying, urging forward, head jerking and rearing. A further sign of discomfort is quick tail wagging. After unsuccessful defence reactions some calves just drop themselves down (Taschke, 1995; Graf and Senn, 1999).

Postoperative behaviours indicating pain and distress are restlessness (frequent standing up and lying down), repeated shaking of the head, ear flicking, tail flicking, hind leg kicking, scratching the lesion with the hind foot, reduction of social behaviours and self grooming, head rubbing, backwards movements, neck extension, prolonged lying and reduced exploratory behaviour, avoiding of head pushing against pen mates, reduced feeding time and standing indifferently with lowered head as well as a reduced tameness towards humans (Taschke, 1995; Morisse et al., 1995; Graf and Senn, 1999; Faulkner and Weary, 2000).

Behavioural responses may be modified by age, breed, previous experiences, temperament etc. (Stilwell et al., 2007). For instance, especially younger calves may respond to intense pain merely by becoming apathetic which comprises inert lying with head on flank and showing little response to stimuli such as those resulting from other calves (Stilwell et al., 2009). However, Taschke (1995) did not find such age related differences. It is a general problem in the interpretation of behavioural indicators that a low overt response does not necessarily mean absence of suffering. Especially in prey species such as cattle low overt responsiveness has evolved as a

way of concealing vulnerability towards potential predators (Broom, 2001). Very subtle signs (e.g. inert lying or shallow respiration) may be of crucial importance also in older cattle (Sanford et al., 1989). Moreover, even in humans large discrepancies were found between observed behaviours indicating pain and verbal reports about pain experience in burn patients. Intense levels of pain were reported in spite of minimal behavioural manifestations (reviewed by Choiniere, 1989).

Decreases in individual animal performance after disbudding/dehorning are likely related to physiological or pathological as well as behavioural responses that may be associated with pain.

2.5.4.1. Hot iron disbudding

Hot iron disbudding causes third-degree burns in the zone of direct contact. This means charring and extreme damage of the epidermis that reaches down to the subcutaneous tissue and often also to the skull bone. The surrounding tissue exhibits first- and second-degree burns (Taschke, 1995). According to Choiniere (1989) it is not well known, what exactly causes the pain from burn injuries. In the hours following the injury, the pain is due to the release of chemical substances (histamine, bradykinin and prostaglandins) in and around the injured sites. Peripheral and central neural mechanisms have also been suggested to explain the spreading of pain in surrounding areas. Laboratory studies with humans and animals suggest the phenomenon of hyperalgesia (an increased sensitivity to pain and spontaneous pain), which has been observed to last from minutes to hours. It may result partly from sensitisation of certain classes of nociceptors at the injury site, and partly from changes in the central nervous system leading to facilitation of afferent signals (reviewed by Choiniere, 1989).

The cortisol response to hot iron disbudding lasts about 1- 4 hours (Petrie et al., 1996; Grøndahl-Nielsen et al., 1999; Faulkner and Weary, 2000). A sharp rise is followed by a rapid decline to pre-treatment levels and no plateau phase occurs. Only Morisse et al. (1995) found significantly higher plasma cortisol concentrations than in control animals until at least 24 hours when they took their last blood sample. However, even when cortisol levels returned earlier to control values, indications of pain or distress were still noticeable. In the study of Grøndahl-Nielsen et al. (1999) heart rates were increased until 3.5 hours after hot iron disbudding whereas cortisol levels already

declined after 1 hour. Faulkner and Weary (2000) found behavioural signs of pain (head jerks, ear flicking) during the complete 24 hours of observation time (peak at 6 hours), whereas cortisol responses normally reached pre-treatment levels 4 hours after the procedure. Plasma cortisol concentrations appear not to be influenced by the type of hot iron disbudder. Dehorning with a conventional electrical dehorner (applied for 1 to 2 min) or a Buddex (applied for 10 seconds) resulted in similar cortisol responses (Wohlt et al., 1994). Also the duration of the burning procedure, related to horn bud size and age of calves, did not result in different kinds or intensity of defence reactions (Taschke, 1995). Possibly, this is due to a ceiling effect. Since calves seem to show a maximum of defence reactions already in the first seconds of contact with the hot iron, it might not be possible for them to react even more vigorously to prolonged burning times.

2.5.4.2. Caustic paste disbudding

Caustic paste disbudding causes chemical burn of underlying tissue. The active ingredient used for paste disbudding is a strong alkali, which firstly withdraws water from inside the effected cells, causing intracellular dehydration. Secondly, saponification of subcutaneous fat causes the fatty tissue to loose its function, with increased damage due to the heat of reaction. Thirdly, the reaction with protein forms alkaline-proteinate, which is soluble and contains OH ions, the latter causing further chemical reactions which initiate deeper injury of the tissue. Alkaline injuries are more progressive, compared with acid, and the necrotic tissue becomes moist (Yano et al., 1993). Histopathological findings after alkali burns in pigs have revealed full-thickness epidermal necrosis and superficial dermal necrosis (Coward et al., 2000). The pain caused by alkali is described by humans as “itching pain” or “marked pain” (Ma et al., 2007, cited from Stilwell et al., 2009).

Disbudding with caustic paste caused an increase in plasma cortisol level for 1 hour, reached the highest level at 60 minutes after disbudding and returned to basal levels within 4 hours to 24 hours after treatment (Morisse et al., 1995; Stilwell et al., 2009). Behavioural observations in caustic paste disbudded calves revealed more restlessness behaviour (transitions from lying to standing), inert lying, head shaking and head rubbing than in sham disbudded calves 15 min, 1 hour, 3 hours and 6 hours after the procedure (Stilwell et al., 2007).

2.5.4.3. Surgical disbudding or dehorning

After surgical dehorning (applied at an age of 3 to 6 months), plasma cortisol concentrations increased rapidly and markedly 30 to 60 minutes after dehorning, declined slightly, plateau levelled for 3 to 4 hours, and then returned to baseline values approximately 6 to 9 hours after the procedure (McMeekan et al., 1997; Sylvester et al., 1998b). A new smaller, but significant rise of plasma cortisol levels occurred at 13 to 15 hours after dehorning, returned to pre-treatment level again and did not rise above until at least 24 hours after dehorning when the last blood sample was taken (Sutherland et al., 2002b).

The cortisol response is not influenced by the tool used for the procedure (scoop, shears, saw or embryotomy wire). Consequently pain and stress appear to be similar, although the remaining wounds are of different depth (Sylvester et al., 1998b). Stilwell et al. (2007) suggest, that the marked responses during the first hour after treatment may be limited by a "ceiling effect" that is described as the maximum hormonal level possibly attained after a negative experience (Molony and Kent, 1997; Molony et al., 2002). Indeed, cortisol responses in the first hour after amputation dehorning are similar to those following ACTH injection, indicating that dehorning causes maximum cortisol secretion during this period (Sylvester et al., 1998b). This physiological limitation should be taken in account. Thus, the following cortisol decrease may as well be due to exhaustion of the system and not necessarily to pain reduction. Interestingly, in the study of Stilwell et al. (2007) also the pain related behaviour showed a wavering pattern, that was not found in hot iron or caustic paste disbudded calves: a decrease at 3 hours compared with the level at 1 hour and a new, very pronounced increase at 6 hours. The behavioural responses also indicated that severe pain was still present despite the decrease in cortisol levels.

After surgical dehorning of mature cattle, Taschke (1995) observed head shaking, standing apathetically with lowered head during the first 4 to 5 hours, reduced feeding and rumination up to 12 hours after dehorning, prolonged standing, reduced lying, behavioural depression (standing without feeding or ruminating) up to 24 hours as well as reduced social licking up to 1-2 days after dehorning. Observations on one farm furthermore indicated longer lasting effects by a renewed reduction of social licking between day 9 and 13 (last observation day) after dehorning (Taschke, 1995).

Winks et al. (1977) found that 36 % of dehorned mature Brahman steers had suppurating sinuses 24 days after dehorning. Healing of the wounds was completed between 58 and 65 days after dehorning.

Weight gains during 5 months post dehorning were significantly higher for horned than for the dehorned steers (Winks et al., 1977). The size of the opening of the frontal sinus was inversely related to the live weight gains during the immediate post operative period, but overall gain was independent of size of sinus opening. However, steers with suppurating wounds and small sinus openings gained less weight than steers with small openings that had healed (Winks et al., 1977).

Moreover, dehorning of older calves of differing ages under very extensive conditions such as in Australia can lead to mortalities of about 3 % due to exsanguination (Petherick, 2005).

2.5.4.4. Comparison of methods and conclusions on pain caused by disbudding/dehorning

Although in legal standards disbudding at different ages is usually treated differently, e.g. in terms of anaesthesia requirements (e.g. Tierschutzgesetz, 2006), suggesting that pain perception is more pronounced at older ages, there are almost no scientific investigations available comparing indications of pain at different ages. However, Taschke (1995), who investigated the defence reactions to hot iron disbudding of 73 calves (3 - 8 weeks), could not find any correlation between the calves' age and the intensity of the defence reactions. Likewise, looking at different studies that used calves between 6 weeks and 6 months of age, plasma cortisol responses to different disbudding or dehorning procedures show very similar patterns (Petrie et al., 1996; McMeekan et al., 1997; 1998a, b; Sylvester et al., 1998a, b), suggesting that noteworthy age related differences in pain perception do not exist. However, when comparing disbudding and dehorning, effects due to type and size of the imposed wounds may become important. In terms of animal performance, for instance Laden et al. (1985) and Grøndahl-Nielsen et al. (1999) did not find any short- or long-term effects of hot iron disbudding on food intake and growth rate in 4 to 6 and 8 week old calves. On the contrary, after surgical dehorning in Brahman crossbred steers aged 4, 9, 19 and 30 months, weight gains were significantly reduced during the first 2 to 6 weeks (Loxton et al., 1982). In mature steers (Winks et al., 1977) and in Canadian

feedlot cattle in winter, negative weight effects were still evident after 106 days (Goonewardene and Hand, 1991).

Duration and level of cortisol responses differ, however, according to the methods applied. The cortisol response to hot iron disbudding is significantly lower and shorter than that to surgical dehorning. This suggests that scoop dehorning may be more painful (Petrie et al., 1996; Stafford and Mellor, 2005). Also in calves disbudded with caustic paste Morisse et al. (1995) and Stilwell et al. (2007) found higher cortisol responses than in calves disbudded with hot iron. While for surgical disbudding/dehorning there is some evidence that additional cauterization may help to decrease postoperative pain (Petrie et al., 1996; Sylvester et al., 1998a; Sutherland et al. 2002b), reduction of the acute cortisol response is insufficient to recommend it to general use. Moreover, struggling and other escape behaviours during cautery indicate that it is itself an aversive experience (Stafford and Mellor, 2005).

In fact, in terms of behavioural responses during the procedure itself, hot iron disbudding elicits most struggling compared to the other methods (Stilwell et al., 2007). Stilwell et al. (2007) suggest that the difference to scoop disbudding or dehorning is mainly due to the shorter time scoop dehorning takes and the aversiveness of the contact with the extremely hot iron. Struggling in caustic paste disbudded calves is minimal and does not differ from sham disbudded calves (Stilwell et al., 2007), because caustic activity and consequently pain takes some short time to come into effect (Stilwell et al., 2007, 2009). Immediately after disbudding Morisse et al. (1995) found no difference in pain related behaviours between hot iron and caustic paste disbudded calves. Stilwell et al. (2007) concluded on the basis of their behavioural observations that in the first and third hour after treatment all three methods cause probably similar pain, but that at 6 hours pain seems to be much more severe in the scoop dehorned than in hot iron or caustic paste disbudded animals. Also when comparing responses over a 24 hour period after disbudding, scoop dehorned calves showed higher incidences of pain related behaviours than caustic paste and hot iron disbudded calves. Between the latter no significant difference was found, although the kind of behaviour was slightly different. Caustic paste disbudded calves showed more restlessness (transitions from lying to standing), inert lying, head shaking and head rubbing (Stilwell et al., 2007).

However, it has also to be taken into account that the ages of the calves were different in the different treatments (about 117 days old in scoop dehorned, 98 days old in hot iron disbudded and 25 days old in caustic paste disbudded calves).

Though there are physiological and behavioural indications that altogether least pain might be imposed by hot iron disbudding and most by surgical disbudding or dehorning (reviewed by Stafford and Mellor, 2005), a clear ranking of the different methods is very difficult, since it is generally not easy to rank different qualities of pain (cut, caustic burn and burn) in terms of unpleasantness, intensity and duration of the pain (e.g. shorter lasting, but more intensive pain versus less intensive, but longer lasting pain). Moreover, results of the different studies are not unequivocal. In addition, it needs to be stressed that the studies cited cover only periods of at most 36 hours of physiological investigation and thus knowledge about possible long-term differences between methods is lacking.

In general, it cannot conclusively be clarified how long the disbudding or dehorning pain persists. In investigations lasting 24 hours, pain related behaviour was still evident at the end (Faulkner and Weary, 2000; Stilwell et al., 2007). Stafford (unpublished data, cited from Stafford and Mellor, 2005) found dehorned calves grazing and ruminating less between 24 and 48 hours after dehorning, which suggests that there was chronic pain, even if not sufficient to stimulate a significant rise in plasma cortisol concentration. Findings in humans suggest that burn injuries involve a longer lasting pain component related to tissue regeneration and the healing process. As skin newly emerges, pain is commonly experienced together with intense tingling or itching sensations which may be almost equal in discomfort to the pain itself (reviewed by Choiniere, 1989). This may be the reason for the findings of Taschke (1995) who still observed head jerking and hind leg kicking 11 days after hot iron disbudding in several calves. One calf, for instance, showed 39 times head jerking on day 4 after disbudding and 124 times head jerking 11 days after disbudding (2 hours observation time each day). Furthermore, in mature cows, Taschke (1995) still found pain indications up to 13 days after dehorning.

In principle, it can also not be ruled out that as a long-term consequence of disbudding or dehorning neuromata may develop from the remaining stumps of damaged nerves. Neuromata may give rise to abnormal spontaneous nervous activity that is perceived as pain in the removed tissue (Beward and Gentle, 1985). Neuroma development has

been found in docked tails of piglets (Simonsen et al., 1991), lambs (French and Morgan, 1992) and fattening cattle (Branieckl, unpublished data, cited from Winterling and Graf, 1995) as well as in beak-trimmed laying hens (Beward and Gentle, 1985). However, in laying hens it appears that the risk of neuroma persistence rises with increasing age of the animals when the mutilation is carried out (Glatz, 2000). Choiniere et al. (1988, cited from Choiniere, 1989) examined patients who have been hospitalised for burn injuries. One year or more after the injury 30 % of them reported pain and about 80 % paraesthetic sensations (a skin sensation, such as burning, prickling, itching, or tingling, with no apparent physical cause) in the healed wound. Malenfant (1996) also found about 36 % of burn patients complaining about chronic pain and 71 % of paresthetic sensations in the healed wound. Regarding dehorning or disbudding there is a complete lack of investigations and therefore evidence on actual risks that such long-term pain may be present.

2.5.4.5. Distress of Handling

Restraint, firm handling of the buds without actual amputation and blood sampling by venipuncture with or without injection of a local anaesthetic, caused only transient and moderate rises of plasma cortisol levels during 20 to 40 minutes after the onset of handling and blood sampling (McMeekan et al., 1998a; Graf and Senn, 1999). Wohlt et al. (1994) found cortisol responses in control calves, which were handled and restraint as for dehorning without being actually dehorned, of one third to a quarter of that after actual dehorning. Moreover, the responses were resolved 5 hours earlier than after actual dehorning. In contrast, Sutherland et al. (2002b) did not find any significant influence of handling and blood sampling (venipuncture from the jugular vein) on plasma cortisol change, nor did Stilwell et al. (2009) find an effect of handling on plasma cortisol level or behaviour. This means that behavioural and physiological responses will in part be due to the mere handling and this part will vary according to the animal's level of fear of humans, individual differences and circumstances. However, it can be expected that in relation to the responses triggered by the actual mutilation they are of minor extent.

2.5.5. Stress and pain alleviation during disbudding or dehorning

2.5.5.1. Sedation

In order to ease the disbudding/dehorning procedure and decrease handling stress for the animals and handlers sometimes sedatives are administered. However, as Löscher (2006) described xylazine as pain alleviating in cattle, it is a rather frequent misconception in practice that deep sedation provides anaesthesia as well. Grøndahl-Nielsen et al. (1999) showed that sedation with xylazine combined with the analgesic butorphanol, used in different groups of calves before sham disbudding or hot iron disbudding, reduced physical activity like leg movements during hot iron disbudding and the cortisol response in the first 30 minutes after the procedure, but it only slightly reduced head jerks compared to non-sedated animals. Stilwell et al. (2010) also found more struggling, more ear-flicks at 10, 25 and 40 minutes and more head-shakes at 40 minutes after hot iron disbudding in xylazine-alone treated calves compared with calves treated with a combination of xylazine and lidocaine. All sedated groups showed similar high plasma cortisol concentrations, even the sham disbudded group, which was also treated with xylazine.

However, sedation made the administration of local anaesthetic easier and thus eliminated the need for physical restraint during the administration of the local anaesthetic and during dehorning.

2.5.5.2. Local anaesthesia

The cornual nerve, a branch of the Trigeminal nerve (cranial nerve V), provides sensation to the skin of the horn/bud region. Injection of a local anaesthetic around the cornual nerve, as it traverses the frontal crest, desensitizes this region (Frandsen et al., 2003). Partly different results regarding local anaesthesia effects on physiological and behavioural pain indications towards disbudding/dehorning have been obtained in different experimental investigations (Morisse et al., 1995; Petrie et al., 1996; Mc Meekan et al. 1998a, b; Sylvester et al., 1998b; Graf and Senn, 1999; Grøndahl-Nielsen et al., 1999; Sutherland et al., 2002b; Sylvester et al., 2004; Vickers et al., 2005; Stilwell et al., 2009). They may partly be due to different disbudding methods applied in calves of different ages (caustics: 10 to 35 days, hot iron: 10 days to 8

weeks, scoop disbudding: 6 weeks, scoop dehorning: 3 to 6 months) and different implementations of local anaesthesia, e.g. as regards applied volumes of the anaesthetic. For instance, Morisse et al. (1995) observed an incomplete to lacking effectiveness of anaesthesia during caustic and hot iron disbudding in 40 % of animals that still attempted to escape the operation while 60 % remained motionless showing no evidence of pain. Also Vickers et al. (2005) did not find a significant reduction of behavioural indicators of distress despite application of a local anaesthetic prior to disbudding with caustic paste. They presumed that the basic pH of the caustic paste negatively affected the action of the local anaesthetic. However, volumes of the anaesthetic used (1.5 ml lidocaine to block the cornual nerve and 3 ml s.c. at the base of the horn) might have been insufficient, as Stilwell et al. (2009) concluded from their study that even 5 ml of 2 % lidocaine injected around the cornual nerve could only reduce, but not prevent cortisol rise and pain-related behaviours. Also in the study of Morisse et al. (1995) under field conditions only volumes of 4 ml were used which in some calves might have been insufficient. They, however, considered other factors such as poor handling of calves or individual differences in the neural topography of the horn area as potential causes. Weary (2000) warns that differences in the behavioural response between treated and untreated calves can be sufficiently subtle so that it is difficult for observers to be certain if adequate nerve blockage was achieved. Therefore, efficacy of the anaesthesia should always be controlled before disbudding by testing sensitivity of the skin around the horn bud by pricking (Waiblinger, 2001; DEFRA, 2003; Stilwell et al., 2009). This also means that the person doing the disbudding or dehorning should always allow enough time (not specified) for the anaesthetic to numb the area before they begin (DEFRA, 2003).

Despite single studies that did not find indications of pain release through local anaesthesia (e.g. Petrie et al., 1996, for hot iron disbudding), Stafford and Mellor (2005) concluded in their review that in principle a cornual nerve blockade using lignocaine reduces immediate behavioural pain responses like escape behaviour seen during the disbudding/dehorning procedure and eliminates the plasma cortisol response for the duration of its action. However, calves disbudded using a local anaesthetic still require restraint, because calves respond to both, the pain of the procedure and to the physical restraint. The injection of the anaesthetic provokes transient stress and pain, not primarily due to the puncture itself, but presumably due

to the pressure caused by the injected volumes (Graf and Senn, 1999). However the slight rise of cortisol concentration and defence actions often ceased already during the injection, because anaesthesia rapidly takes effect (Graf and Senn, 1999). Nonetheless, calves must also be restrained while the local anaesthetic is administered, as well as during the actual dehorning. This leads to the suggestion that not only local anaesthetics but also sedation should be applied, and in addition analgesia with a non-steroidal anti-inflammatory drug (Stafford and Mellor, 2005) as will be discussed below. However, it must also be considered that sedation might cause additional stress (Stilwell et al., 2010) and depending on its extent, might reduce physical responses to insufficient anaesthetic effects so that monitoring anaesthesia efficacy becomes more difficult. Consequently, in calves used to close human contact that show no major stress response to the handling procedure itself, refraining from sedation is advisable.

2.5.5.3. Nonsteroidal anti-inflammatories

Local anaesthesia does not provide an adequate post-operative pain relief. After the anaesthetic effect has worn off, an increase in plasma cortisol concentration occurs (Sutherland et al., 2002b; Stilwell et al., 2009), which may last on high level for about 5 hours (Sutherland et al., 2002b). Faulkner and Weary (2000) found a surge in pain related behaviours 3 to 12 hours after hot iron disbudding of calves treated with local anaesthesia. The most popular local anaesthetic, lignocaine or lidocaine, is effective for only about 2 hours after administration, bupivacaine for 4 hours (Stafford and Mellor, 2005). This is reflected by calves treated with anaesthetics showing significantly higher cortisol concentrations up to 24 hours post hot iron disbudding than anaesthetised not disbudded calves (Morisse et al., 1995). Further studies indicate that calves treated with local anaesthetics actually have higher plasma cortisol levels than untreated animals after the local anaesthetic loses its effectiveness (McMeekan et al., 1998a; b; Graf and Senn, 1999). After scoop dehorning even extending the local anaesthesia to 8 hours by giving bupivacaine a second time 4 hours after disbudding, did not abolish the cortisol response (McMeekan et al., 1998a). On the contrary, the plasma cortisol concentration increased sharply at 8.3 hours after dehorning when the anaesthetic effect had ended and increased steadily until the last sampling at 9.3 hours after dehorning. Concentrations were then higher

than in animals dehorned without anaesthetic treatment (McMeekan et al., 1998a). McMeekan et al. (1998b) assumed that local anaesthesia might indirectly enhance inflammatory pain in dehorned calves, because cortisol is a potent anti-inflammatory substance in mammals, but is markedly reduced during the period of local anaesthesia. Thus, the prevention of the usual large cortisol response during the nerve-blockade could lead to unimpeded progression of inflammatory reactions in the amputation wounds (McMeekan et al., 1998a). Another explanation may be that calves not given local anaesthesia may become habituated to the noxious sensory input originating from the wounds, so that they may still experience nociceptor input, but this does not elicit such a large cortisol response anymore due to feedback mechanism in the hypothalamic-pituitary-adrenocortical-system that tend to lead back to homeostasis. As described in chapter 2.2.4.2., the return of cortisol levels to pre-treatment values may not in any case indicate an actual relief from pain.

In any case, administration of nonsteroidal anti-inflammatories (NSAIDs), e.g. ketoprofen (phenylbutazone is ineffective according to Sutherland et al., 2002a), is a good option to prolong postoperative analgesia (McMeekan et al., 1998a; Faulkner and Weary, 2000; Stafford and Mellor, 2005). Oral administration of ketoprofen in the milk 2 hours before and 2 and 7 hours after hot iron disbudding of 4 to 8 week old calves (combined with xylazine and lidocaine injections), significantly reduced head shaking 3 to 12 hours after disbudding and ear flicking 3 to 24 hours after disbudding compared to control animals only treated with xylazine and lidocaine. Additionally, ketoprofen treated calves tended to gain more weight during the total observation time of 24 hours after disbudding compared to control animals (Faulkner and Weary, 2000). However, calves thus treated with ketoprofen showed still some head shaking and ear flicking. Furthermore, the treatment did not reduce the frequency of head rubbing at all, whereas the frequency of pain related behaviours in sham disbudded control calves were near zero (Faulkner and Weary, 2000). McMeekan et al. (1998b) found that plasma cortisol and behavioural responses were kept close to baseline levels in the hours following dehorning, although there was a small but significant increase of cortisol concentration 30 minutes after dehorning.

It is important to note that ketoprofen or other NSAIDs will have little effect on the pain caused by the amputation itself, as its action is on the inflammatory pain that starts not until 2 hours after disbudding/dehorning. On this line, ketoprofen alone

(injected intrajugularly 15 to 20 minutes before scoop disbudding) did not significantly reduce the initial peak in plasma cortisol concentration during the first 1 to 3 hours after disbudding compared to animals disbudded without ketoprofen, whereas the plasma cortisol concentration returned earlier to pre-treatment levels at about 2 hours rather than 8 hours after disbudding (McMeekan et al., 1998b). However, in calves younger than 2 weeks and disbudded by hot iron, intramuscular administration of ketoprofen in addition to lidocaine produced a reduction in cortisol concentration already within the first 3 hours after disbudding, but did not affect later cortisol responses up to 8 hours post disbudding compared to animals solely treated with lidocaine (Milligan et al., 2004). The authors assume that the potentially beneficial effect of using a nonsteroidal anti-inflammatory drug increases with the size of the horn buds removed, as the amount of tissue damage and postoperative inflammatory pain should increase accordingly.

2.6. Conclusions regarding disbudding, dehorning and pain alleviation

While dehorning has markedly stronger negative welfare effects than disbudding, any method of disbudding/dehorning causes distress and pain in the treated animals, which should be alleviated as far as possible, preferably by a combination of sedation (in animals not used to handling), local anaesthesia and anti-inflammatory treatment. Sedation allows an easier administration of the local anaesthetic without major struggling, but might interfere with control of anaesthesia efficacy. The combination of a sedative, if necessary and local anaesthetic allows disbudding/dehorning without immediate pain and stress response, and the addition of a non-steroidal anti-inflammatory drug reduces the pain during the hours following disbudding/dehorning. Efficacy of local anaesthesia shall be individually controlled.

3. Quantitative survey

3.1. Introduction

Dairy farming is an important sector in German agriculture. In total 87 162 cattle farms exist in Germany, of which 62% keep dairy cows (33.4 % of all cattle in Germany are adult dairy cows; Statistisches Bundesamt, 2011). Germany holds most dairy cows out of all 27 EU countries in 2010 (AHDP, 2011).

No official statistical data are available about the extent of disbudding/dehorning in dairy cattle or keeping polled cows, and about the common disbudding/dehorning practices regarding cattle age at which the procedure is carried out, medication used or qualification of the operators. Such data would allow an evaluation of the degree of possible welfare problems or of potentials of change. Within the EU-financed project ALCASDE (Alternatives to castration and dehorning) and within the framework of this dissertation it was not possible to conduct a large representative survey. However, using a web-based questionnaire, it was the aim to collect quantitative data from a maximum number of cattle experts (i.e. veterinarians, technicians for artificial insemination, advisors etc.) and farmers in the German dairy cattle sector on extent and manner of disbudding/dehorning and distribution of polled cows or those kept with horns. Furthermore, a quantitative overview over different reasons and motivations of German farmers for decisions for or against horned or polled cattle shall be given.

3.2. Materials and methods

Two different questionnaires (Annex 1, Annex 2) were set up as web-based forms for farmers and experts on the homepage of the University of Kassel in spring 2009. They contained questions on general information about the surveyed farms, disbudding/dehorning practises (methods, age of the treated animals, medication, and person carrying it out) and asked for opinions and experiences about the topic.

Chambers of Agriculture of the Federal States, Associations of Milk Inspection Boards of the Federal States, Chambers of Veterinarians of the Federal States, the Federal Association of Clinical Veterinarians (BPT), Cattle Breeding Associations and the Farmers' Organisation, altogether 117 institutions or organisations, were contacted by telephone or email and asked to inform their members about the

questionnaire and to provide the link to it. Farmers and experts could fill in the form in the internet and submit via internet, e-mail, fax or mail. Every expert's answer was weighted according to the number of farms and animals it represented and according to the proportion of dairy farms in the Federal State the surveyed farms were located in (based on census data from Statistisches Bundesamt, 2009).

3.3. Results

As it is unknown how many experts and farmers received the link to the questionnaires by the contacted institutions or organisations, no response rate can be ascertained. Altogether 226 dairy farmers (=0.23% of all German dairy farms) and 36 experts, covering about 7313 farms (=7.4% of all German dairy farms) submitted the questionnaire. The information from the farmers' survey can be classified as census data, since farmers and farm managers gave information about the farms they work on. Information given by experts was mostly classified by themselves as fairly reliable estimates (52%) or rough estimations (42%) and only a low percentage as census data (6 %). The regions surveyed by the experts are shown in Fig. 3.1 and the percentages of the farmers' answers according to federal states are presented in Tab. 3.1.

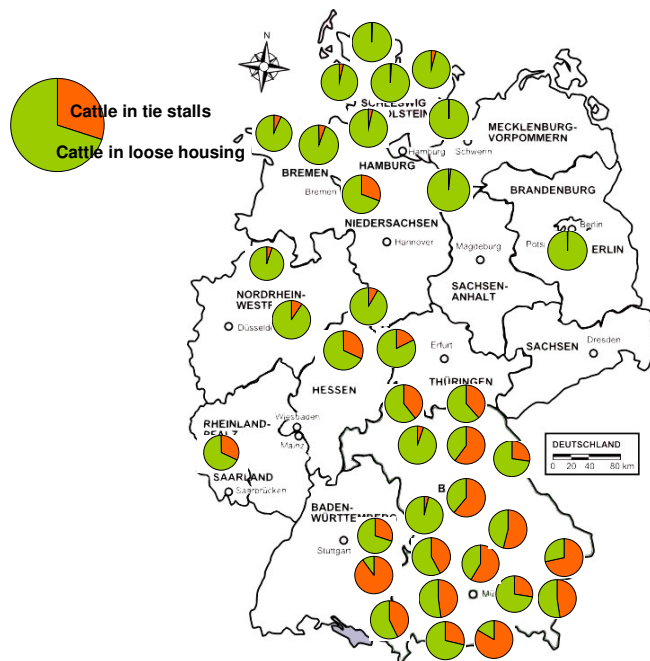


Fig. 3.1: Proportion of tie stalls and loose housing as reported from the experts involved in the survey from their different home regions (one chart for every response, n = 36).

Tab. 3.1: Home states of farmers involved in the survey (n = 226)

Federal states involved:	Number of answers	% of all answers
Bavaria	97	42.9
Lower Saxony	80	35.4
Schleswig Holstein	14	6.2
Hesse	12	5.3
North Rhine Westphalia	8	3.5
Mecklenburg-Western Pomerania	3	1.3
Brandenburg	3	1.3
Rhineland-Palatinate	3	1.3
Saarland	2	0.9
Baden-Württemberg	2	0.9
Saxony	1	0.4
Thuringia	1	0.4

3.3.1. Size of farms, housing systems, herd sizes, production schemes and proportions of dehorned cows

According to experts` and farmers` survey, the dairy breeds predominantly kept were Holstein Friesian, Red Holstein and Simmental. The number of dairy cows on the surveyed farms ranged from 10 – 1100 per farm, with a mean value of 71 cows per farm. Experts estimated an average number of dairy cows of 64 animals in loose housing systems and 27 cows per farm in tie stalls; in the responding farmers the respective data were 29 cows per farms in tie stalls and in loose housing 85 cows per farm. Small herds were rather kept in tie stalls (Fig. 3.2). The most widespread housing system according to the farmers` survey is cubicle housing (67%), and only 6 % of all interviewed farmers used deep litter housing (experts 53% loose housing, not distinguished according to cubicles and deep litter housings). Experts estimated a much higher proportion of tie stalls (47%) than present among the surveyed farmers (27%). The distribution of the different housing systems across Germany is very uneven, with increasing proportions of tie stalls from north to south (Fig. 3.1).

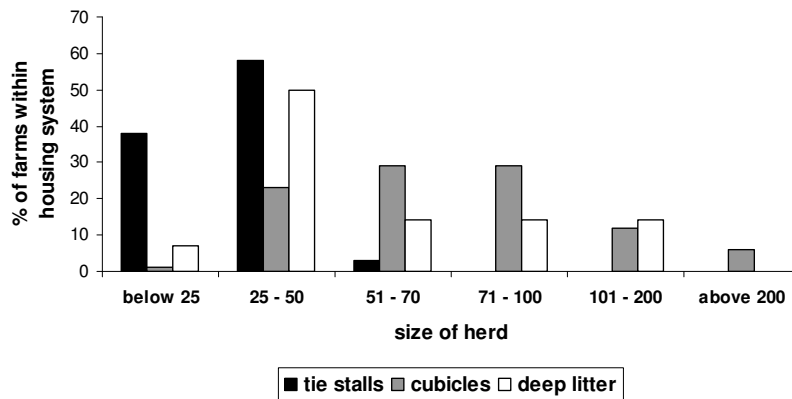


Fig. 3.2: Housing systems according to the herd size (farmers' survey, n = number of answers = 225)

The majority (92 %) of the surveyed farms produced conventionally. This corresponds well to the experts' estimations of 93 %. Experts further assumed that organic farms have less tie stalls and in general smaller herd sizes than conventional farms (Tab. 3.2). Indeed, there were some more surveyed organic than conventional farms in the size range below 50 cows and no organic herds with sizes between 100 and 200 animals, but even more organic farms in the size range above 200 (Fig. 3.3).

Tab. 3.2: Herd sizes and proportions of tie stalls in organic and conventional farms (experts' survey, n = number of answers = in brackets)

	organic	conventional
Average number of cows	30 (28)	53 (34)
% of tie stalls	35 (26)	48 (30)

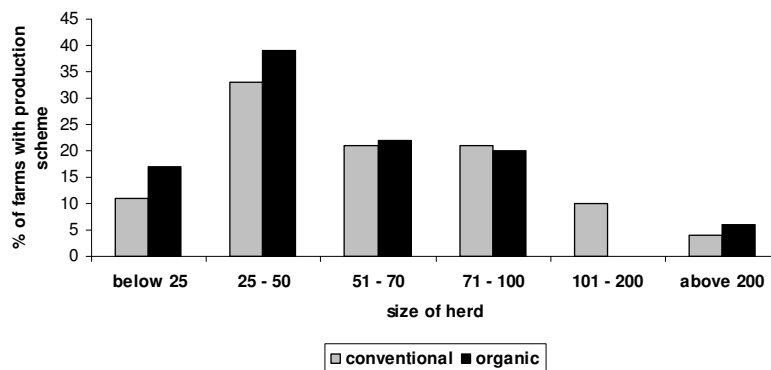


Fig. 3.3: Herd size in relation to the production scheme (farmers' survey, n = number of answers = 224)

According to the experts 76 % of conventional and 33% of organic farms practise disbudding/dehorning, so in total 70.4% of dairy farms keep more than 70% of their cattle dehorned. Table 3.3 shows the proportion of dehorned cows according to farmers` survey. Of the surveyed conventional farms 94% kept over 70 % of the herd dehorned, whereas it were only 33% of organic farms.

Experts reported the proportion of farms with dehorned cows much higher with loose housing (91.2 %, farmers: 89% over 70 % dehorned cows) than with tie stalls (51.9 %, farmers: 80 % over 70 % dehorned cows). The surveyed farms with loose housing predominantly kept horned herds on deep litter, whereas cubicle housing was most unusual for horned cows (2 %, experts: not distinguished between loose housing systems), and this housing system had the highest proportion of 100 % dehorned cows in the herds.

Tab. 3.3: Proportion of dehorned cows per farm (farmers` survey, n = number of answers = 226)

Cows dehorned per farm	% of farms
100 %	65.9
70-99 %	23.0
50-70 %	1.3
25-50 %	0.9
<25 %	0.9
0 %	8.0

3.3.2. Disbudding and dehorning - Age and technique

Calves are predominantly disbudded before they reach the age of two month (Tab. 3.4, Tab. 3.5).

Tab. 3.4: Percentages of animals per farm disbudded/dehorned at different ages (multiple responses possible, farmers' survey), in brackets: n = number of valid answers

Percentages of animals	0%	<25%	25%-50%	50%-75%	75%-99%	100%	Number of valid answers	Missing answers
0-2 weeks	40.1 (47)	23.2 (33)	9.9 (14)	4.9 (7)	10.6 (15)	11.3 (16)	142	37.2 (84)
2-6 weeks	3.8 (7)	8.6 (16)	9.1 (17)	15.6 (29)	30.1 (56)	32.8 (61)	186	17.7 (40)
6-8 weeks	28.1 (32)	38.6 (44)	9.7 (11)	7.9 (9)	9.7 (11)	6.1 (7)	114	49.6 (112)
> 2 month (incl. adult animals)	77.9 (74)	16.8 (16)	1.1 (1)	0 (0)	3.2 (3)	1.1 (1)	95	58.0 (131)

Tab. 3.5: Age of treated animals according to the used method in experts' survey, in brackets: n = number of valid answers

	Age in weeks, mean (range) (n)
Hot iron (cautery)*	4 (1-9) (32)
Caustic paste**	3 (1-6) (15)
Scoop/tube	2 – 4 (3)
Wire/saw	24 (8-48) (28)

Hot iron is the most prevalent method applied for disbudding, 88 % (farmers' survey) to 95 % (experts' survey) of farms use it (Tab. 3.6). Concerning disbudding, the operator is mostly the stockperson (Tab. 3.7, 3.8). Dehorning with wire saw is rather infrequently performed and more often implemented by a veterinarian; 85% according to experts' survey and 47% according to farmers' survey.

Tab. 3.6: Proportions of farms practicing the different disbudding/dehorning methods, in brackets: n = number of valid answers

	% of farms; experts' survey (n)	% of answers, farmers' survey (n)
Hot iron (cautery)	95.2 (29)	88.3 (197)**
Caustic paste	4.5 (28)	3.6 (8)***
Scoop/tube	0.2 (29)	1.3 (3)
Wire/saw	2.0 * (29)	6.7 (15)

* The dehorning methods were asked in an extra question apart from the disbudding methods. Since all disbudding methods therefore relate not to all calves but only to the calves that get disbudded (and not dehorned), the total value including also the dehorned calves does not sum up to 100%

** 3 answers: hot air disbudding ("Heißluftgerät")

*** 2 answers: nitric acid

Tab. 3.7: Person carrying out disbudding (% of farms, experts' survey), in brackets: n = number of valid answers

	Survey (n)	Stockperson (n)	Veterinarian (n)	Other person* (n)
Hot iron (cautery)	experts	87.7 (35)	4.3 (35)	7.9 (15)
	farmers (205)	87.7	2.5	9.7
Caustic Paste	experts	97.9 (27)	0.3 (27)	0.7 (10)
	farmers (7)	71.4	14.3	14.3
Scoop/Tube	experts	-	-	-
	farmers (3)	0	66.7	33.3

* professionally trained person, just someone, who has time, person responsible for claw trimming apprentice, farm manager, person responsible for milk performance test, person responsible for artificial insemination

- = no figures given

3.3.3. Measures concerning pain relief and disinfection

Caustic paste apparently is mostly applied without any accompanying treatment (Tab. 3.8), and according to experts' survey the usage of disinfection after this procedure is also not common (Tab. 3.9). In hot iron disbudding, sedation is partly used, but very little local anaesthesia and analgesia (Tab 3.8), which is more frequently applied in surgical disbudding and dehorning with wire saw (Tab. 3.8). The experts estimated that about half of the farms use disinfection after hot iron disbudding and scoop disbudding (Tab. 3.9) and that most farms use it after dehorning (Tab. 3.9). Irrespective of the applied method of dehorning, the majority (77%) of the surveyed farmers stated that they do not apply any treatment after disbudding/dehorning (Tab.3.10).

Tab. 3.8: Use of drugs during disbudding/dehorning (% of farms)

	Survey	N	SED	LA	AG	SED + LA	SED + AG	LA + AG	SED + LA + AG	None	Total
Hot iron (cautery)	Experts	31	42.0	6.4	0.9	3.2	0.4	3.0	0.7	43.6	100.2
	Farmers	142	48.6	2.1	0	4.2	0.7	0	0.7	43.6	
Caustic Paste	Experts	13	5.7	0	7.5	0	3.4	0	0	83.4	100
	Farmers	6	16.6	0	0	0	0	0	0	83.3	
Scoop/Tube	Experts	4	8.3	8.3	8.3	47.8	1.3	0	26.3	0	100.3
	Farmers	3	0	0	0	33.3	33.3	0	0	33.3	
Wire/saw	Experts	23	20.2	10.0	0	45.5	1.1	1.1	20.2	1.9	100
	Farmers	15	40.0	33.3	0	20.0	0	0	6.7	0	

SED = sedation, LA = local anaesthesia, AG = analgesia

Tab. 3.9: Treatment after the procedure (experts` survey), in brackets: n = number of valid answers

	% of farms using disinfection (n)	% of farms using other treatments
Hot iron (cautery)	45 (35)	-
Caustic Paste	3(17)	-
Scoop/Tube	45 (12)	-
Wire/saw	67(23)	0.7*

* head bandage, styptics, wood tar, antiparasitics

- = no information given

Tab. 3.10: Disbudding/dehorning – Treatment after procedure (farmers` survey, multiple answers possible, n = 237)

	None	Disinfection	Other*
% of answers	77	23	16
% of treated animals of all animals disbudded on the farms (mean value)	91.8 (min: 10 max: 100)	83.4 (min: 1 max: 100)	44.7 (min: 17 max: 100)

* homeopathy against pain (3 answers); tourniquet against the bleeding (3 answers);

“qualimec” in the summer against maggots in the wound (2 answers)

3.3.4. Opinions and experiences concerning disbudding/dehorning

Among the choice of possible reasons to practice disbudding/dehorning presented in the questionnaires, experts as well as farmers found reduced risks for the stockman and for injuries amongst pen mates to be most relevant (Tab. 3.11). Partly, additional reasons were specified (Tab. 3.12).

Tab. 3.11: Reasons for practising disbudding/dehorning (multiple responses possible), number of answers, in brackets: percentage of answers

	Survey	1 most relevant	2	3	4	5	6 less relevant
		n. of answers					
to reduce the risk for the stockman to be injured by cattle horns	experts	16	16	3	0	1	1
	farmers	156 (76.1)	33 (16.1)	9 (4.4)	4 (2)	1 (0.5)	2 (1)
to allow easier handling of cattle	experts	14	16	5	0	1	1
	farmers	128 (63.1)	47 (23.2)	18 (8.9)	6 (3)	1 (0.5)	3 (1.5)
to reduce the risk of injuries among pen-mates	experts	19	13	3	2	0	0
	farmers	149 (73.4)	36 (17.7)	8 (3.9)	4 (2)	1 (0.5)	5 (2.5)
to adjust cattle to the existing housing facilities	experts	6	10	7	6	7	0
	farmers	48 (23.9)	26 (12.9)	45 (22.4)	29 (14.4)	17 (8.5)	36 (17.9)
to reduce the risk of carcass depreciation due to skin lesions	experts	0	0	1	5	8	23
	farmers	15 (7.6)	7 (3.6)	30 (15.2)	33 (16.8)	31 (15.7)	81 (41.1)
others	experts *	3	4	2	2	4	11
	farmers**	20 (15.2)	11 (8.3)	17 (12.9)	9 (6.8)	11 (8.3)	64 (48.5)

* easier to sell cattle without horns; requirements of breeding associations; financial losses at the sales of breeding cattle

** see Table 3.12

Tab. 3.12: Additional information from farmers about their motivations to keep dehorned cows (open question)

Reason	Number of times mentioned
Better social behaviour amongst dehorned cattle (calmer)	16
Easier to sell cattle without horns/ financial losses at sales of breeding cattle	9
Horns cause problems with technical devices and stable equipment (fences, milking- and feeding techniques, water pipes)	9
Injuries from the feeding rack (e.g. horns pulled off)	4
Planning change to loose housing	3
Horns cause problems in the fishbone milking parlour	1
Requirement of farmers insurance	1
Risk of injuries to the udder caused by horns	1
Security for the partly disabled stuff/stockpeople	1

In a further question farmers and experts agreed that access to cattle markets (farmers: 25%; experts: 25%), requirements of the slaughterhouse (farmers: 2%, experts: 3%) and the requirements of the farmer insurances (farmers 20%; experts: 20%) are obligations to dehorn. According to experts and farmers the only obligation not to dehorn arises from the quality scheme of the organic association Demeter.

Most experts judged that cattle breed does not affect the decision to dehorn. Almost half of them (47 %) stated that females are dehorned more often than male cattle. The vast majority of experts did not agree with the notions that local traditions influence the decision to dehorn (94 %), that better educated farmers disbud more often (86 %) and that horned cows are rather kept by older farmers (83 %). In fact, the surveyed farmers below 30 years of age kept proportionally more horned cows (25 % in this age range) than farmers above 30 years (7% of in the age range 31- 50 and 13% of farmers above 50 years).

Only 13 % of farmers and 50 % of experts knew of specific training opportunities regarding the practice of disbudding/dehorning. These were courses of instruction offered by veterinarians, advisors, breeding associations, insurances, agricultural schools, chambers of agriculture of the Federal States and research centres but also the instructions during farmers training, technical literature and specialised press. The majority of farmers (82 %) and experts (58 %) did not see any discussion about disbudding/dehorning going on, nor did they see any attempts to improve the current

practice of disbudding/ dehorning. Experts saw potentials for improvement in an increased use of anaesthetics, sedation, analgesia, disbudding instead of dehorning and furthermore, to put more efforts into breeding of suitable polled cattle and to promote a better practice of disbudding. Areas in which the surveyed farmers could see possibilities for improvements in the disbudding/dehorning practice were better pain alleviation and sedation, disbudding at an early age and better restraint of the calves during disbudding (fixation box). The majority of farmers (72 %) was interested in polled cattle, 5 % would consider implementing new housing facilities to allow the keeping of horned cattle, but 30 % were not interested in alternatives to disbudding/ dehorning (multiple responses were possible: 203 persons answered and 227 answers were given). Likewise the majority of experts (67 %) regarded polled cattle as the only serious alternative to disbudding/dehorning and only one expert mentioned that new/other housing facilities could be an alternative as well. In an open question some farmers stated that it would be good to have other methods of disbudding/dehorning and some would welcome the re-launch of caustic paste or/and improved hot iron devices (higher temperatures and therefore faster).

3.3.4.1. Keeping horned cattle as an alternative to disbudding/dehorning

Though only 34% of the interviewed farmers kept (also) horned cows, 38 % of the farmers filled in the questions about specific additional expenditure necessary to keep horned cattle (Tab. 3.13) and 15 % of farmers stated their main reasons to prefer horned animals (Tab. 3.14) although only 11% kept more than 70% of their cattle horned.

Tab. 3.13: Agreement with different statements about necessary additional expenditures in order to keep horned cattle, multiple responses possible: n = 87 farmers answered and 159 answers were given.

	n. of answers	% of answers
No specific additional expenditure*	20	23.0
Requires larger housing facilities	19	21.8
Requires more efforts for management **	15	17.2
Requires special arrangement of housing	17	19.5
Requires more caution to handle the animals	75	86.2
More working time per day	13	14.9

* horned cows are healthier, therefore less costs

** calmness in handling, continuous observing of the herd to spot problems

Tab. 3.14: Agreement with different possible reasons for keeping horned cattle, multiple responses possible, n = 34 farmers answered and 65 answers were given

	n. of answers	% of answers
Saves the work of disbudding/dehorning	10	29.4
No bad experience with horned cattle	16	47.1
Horns belong to the nature of the cow	21	61.8
Horns belong to “my” breed	13	38.2
Horns are tradition	5	17.7

3.3.4.2. Breeding polled cattle as an alternative to disbudding/dehorning

Experts estimated about 2.2 % of the farms to keep polled dairy cattle. In fact, no surveyed farmer kept above 70% of the herd polled, but 8.5% kept some polled cows (below 25% of the herd). From the choice of three different reasons to keep polled cattle 19 % (n = 42) of the farmers chose one or more options (84 answers given), with the aspect of labour reduction being chosen most often (79%; promotion of polled breeds 72%; animal welfare: 60%).

3.4. Discussion

3.4.1. Representativeness of survey results

An important question for the evaluation of the results of the survey is to which degree experts and farmers reported about a representative sample of dairy farms in Germany. The farmers’ survey covered only 0.23% of all dairy farms and 0.38% of all dairy cows in Germany, but it can be classified as census data. Experts’ survey, in contrast, indeed covered 7.4% of all dairy farms and 6.8% of all dairy cows in Germany, but information given by experts was mostly classified by themselves as fairly reliable estimates (52%) or rough estimations (42%) and only a low percentage as census data (6 %).

However, the experts’ estimation of the average number of dairy cows per farm (46 cows) corresponds well with official census figures of 45 dairy cows (Statistisches Bundesamt, 2010). The surveyed farmers, however, kept on average 71 cows. This reflects a certain bias in the likelihood to answer to the questionnaire towards farmers keeping bigger herds. Likely this is due to the way of distribution of the questionnaire via internet from the organisations to the farmers. Smaller farms may be less

organised in organisations and/or may not always have internet access. Still, the figures of the farmers' survey are to a certain degree astonishing, as the proportions of answers from Bavaria were relatively high (43 %). In Bavaria farm sizes are relatively small (28 cows per farm, aid, 2009). However, also within Bavaria the bias towards bigger herd sizes as explained above may have worked and the 3.5 % of answers from the eastern federal states (including one farm with 1100 dairy cows) had raised the average number a lot. The average number of dairy cows on organic farms according to the experts' estimations was lower (30) than on conventional farms (53). The data concerning organic farms correspond well with Hörning et al. (2005), who calculated a median herd size of 30 dairy cows.

The experts' estimation of 47 % tie stalls is much higher than data from Statistisches Bundesamt (2010a) of only 27 % of tie stalls in Germany, which is exactly in accordance with the 27% of tie stalls in the farmers survey. Reason for the assessment of the experts might be the high number of answers from Bavaria. According to Sprengel (2009), surveying 27906 Bavarian dairy farms, 65 % of conventional Bavarian dairy farms have tie stalls with an average number of 26 cows per farm. From organic dairy farms in Bavaria, 60 % have loose housing systems with 41 cows per farm on average (Sprengel, 2009). Both the samples of the farmers' and experts' survey represent about double of the actual proportion of organic dairy farms which was in 2009 at 4 % (Deutscher Bauernverband, 2009; 4.7 % in Bavaria, Sprengel, 2009). Possibly organic farmers and experts associated with organic farming had a higher motivation to participate in the survey, since the topic of mutilations of animals is more critically seen in organic production (EU Regulation on Organic Agriculture, 2008). Against the background of this disproportionately high percentage of organic farms and only very few answers from the eastern federal states (experts: 1 answer = 2.8%; farmers: 8 answers = 3.5%), which are known for much bigger herd sizes (ADR, 2010: average herd size in eastern federal states: 158; average herd size in western federal states: 45), the results are of limited representativeness for entire Germany.

3.4.2. Proportion of dehorned cows

Experts estimated that 70% of the farms are mainly keeping dehorned dairy cows. This comparatively low rate of dehorned animals corresponds with data from Lüdtke, 2004, who found 79% dehorned cows in a survey covering 426 Bavarians farms, of which 70% were dairy farms and 60% had tie stalls. Again, the high percentage of answers from Bavaria seems to make the data from experts' survey more representative for the situation in Bavaria than for entire Germany. Although the answers were weighted state wise according to the proportion of farms in the single States (based on the census data from Statistisches Bundesamt, 2009), the weighting could not change the proportions, because Bavaria is the state with the most dairy farms in Germany.

Regarding the farmers survey, about 90 % of the farms kept dehorned cows. This result is probably more representative for the situation in Germany, although a high proportion of farmers answered from Bavaria as well. Firstly, the surveyed farmers had on average bigger herds than the average herd size in Bavaria and furthermore, it is unlikely, that dehorning farmers were more motivated than farmers keeping horned cows, to submit the survey.

Due to the fact, that the eastern regions of Germany, which are known for bigger herd sizes (ADR, 2010), were underrepresented in the survey (according the Statistisches Bundesamt, 2010, 38% of German dairy farms keep more than 100 dairy cows and it were only 16% in the farmers` survey) the average percentage of dehorned dairy cows in entire Germany might be even higher than 90%.

Although only a minority of 28 % of experts stated that horned cows are rather kept on smaller farms with smaller herds, among the surveyed farmers horned cows were actually mostly kept on smaller farms. Also Hörning et al. (2005), who investigated 278 organic farms (including 50 % of farms with horned cows) found horned herds to be significantly smaller than dehorned herds (29.3 vs. 41.5 cows/herd). On smaller farms it is probably easier to establish a good human-animal relationship, which is crucial to handle horned herds (Waiblinger, 1996). Furthermore, in the focus group discussions, some farmers keeping horned cattle expressed their opinion that herd sizes above 100 animals negatively affect the social stability within the herd, leading to more conflicts and thus to more injuries in horned herds (see chapter 4.3.1.).

According to cattle experts from 25 European countries (including also data from the German experts of the current survey) 82 % of all dairy farms in the EU dehorn their cattle (Cozzi et al., 2009). Regarding this, it should be taken in mind that the conditions of dairy farming (herd size, housing facilities, use of pasture, performance status, breeds etc.) across Europe are quite heterogeneous and sometime very different from the German situation and therefore a direct comparison is not possible. In general, it was found in both surveys that organic farms dehorn less than conventional farms (more than 70 % of the herd horned on organic farms: 66 % according to farmers and experts; on conventional farms: 6 % according to farmers, 24% according to experts), which is in line with results from Hörning (2000a), who found on 241 German dairy farms that 10 % of conventional herds and 51 % of organic herds were horned. European data also show the tendency that the majority (74 %) of conventional dairy farms disbud/dehorn their animals, whereas “only” 43 % of European organic farms practise disbudding/dehorning (Cozzi et al., 2009), which is about 10 % more dehorned cows on organic farms than found in both surveys in Germany. Regarding that the EU-Regulation on Organic Agriculture (2008) states that “operations such as dehorning may not be done routinely” the percentages of dehorned organic dairy cows seem rather high. However, “the competent authority may allow them for reasons of health or security, case by case” (EU Regulation on Organic Agriculture, 2008).

Another aspect is the standard regarding space allowances stipulated by the EU-Regulation on Organic Agriculture (2008). Conventional housing systems are not bound to any minimal space allowance per dairy cow whereas organic farms should provide at least 6 m² per dairy cow in the stable and 4.5 m² outdoor area per cow (EU Regulation on Organic Agriculture, 2008). More generous space allowances are in accordance with the needs of horned cows (Schneider, 2008). Conventional farmers willing to keep a horned herd, may have more problems than organic farmers to attain adequate prices for their products in relation to increased costs due to higher space allowances, adequate stable equipment and higher management efforts. On European level dehorning was found to be less frequently performed in tie stalls (49 % of dehorned cattle) than in loose housing (87 %, Cozzi et al., 2009). This was confirmed in the current surveys (80 % in tie stalls vs. 90% in loose housing over 70 % of the herd dehorned).

3.4.3. Methods of disbudding/dehorning and pain alleviation

Farmers as well as experts stated that it is quite common in Germany to disbud calves before they reach the age of two month, which is in accordance with the German Animal Welfare Act (Tierschutzgesetz, 2006) that allows disbudding of calves below the age of six weeks without medication. Dehorning of older cows represents rather an exception than routine in Germany and may only be carried out by a veterinarian under administration of anaesthesia which again may only be applied by a veterinarian (Tierschutzgesetz, 2006).

According to the European survey data from Cozzi et al. (2009), 89 % of all treatments to suppress/remove the horns are performed in calves younger than 8 weeks (disbudding), whereas only 11 % are done in older animals (dehorning), which is in agreement with scientific recommendations (Weary, 2000, see chapter 2.5). Just as the vast majority of German farmers disbuds the calves between 2 and 6 weeks of age with hot iron, this is also the most common method used in northern (Denmark, Estonia, Finland Ireland, Sweden, United Kingdom) and central (Austria, Czech Republic, France, Germany, Netherlands) European countries. In Germany, the only applied method to dehorn adult dairy cows is the amputation by wire/saw. In other EU states this is also the predominant method, besides the regionally restricted use of dehorning shears (Denmark, France, UK, Sweden) or tubes (Greece, Bulgaria, Cozzi et al., 2009), which are broadly unknown in Germany.

Although the application of caustic paste is prohibited in Germany by the Arzneimittelgesetz (2005), experts as well as farmers reported its use to a low extent (4 %). In contrast, this method is the prevailing disbudding method used in Spain and Portugal (Cozzi et al., 2009).

Since application of anaesthesia during disbudding of calves below the age of 6 weeks is not mandatory (Tierschutzgesetz, 2006), it was to be expected that such medication is not common in disbudding with hot iron (4.2 %) or caustic paste (0 %). According to the EU Regulation on Organic Agriculture (2008), however, “any suffering to the animals shall be reduced to a minimum by applying adequate anaesthesia and/or analgesia ...”.

However, almost 50 % of the surveyed farmers in Germany used sedation for hot iron disbudding. One reason could be that hot iron disbudding elicits most struggling

behaviour compared to the other methods (Stilwell et al., 2007). Behaviours like scurrying, urging forward, head jerking and rearing (Taschke, 1995; Graf and Senn, 1999) are likely to be bothersome during the disbudding procedure and therefore curtailed with sedation. In addition, in Germany the veterinarian may hand over sedative drugs to the farmer for the farmer's use. Therefore, the application of sedatives is cheaper and easier to organise than the application of local anaesthetics which must be administered by the veterinarian according to the German Animal Welfare Act (Tierschutzgesetz, 2006). In addition, many farmers may expect that sedation also provides anaesthesia for the calves (Knierim, 2011). However, as discussed in chapter 2.5.6.1., this is not fully the case. The non-use of sedation during disbudding with caustic paste is likely linked with the lacking or minimal struggling behaviour during application of the caustic paste (Stilwell et al., 2007). This may again mislead farmers to believe that no pain is involved (see chapter 4.3.3.) which is, however, not true as discussed in chapter 2.5.4.

The only medication capable to ease the inflicted pain during and after disbudding efficiently to a certain extent (anaesthesia in combination with an anti-inflammatory drug, McMeekan et al., 1998a; b; Graf and Senn, 1999; Faulkner and Weary, 2000; Stafford and Mellor, 2005) does not occur often in practice. According to the experts, it is used in 3.7 % of the farms for hot iron disbudding and never for caustic paste disbudding. Applications indicated in the farmers' survey are even lower (0.7 % hot iron, 0 % for caustic paste and scoop/tube, 6.7 % for wire/saw), although the German Animal Welfare Act requires to minimize pain as far as possible (Tierschutzgesetz, 2006).

According to Cozzi et al. (2009), in some other European countries application of local anaesthesia in disbudding is more usual, leading to European average figures of 75.3 %. Sedation is less common, and on average applied in 41.1 % of the farms (14.2% in combination with local anaesthesia, 6.2% with anaesthesia and analgesia). Also on European level, the application of anaesthetics in combination with analgesics is low (10.1 % during dehorning, 7 % during disbudding, Cozzi et al., 2009).

In Germany, even during the dehorning procedure, only 60% of the surveyed farms (77% in experts' survey) use local anaesthesia. It may be that farmers do not know in every case exactly the kinds of drugs that have been administered by the veterinarian.

The relatively high number of reported dehorning procedures that are seemingly against the applicable law (Tierschutzgesetz, 2006), show that more information efforts are needed to convey the standards of the Animal Welfare Act to farmers and veterinarians.

A further point for improvements is the low use of disinfection after the disbudding/dehorning procedure. Data from the current farmers` survey indicate that most farmers (77 %) do not use disinfection after disbudding/dehorning. The incidence of infections after hot iron disbudding can be up to 46 % (Taschke, 1995). After the dehorning of adult steers, Winks et al. (1977) recorded 36 % of the cases developing infections. Therefore, disinfection should be used routinely after disbudding/dehorning.

Considering the results from many investigations about animals pain during dehorning/disbudding (see chapter 2.5.4.), almost all animals disbudded (99.3%) and 93 % of dehorned animals (only 0.7%(disbudding) /6.7% (dehorning) of the farmer stated to use the recommended combination of anaesthetics and analgesics) in Germany are exposed to considerable pain and distress due to lacking or insufficient pain treatment. Considering that dehorning concerns the vast majority of European dairy cow population (23.1 million, AHDB, 2011), more efforts should be undertaken to actually make the procedure in practice as painless as medically possible.

3.4.4. Opinions and experiences

Reducing the risk amongst pen mates, easier handling of cattle, reducing the risk for the stockman to be injured were regarded as the major reasons to dehorn by farmers as well as by experts. Although the reason “adjusting to existing housing facilities” was ranked less important, the additional reasons mentioned were mostly directly linked with problems associated to inappropriate housing facilities (e.g. problems with technical devices and milking parlour, injuries from feeding rack). This point was also reported as one major reason for disbudding/dehorning from eastern and southern European regions (Bulgaria, Hungary, Poland, Romania, Slovenia and Cyprus, Greece, Italy, Portugal, Spain, Cozzi et al., 2009).

About one quarter of farmers and experts agreed with the pre-formulated answers that requirements of the cattle market and farmers insurance are quasi obligations to dehorn. Similar, slightly higher figures (31 %) were reported on European level

(Cozzi et al., 2009). This indicates that farmers willing to keep horned cattle do not only have to invest additional efforts in stable adjustments and cattle management but also have to face other difficulties. For example, in some EU States (for instance, the UK, Ireland and Austria) experts reported that animals that are brought for sale at auctions or markets must be dehorned (Cozzi et al., 2009).

The vast majority of the surveyed farmers (87 %) were not aware of any specific training concerning the practice of disbudding. Probably, these farmers adopted disbudding practice during their farmers training (on other farms), but ever since never attended such training. Considering that only 8 % of the surveyed farmers never practice dehorning and on most of the remaining farms (88 %), disbudding is accomplished by the stockman, it is questionable if sufficient expertise concerning the practise is existent on the farms. Indeed, answers regarding disinfection and pain treatment suggest that either often there is just “learning by doing” or the content of training activities is not always up to date.

Higher percentages (50 %) of cattle experts were knowledgeable about training opportunities. Partly, they might be the ones offering such courses. Looking at Europe, it appears that in the whole region of Central Europe (Austria, Czech Republic, France, Germany, Netherlands) such course offers are better known (53 % of experts) than in Eastern (40 %) and Southern Europe (10 %, Cozzi et al., 2009). The discrepancy between the German experts’ and farmers’ answers raise the question, if existing training opportunities are communicated sufficiently. A further problem might be that farmers might not be interested in training opportunities, since 82 % stated that there is no discussion going on about dehorning or improvements in dehorning practice. If farmers are convinced that they do not need to improve their current dehorning practice, it probably will be quite difficult to communicate the need of training courses.

On the other hand, only 30 % of the German surveyed farmers were not interested in alternatives to dehorning. A majority of 60 % of all surveyed farmers would welcome an alternative to save the work of disbudding, which namely could be the rearing of polled cattle (mentioned by 72 %). Only 5 % of German farmers were interested in the development of alternative housing systems capable to host horned dairy cows. However, the overall prevalence of polled dairy cattle in Europe is actually still very low (<1%, Cozzi et al., 2009).

In the light of this, it is informative to look at the motivation of farmers already keeping horned cattle. There might be two different approaches leading to the decision to keep horned cattle. The first approach may actually root in the attitude of “not changing things”, which might be more represented by older or traditionally orientated farmers (Cozzi et al., 2009; Kling-Eveillard et al., 2009). The second approach probably arises from a deliberate decision against mutilations and intensive farming (see chapter 4.3.1.). The first approach appears less important in Germany, since only 18 % of the farmers who keep horned herds stated “tradition” as one reason to keep the horns, whereas 62 % found horns an important part of the nature of the cow and therefore represented rather the second approach. The image of the “traditional, ignorant old farmer” still keeping horned cows seems at least in Germany somewhat obsolete, since completely horned herds occurred most often when farmers were below 30 years of age.

For a complete understanding of the matter, also financial aspects have to be considered. They might play a role for the decision to dehorn as well, since the keeping of horned cattle is very probably more cost intensive. 86 % of farmers keeping horned herds acknowledged that more caution is needed in handling the animals, 22 % found larger housing facilities necessary, 17 % more efforts for herd management and 15 % agreed that working time per day increases. Even if a farmer would like to keep horned cattle, capital for required housing adjustment could be lacking on the one hand and on the other hand, the decision for horns possibly also implies the willingness to reduce the future profit due to the necessity of lower stocking densities and higher labour investment.

Since neither the assumed negative effects of the missing horns on the cows health and fertility (Venge, 1959; Ezenwa and Jolles, 2008; Stranzinger, 1984; Pilz, 2006; Spengler Neff, 1997) are scientifically investigated yet, nor possible economic consequences, economic considerations are very likely to be to the disadvantage of horned cattle. Specific attitudes towards the animal or idealism reflected in certain quality schemes seem to be a possibility to tackle these economic disadvantages. As a result, dehorning is banned in biodynamic dairy production systems and by some organic farming schemes, mainly carried out in Northern and Central Europe (Cozzi et al., 2009).

3.5. Conclusion

As the general conditions in cattle husbandry and on the cattle market do not make it an easy choice, only a small proportion of dairy farmers currently decide to keep horned cattle.

In Germany, a horned cow is most likely to be found on a relatively small organic farm in loose housing or on a conventional farm in tie stalls.

Although most cows are disbudded at an early age using hot iron, information gathered in the surveys call for improvements of the disbudding procedure, especially in terms of pain alleviation during and after disbudding. Most farmers, however, do not know about specific training opportunities or any discussion to improve the current practise of disbudding/dehorning. For the majority of farmers, the only imaginable alternative to avoid disbudding/dehorning is the breeding of polled cattle.

4. Qualitative survey

4.1. Introduction

As presented in Chapter 3, the vast majority of German dairy farmers are practicing disbudding as a routine procedure without adequate medication for pain alleviation. When taking into account the intentions of current animal welfare legislation to minimize pain as far as possible (Tierschutzgesetz, 2006) there are good reasons to improve or change this practice which has been shown to cause a considerable amount of animal distress and pain (e.g. Faulkner and Weary, 2000, see chapter 2.5.5.). However, in the societal debate it is also important to take into account arguments, attitudes, motivations and experiences of the farmers having decided for different practices with respect to disbudding/dehorning, keeping horned cattle or using polled cattle. Moreover, farmers' views may help to create more efficient approaches to initiate any change of practice. Currently, in the literature there is no information available about how different groups of farmers view the issue of disbudding/dehorning. Starting from such a lack of systematic information, the method of focus group discussions is suitable to provide first insights into the possible range of notions and beliefs, behaviour pattern and attitudes, as well as into motivations and underlying motivational structures behind (Blank, 2007).

Characterizing for this method is that group interaction and spontaneity arising from the social context is used to generate qualitative data (Finch and Lewis, 2006). It was the aim of the presented qualitative survey to get a better understanding of the reasons why farmers choose a certain method of disbudding or why they might decide to keep horned or polled cattle. Discussing practical experiences with different disbudding methods or the management of a horned or polled herd should reveal critical points and possible obstacles or necessities on the way of improving or abandoning the current disbudding practice.

4.2. Farmer groups, materials and methods

Three focus groups were conducted in spring 2009 in three different regions of Germany:

The first group meeting took place in the traditional dairy cow region of the Allgäu with 16 participants. This group represented farmers keeping horned dairy cows, although one farmer practised disbudding. The participants had been recruited with the help of the Bio-Ring Allgäu e.V., an association working for the publicity of organic agriculture, peasant culture and tradition.

The second group meeting in Saxony included 9 participants, representing farmers keeping polled cattle in suckler herds. They had been recruited with the help of an employee (department of animal husbandry) of the Saxonian State Office of Environmental Affairs, Agriculture and Geology.

The third group meeting took place in North-Rhine Westphalia near the Dutch border, with eleven participants representing dairy farmers practising disbudding, although one farm kept also a horned herd in addition to a dehorned herd. The participants had been invited in cooperation with Haus Düsse, which is part of the Chamber of Agriculture of North Rhine Westphalia and responsible for agricultural education, information and research.

Following common recommendations (Morgan, 1998; Lamnek, 2005), all three meetings lasted about 2 hours. All communication was in German language.

Before starting the discussion, every farmer was asked to fill in a questionnaire to give some general information about his farm (Annex 3). Every discussion was opened by a short welcome and a broad introduction to the topic by the moderator.

The moderator was an animal scientist with background knowledge of the topic, but also some experience in moderating groups (though not focus group discussions). A second person (the author) kept a record of the discussions, but also tape-recorded and transcribed them later. The welcome was followed by a short round of introduction, which aimed at creating a comfortable atmosphere to encourage each participant to take part in the discussion.

An interview guide for the moderator outlining the main topics to be tackled in the discussion (Annex 4) served to standardize, as far as possible, the three different discussions. Generally, all questions were at first formulated openly to enable all farmers to share their views and opinions spontaneously. After this initial screening, the moderator contributed further viewpoints to the discussion or confronted the farmers with alternative situations to stimulate further responses.

To introduce the topic and to get an idea of the basic attitudes towards their profession and towards the animals, the participants were asked what it means for them to work with animals and what especially makes them like or dislike certain work.

In the second part, participants were asked to discuss the pros and cons of working with horned or dehorned/poled cows and which motivations or incentives had influenced their decisions. If not mentioned by the farmers, they were animated to reflect own experiences in managing their animals. Aim was to grasp their personal view on contentious issues such as work safety, ethics, aesthetics and animals welfare.

To investigate which criteria exactly made the farmers choose "their" dehorning practice, if applicable, the third part of the discussion dealt with the pros and cons of the applied disbudding and dehorning methods and tools, including the use of drugs and disinfection. Important in this connection was to understand how farmers feel about animals' suffering during and after the procedure and in which way they do assess it.

The fourth and last part of the discussion aimed to clarify if it were imaginable for the farmers to change their practices in the future and which conditions, motivations or regulations could influence their decision.

A qualitative analysis of content, underpinned by (translated) citations from farmers was carried out and supplemented by quantitative data characterizing each focus group.

4.3. Results

4.3.1. Focus Group – “Allgäu”

The 16 farmers (15 males, 1 female) attending the meeting already knew each other, because they were associated to a group promoting the keeping of horned cattle. All but one farmers kept their cows in loose housing, one organic farm had tie stalls, 15 produced organically, one conventionally and 15 did not practise disbudding while one organic farmer disbudded. All of them used to keep their dairy cows on pasture during summer, except one organic farmer who had not enough accessible fields and, therefore, provided access to pasture only occasionally (about 6 weeks per year). The herd sizes of the attending farmers ranged from 15 to 100 dairy cows (average 51.6).

4.3.1.1. Significance of dairy cows on the participants’ farms and self-appraisal as dairy farmers

Two farmers answered spontaneously that the dairy cows are the very “core of their farms”, on the one hand, because it is the only way to use the land in that region, on the other hand, they appreciated them as animals which can “turn grass into nourishment for humans”. Two farmers added that there is no alternative, as “to be a farmer in that region means to be a dairy farmer”. However, although the cows are their livelihood they depend on, they did not regard the animals as a mere means of production, but as a “gift to humanity” and they esteemed them as “living beings”.

Asked about their attitudes towards breeding, they all agreed on the fact that they cannot separate the breeding from the milk production. They all regarded themselves as breeder on a certain level: “Dairy cow and breeding that is connected somehow. Every farmer here is breeder in a certain manner, in the moment choosing one calf to keep and the other to sell”.

Their primary aim of selection is not enhancement of the absolute milk yield, but of the adaptation of their cows to the given environment (namely feed supply in the special region), physical health and longevity.

One farmer pointed out that, since he is keeping horned cows, his priority in terms of selection criteria is the character and the temperament of the cows. A high milk yield

could be useless for him, if the high yielding cow turns out to be aggressive to herd mates and has to be removed from the herd for this reason.

4.3.1.2. Attitudes towards different work or interactions with the cows - likings and dislikings

Two farmers did not subscribe to this question because from their point of view “all the different works have to be done for the good of the cows” and they never really thought about which works they like most of all. One farmer “admitted” that he does not like claw trimming (one other agreed) and he prefers to delegate this work to a professional claw trimmer. All agreed that selling (old) cows to slaughter (one said: the worst work) or disbudding of calves are works they do not like. Some added later, when asked about their reasons to keep the horns, that disbudding of calves was “one of the worst works to do”.

Interactions they mentioned as enjoyable were milking (2), putting the cows on pasture and observing them in the field (2) or in the stable (1) and grooming the cows (1). It was never directly mentioned, but obviously they preferred works which lead to good welfare and pleasure of the animals and disliked works which result in pain, fear or discomfort for the animals.

4.3.1.3. To have horned or dehorned animals

Although only one of the farmers was practising disbudding, some of them still had some dehorned cows in their herds left, because they had stopped dehorning just some years ago. One farmer stopped dehorning only a short time ago and therefore his herd was still completely without horns. The farmer still disbudding his calves regarded his housing conditions not to be suitable for horned cows.

Four farmers had stopped disbudding, because they had learned about the theories of Rudolf Steiner or got information about the importance of horns (one mentioned a course he had attended). Some described the decision to abandon disbudding as an inner process or development. “At one time I borrowed a hot iron disbudder, because I thought, yes, I have to dehorn, but I was already in the process of thinking, may I, must I? And then I found that truly I do not have the right to take something away from the animal, just because it does not suit me.”

4.3.1.4. Motivations to keep horned cattle (pros)

The farmers put forward that “men do not have the right to adjust the cows to artificial housing systems”. Some have always disliked disbudding because of the inflicted pain, but nevertheless they practised it, because they thought it necessary. Having the opportunity to stop this practice was described as “a relief”. They argued that other parts of the animal (such as tail and claw) “can be dangerous for humans as well and we cannot cut these away either”. The farmers of this group generally held the view that the risk of injuries for themselves was never a problem since they had changed from tie stalls to loose housing. They had never heard of accidents with horned cows in loose housing. On the contrary - they liked the fact that humans have to show more respect for the cows. According to their opinion “horned cows have much more charisma and are prettier in general”. But they also agreed that stockpeople and other persons handling the cows have to learn how to behave in the presence of horned animals, because the cows are able to detect fear and insecurity in stockpeople.

A commonly shared argument was that cows need their horns for better digestion, vitality and fertility. One farmer described his experience that he always had serious health-related problems in his herd, especially with the calves. The problems increased with the change to organic production due to the more restrictive use of allopathic medicine and did not improve until he stopped disbudding. Others agreed that it were easier to keep horned cows healthy without medication. All of them were convinced that milk quality in horned cows is much better.

4.3.1.5. Problems in horned herds (cons)

The main problem mentioned was the risk of skin injuries and injuries of the udder leading to blood in milk. Dangerous situations were seen in connection with the integration of new animals, crowded housing facilities, inappropriate technical devices and single aggressive animals within the herd.

One farmer reported from problems to find a skilled replacement to look after his cows, when he is tied up with other business and therefore not able do the work himself. Other farmers get sometimes complaints from cattle transport drivers or veterinarians because of their horned animals. “I have got the problem, when a vet has to go in the stable...or whatever person... I am really concerned, that something could happen in the stable.”

They stated that the common opinion of neighbours in their villages is that “keeping horned cattle is just mad” and one farmer found the reassurance from a group of farmers keeping horned cattle important. “It is just a common notion (that cows have to be dehorned). When you are used to do it, it is not that easy to change. To become acquainted with S. (other farmer with horned cows) had helped us to stick to our opinion (to keep the horns).”

4.3.1.6. Special requirements for keeping horned cattle

To offer more space for the cows was always mentioned in the first place. Adjusted housing facilities with proper feeding racks and milking parlours were also seen as an important point. As hardly less important stated was the continuous observation of the herd in order to detect technical problems and aggressive animals as soon as possible. Aggressive animals, for example, were suggested to be furnished with little balls on their horns to round sharp tips. If this does not suffice, aggressive animals would have to be removed from the herd. All farmers agreed that horned herds “have to be composed very carefully” and that “not every cow fits in every herd”. All farmers assumed that it may be better to avoid having more than one breed within one herd. They also repeatedly underlined the importance of selecting peaceful and agreeable animals for breeding.

Further, the personality of the farmer and a good animal-human relationship were highlighted as important points. One farmer of this group claimed that a good animal-human relationship can even compensate suboptimal housing conditions. Farmers would have to learn to deal with the distinct behaviour of horned cows and need to be calm and self-confident while handling the herd. “You have to learn, when you are in loose housing with horned cows, how the animals react - they might react completely different from what we might expect - and that is a learning process”. The farmers reported that they have to develop novel solutions for risky situations such as the integration of new animals into the herd. Disturbances of the herd such as frequent regrouping should be minimized by a low replacement rate and buying new animals in winter should be avoided at all because they cannot be introduced into the herd on pasture at this time. Special management efforts such as “locking of the animals in the feeding rack in certain situations” were mentioned. All said that they have to consider things which they had never thought about when keeping hornless cattle.

Abilities and the knowledge needed to manage a horned herd appeared to be part of their self-appraisal as skilled farmers. In this connection they mentioned more than once the term “peasant culture or tradition”, which they mainly perceived as the refusal of a growth-orientated, industrialized agriculture/animal production. They assumed that it might be difficult to keep horned herds comprising more than 100 animals. However, they emphasized that they would not want that big herds anyway, because that “would be the first step to industrialize the animals” or “like capitalising living beings”.

4.3.1.7. Legal standards and recommendations concerning dehorning

Since it does not affect them, most of the farmers did not know the applicable law concerning disbudding and dehorning. One farmer claimed that disbudding should be banned for all cows, but another farmer contradicted because such regulation would cause an enormous amount of stress and injuries amongst cows in inadequate housing facilities. They more or less agreed that it would be good to ban disbudding at least in organic production, but they also found it difficult to enforce such a ban by regulation, because every farmer should make that decision by heart.

4.3.1.8. Prospects for the future

No farmer of this group was interested in polled cattle, because they just like dairy cows with horns for the above mentioned reasons and they did not distinguish between dehorned or polled, because “the missing horns ultimately lead to the same result”.

No farmer of this group planned to disbud/dehorn in the future. The only farmer who still practised disbudding would like to stop it, but can not do it at present because of his unsuitable housing facilities.

All farmers thought that consumers should be better informed about the importance of the horns and their influence on milk quality, and that milk of horned cows should obtain a special status due to its special quality and the higher production costs due to special requirements for keeping horned cattle. They all feared that their milk cannot compete at the market against industrially produced milk, unless the consumer is informed and therefore willing to pay more money for this product. However, they were all very strong-willed to resist the “quasi- compulsion” to increase the number of animals in their herds, because from their point of view, this would be connected with

the loss of their “peasant cultures” which they wanted to keep. One farmer said: “We have to hold on ...and I wish or I hope that we all have the physical, psychological and financial strength to make it.”

4.3.2. Focus Group “Saxony”

The nine male participants of this group discussion also knew each other already, because they were all dedicated cattle breeders, who are meeting regularly for the exchange of experiences. They were four farm managers of bigger conventional suckler cow farms (160 – 1100 animals/farm, average: 596 animals /farm) and one of a smaller farm (45 cows) keeping also suckler cattle and four cattle experts, two employees of the Saxonian State Office of Environmental Affairs, Agriculture and Geology, responsible for animal husbandry, one consultant for cattle breeding and one person from a cattle breeding association. The cattle experts participated also in the discussion.

The farms kept suckler cows on pasture during summer and in loose housing during winter. The participants reported that their region is mainly known for its crop production, but that some parts of the land are inappropriate for crop production due to the danger of flooding in flood plains or due to steep hillside situations or bad climatic condition in mountainous regions. These areas are sometimes used to keep suckler herds on permanent pasture. Due to the often unfavourable pastures in this region (flood plains are wet and rangy regions are cold and snowy in winter) 85 % to 90 % of the suckler herds in Saxony are kept in stables in winter, differently from regions further north (Brandenburg) in which about 70 % of the suckler herds are kept permanently outdoors.

4.3.2.1. Significance of suckler herds on their farms and self-appraisal as farmers

Three of the farmers were mainly crop producers, which had to find a use for unfavourable residual parts of their land and only therefore have chosen to keep suckler herds. On these three farms the suckler herds accounted for 30 %, 2 % and 5 % of the whole farm production. For the other two farmers, the suckler herds were the main income and therefore core of the farm production.

All farmers of that group regarded themselves as cattle breeders by heart. One mentioned that 80 % of his animals are registered in the stud book. Some farmers showed their breeding bulls successfully on cattle shows in Italy, France and in the Czech Republic.

4.3.2.2. Attitudes towards different work or interactions with the cows - likings and dislikings

One farmer stated that he likes it to watch the herd grazing, a habit he would use to relieve stress. One other agreed. Otherwise no specific work or interactions were mentioned.

4.3.2.3. To have horned or dehorned animals

All farmers of this group kept polled cattle, but three of them still had also non-polled animals that get disbudded. The percentage of polled cattle on the farms was reported to mainly depend on the used breed, because the development of the polled population is quite different within the various cattle breeds, e.g. Simmental and Charolais are available in acceptable quality as polled animals. One cattle expert claimed that “100 % of Simmental and up to 80 % of Charolais herds in Saxony were polled, whereas polled percentages amongst Limousin and Blonde d`Auquitaine were “much smaller yet”.

4.3.2.4. Motivations to disbud the calves and to keep polled cattle (pros)

For all participants it was not imaginable to keep horned cattle. Reasons mentioned were the expectation of frequent and severe injuries of the animals in the stable during winter and the risks for the safety of the stockman. Nearly all of them had experienced horned herds in the past, as they started disbudding in the 70th. One farmer reported of accidents which happened on his farm with hornless cattle which – caused by a horned animal - would have been deathly for the stockman. One of the farmers, who was also a cattle dealer added that for the reasons mentioned he does not buy young bulls which are not disbudded.

A further important argument against the horns put forward was the extensive management of the suckler cows leading to sometimes shy and generally not tame animals. The farmers stated that human-animal interactions were largely restricted to injections and similar unpleasant experiences for the cows, with no chance to build a positive human-animal relationship which could minimize the risk of injuries for the

stockman. Moreover, the suckler cows were accustomed to large areas of pasture and undisturbed herds during summer. This might complicate the change to limited space allowance and frequent regrouping in loose housing during winter. One farmer remembered past times, when he kept horned herds and described his experience: "...and the groups got mixed several times according to the phase of pregnancy, and every time new fights arose amongst the cows and sometimes the injuries were devastating." All judged it as "unjustifiable to keep cattle with horns", especially regarding the fact that stress and injuries caused by the presence of horns would make the animals grow slower, with important economic consequences.

However, on the other hand the participants did not consider disbudding as the best solution. They remarked that disbudding itself costs them more work than it would in dairy calves, because they first have to catch the shy animals born on pasture. Since they cannot do this every week, they sometimes have to disbud calves older than 6 weeks. Furthermore, the risk for infections after disbudding is higher, because the calves return to pasture immediately after the procedure. These problems and economic reasons including decreased labour demands cause the participants of this group to advocate the breeding and keeping of polled cattle. "It is just a great thing! You don't have to handle the animals another time. That is work intensivethis work can be saved in the future."

4.3.2.5. Disadvantages of polled cattle (cons)

Asked about the possible disadvantages of polled cattle all agreed that there will be none, when the breeding process will be further advanced. Nevertheless, at present the participants judged that the basis for selection is still too small and lacks diversity within the polled breeds. In their views this is the main cause for the often lower quality of the carcasses of polled cattle, especially relating to a good (plastic) development of the muscles, which is a clear disadvantage for the marketing of the carcasses. Polled animals often have a narrow head, and cows tend to be smaller (at least within the Simmental breed), which is sometimes regarded as unwanted by breeders and breeding associations. To counteract this tendency, in the 90th the Saxon breeders introduced huge, large polled bulls from Denmark. This resulted in bigger animals that tend to be very long, but still show insufficient characteristics of the muscles. Moreover, polled bulls tend to be slower in their development. However,

according to the breeders in this group, these problems can be solved by means of strict selection and will improve with the broadening of the gene pool.

4.3.2.6. Disbudding and dehorning methods

If the calves are not polled, all farmers disbud them as early as possible with hot iron or caustic paste. They never use pain relieving drugs, but disinfection after the procedure.

The main aspects named for selection of the disbudding method were low costs and easy handling of the animal. Advisors and veterinarians were not regarded as competent concerning the disbudding practice. All farmers try to disbud as early as possible, because the calves' resistance is lower in younger animals. They were all convinced that disbudding young calves causes them only little pain, comparable with injections or ear tagging. One farmer even said: "Ear tagging is worse than disbudding with caustic paste. This is really the easiest and most humane method of disbudding."

It was put forward that it would be an indication of bad character if a calf shows greater distress during disbudding. "There are animals who do not make any sound during dehorning and others, in contrast, already panic when they just get into the calf crush, ..., because they have a problem in their character and will be removed from the herd first, when it comes to selection, ..., but this does not mean that they really feel pain during dehorning". All agreed that dehorning of adult cows should be avoided, because it is really hard work to do and undoubtedly painful for the animal.

4.3.2.7. Legal standards and recommendations concerning dehorning

The applicable law concerning disbudding and dehorning was broadly unknown amongst the participants of the group. One farmer remarked that regulations are unnecessary and others agreed that every farm manager should be allowed to choose "age of disbudding/dehorning and the applied method as a part of the individual farm management".

However, on the whole, after they learned about the existing standards, they approved them; they just did not like the fact that there are any legal rules at all. However, since they exist, they would welcome a standardisation of the different national rules within the EU.

4.3.2.8. Prospects for the future

All farmers that are still practising disbudding stated that they want to stop it in the future when polled breeds are further developed. The farmers hoped that they can achieve higher qualities concerning the carcasses of the polled animals in the breeds Simmental, Charolais, Limousin and Blonde d'Àquitaine within the next 10 to 20 years. They would prefer a stricter cattle breeding law which should forbid the use of unlicensed bulls of low quality in order to support this aim.

Concerning possible future legal obligations to apply pain relieving medication during disbudding, they were afraid of negative economic consequences. "This means an additional effort and additional cost and when it becomes standard, no one (customer) wants to pay for it."

4.3.3. Focus Group - North Rhine Westphalia ("NRW")

The thirteen people (10 males, 2 females) attending the meeting included nine dairy farmers (8 conventional, 1 organic) and two agricultural students working on conventional dairy farms. Two further participants were responsible for a demonstration and research farm of the chamber of agriculture of North Rhine Westphalia. This farm kept a small organic herd with horned cows (40) in addition to a bigger dehorned conventional herd (220). The other farmers kept between about 90 and 500 dairy cows per farm (average of all herds: 187 cows/farm). All farmers kept the high performance breeds Holstein Friesian or Red Holstein in loose housing and all of them were practising disbudding.

4.3.3.1. Significance of dairy cows on the participants' farms and self-appraisal as dairy farmers

For most of the farmers milk production was the predominant and obligatory source of income for different reasons. "For us, the dairy cows play the major role for the income.all the other things, like potatoes or crop production are nice things as well, but not crucial - that are the cows!" Some mentioned that they come from regions mainly covered by permanent pasture, where crop production is no economically viable alternative due to poor soil quality. Others pointed out that the housing and milking facilities for dairy cows are expensive and therefore a change in use is not easily possible. "I cannot just empty my stable. We have completely

different cycles than the pig farmers. We are very much bound to the cows and we have to follow through for good or for evil.”

One farmer said he likes it to work with cows and others agreed that farmers “should have some kind of relationship to the animals they work with”. One farmer contradicted and stated that he would sell all his cows immediately, if a better source of income arose. Still he said: “Of course, everybody knows his cows by heart... that’s inevitable, every dentist knows the teeth of the patients he works with every day, but ultimately, we have to care that we can feed our families from the cows.”

Asked if they regard themselves as breeders or milk producers, all but one shared the opinion that they are milk producers and therefore have to take part in genetic improvement, thus have to produce replacement of high quality for their own herds. One farmer bought replacement heifers and therefore did not regard himself as a breeder. None of the farmers, however, was selling cows on cattle auctions.

4.3.3.2. Attitudes towards different work or interactions with the cows - likings and dislikings

First answers were, that they never had thought yet about the question which work they like most, “because every work has to be done”. “It is quite difficult to classify, which work is fun to do and which not. You have to do all of them every day, anyway.” They further explained: “As a typical family farm, we do all the daily work with the animals ourselves - but all external work we transfer to others.”

Nevertheless, disbudding and claw trimming were mentioned as unpleasant works, because of the smell in the first case, and because of the dirtiness of the work in the second. One farmer reported that he prefers feeding the cows to milking them.

4.3.3.3. To have horned or dehorned animals

All farmers except those from the small organic herd of the demonstration farm used to disbud the calves they keep as replacement. The farmers rearing also fattening cattle were additionally disbudding the male calves. If not kept, the male calves are getting sold at the age of about 14 days. Since the male dairy calves are exclusively used as veal calves, dehorning was reported to be unnecessary and, indeed, unwanted by the veal farmers because of possible growth checks. Additionally, farmers do not want to invest the work of disbudding in calves for which they get only little money.

4.3.3.4. Motivations to disbud the calves (pros)

Asked about the reasons for disbudding, all farmers agreed that “the disturbance within horned herds is immense”, and therefore it would be impossible to keep horned cattle in stables. The farmer being responsible for the horned organic herd attested a higher risk of injuries amongst the animals, at least, when kept in stables during winter. She said: “.....the cows are conscious of their horns. I use the word weapons of the cow, because they know that it is ordnance what they have on their head. And cows, who have horns, wear them proudly, and in situation in which they need them, they use them without fear.” Some farmers of that group have never experienced horned herds, since they had already practised disbudding in their tie stalls. One farmer once bought horned cows and tried to keep them together with dehorned cows in loose housing. He decided to dehorn them within one week, because of the disturbance in the herd.

Another argument put forward was that due to horned cows being more self-confident, they would be more determined to defend themselves when the farmer needs to inflict an unpleasant situation on them. In addition, a struggling cow (e.g. in restraint) or a stampeding cow would cause much more damage to the stockperson or other animals, when she is horned. Another farmer said: “I would put farmers’ safety in the first place. Every animal which has calved gets handled: it gets fed twice on two days- with yeast – therefore we have to lift the animal, or for tagging with ear marks which get lost all the time, or for infusions, when you have to fix the cow... we have to handle the cows all along, and when they defend themselves - if they had horns - I mean ours haven` t ..., you cannot take the responsibility for that “.

In addition, several farmers found that “a proper dairy cow looks nicer without horns”.

4.3.3.5. Disadvantages of hornless cattle (cons)

The procedure of disbudding itself was not considered a problem by most participants. They argued that they have to handle the calves anyway, e.g. for regrouping and, therefore, disbudding would not be much additional work. Beyond this, the work of disbudding is often assigned to employees or apprentices or alternatively can be delegated to professional claw trimmers or the milk control person, who do it for only a little fee (2.50 €/calf).

4.3.3.6. Disbudding and dehorning methods

All farmers stated that disbudding with hot iron is the best method. One reported that he tried to disbud with caustic paste some years ago, but stopped it immediately, because to him it appeared to be very distressful for the calves. Most farmers (not all of them talked about the age of disbudding) disbud their calves with an age of two weeks up to six weeks - one farmer mentioned that he sometimes disbuds also eight weeks old calves.

Two farmers use to remove the whole bud during the disbudding procedure; others leave them and just burn the surrounding vessels. One farmer described how he restrains the calves using a self-made construction, which has, compared with the feeding rack, the advantage that the calves cannot move the head up and down anymore. Another reported that he sedates the calves and just pushes them flat on the ground of their stable for the procedure. Seven farmers are using sedation during disbudding, because the calves are calmer and do not show so much resistance.

Asked about differences between burning devices, all farmers agreed that electric devices are better when more than ten calves have to be disbudded at once, because gas burners are not always hot enough to guarantee a quick burning procedure. With a burning device that is not hot enough, one farmer experienced severe problems, namely distressing manipulations and very long disbudding times were necessary. Gas burners have the advantage that the stockman does not have to care about the electric cable and can use the device all over the stable. Therefore, some farmers preferred them to the electric burners.

Most farmers thought that the procedure causes just little pain, when done at an early age, between the second and 8th week. "I don't have the impression that the calves suffer pain, that is just agitation, but not that the calves feel any pain, well, not on our farm." Another said: "I do not observe pain in the calves. That is only short-term affection and when it is done well, it is justifiable." One farmer interjected, however, that causing a burn at the head of the calf will most likely be not less painful than causing it at the own hand which he experienced as quite painful. Nevertheless, there was a strong view in this group that the pain which can be inflicted by grown horns is much more relevant than any possible pain during disbudding.

4.3.3.7. Legal standards and recommendations concerning dehorning

The applicable law concerning disbudding and dehorning was not broadly known. Some farmers asked: “is there any rule about dehorning?” and declined: “you do not have to know all (rules)”. After the information had been given that calves older than six weeks have to be disbudded by a veterinarian, they wondered, “are there really vets, who do this? I don’t know any.” They expected that farmers are better skilled to carry out the disbudding, because they have received proper training at a farmers’ school and do have much more practice than veterinarians. Concern was expressed that the farmers’ skills could be underestimated, and therefore new regulations might prescribe disbudding done by veterinarians only. One farmer was sure, that he could do even the dehorning of an adult cows better than any veterinary surgeon. Therefore he did not approve the German legal rules concerning disbudding/dehorning. On the other hand, there was a remark that strict enforcement of legal rules is not to be expected anyway, because it would cost too much. “How do they want to control that, there are endless regulations, but in the end, all theses regulations have to be controlled, and controlling is very expensive. The consumer - that means the government has no money anyway....” One farmer expressed rather strongly that he sees a severe imbalance between the readiness of official bodies to support their existence in terms of fair milk prices and the readiness to impose stricter animal welfare rules every time.

4.3.3.8. Prospects for the future

Eight farmers were interested in polled cows, but they were convinced that it is not possible to breed polled dairy cattle that achieve the same high milk yields as horned breeds. “I do not choose a bull, just because he is polled. If all his other traits do not fit into my scheme for breeding, he won’t be considered.” Or one another said: “I would be afraid, that I landed myself with animals with lower milk yields or bad udders.” Nevertheless, most of them would use polled cattle, if available in high quality. “If you could get polled animals, it would be a positive additional trait. But basically I consider other traits more important for a proper dairy cow.”

The organic farmer would prefer to stop disbudding if possible, but regarded his housing facilities as unsuitable for horned cows. “I think it desirable to have horned cows, although I would rank the safety at work and animal protection higher“.

The manager of the horned organic herd on the demonstration farm stated that she is considering to start disbudding again because of many unskilled trainees and visitors on the farm and the associated safety risks.

All other farmers wanted to continue their disbudding practice.

4.4. Discussion

4.4.1. Methodological issues

When evaluating the results from focus group discussions, it should be kept in mind that they are qualitative studies, i.e. they shall serve to provide insights into different motivations leading to certain behaviours and allow to compare attitudes and images which became obvious during the discussions. No conclusion is possible on how representative the results are for the whole population. However, an attempt was made to cover with the three focus groups the most typical situations in which nowadays either horned, polled or disbudded cattle is kept. Moreover, the chosen number of three focus groups should allow naming all factors relevant for a certain behaviour (Lamnek, 2005).

One important requirement for this is a sensible composition of the focus groups. They need certain homogeneity (Morgan, 1998; Krueger, 2000). This can be achieved through similar age, profession, social group or educational level of the participants (Krueger, 2000). Since different job related backgrounds amongst farmers may lead to discussions beyond the dehorning topic, farmers attending one group were recruited from the same sector of cattle production (suckler herds or dairy cows) and preferably also from the same sector regarding production scheme (organic or conventional). If the main circumstances of the daily work and the attitudes towards animals are comparable among the farmers, it should be easier for the participants to become acquainted with each other and thus to build a familiar atmosphere, which encourages the group members to speak openly whereas in “mixed groups” participants may feel too uncertain to object other statements (Morgan, 1998). Since the aim of the present discussion was to discover motivations to act in one or the other way, the groups were divided according to the differences in “horn-management” as “dehorning dairy farmers“, “farmers keeping horned dairy cows” and “farmers keeping polled suckler cattle”. Thus, specific practices and motivations could always be discussed in detail with the whole group.

In the current discussions, different housing systems in the group Allgäu (one farmer with tie stalls, all other loose housing) or differences in the production scheme (group Allgäu: one conventional farmer amongst organic farmers, group NRW: one organic farmer amongst conventional farmers) did not hinder these participants to actively take part in the discussion, whereas the only farmer who had another “horn-management” than all other group members (group Allgäu: one farmer practising disbudding), did not say a single word during the discussion apart from his own introduction. The only farmer who was responsible for a horned herd in the NRW group cared also for a dehorned one and therefore could discuss this practice as well.

Most of the participants of all three groups knew each other already before the meetings. On the one hand, this made them speak very openly, but on the other hand, it could have made it harder to express a possibly differing opinion for the few unacquainted farmers (the exact number is unknown however, since this was not asked) in the groups NRW and Allgäu.

4.4.2. Reflection on images and attitudes that became apparent

As mentioned above, the interviewed groups cannot be regarded representative for the whole regions they came from. Indeed, also in Bavaria (group Allgäu) about 79 % of farms (n = 412) keep dehorned herds (Lüdtke, 2004) and horned cows as well as organic dairy farms, can be found of course also in Saxony and NRW (% of organic farms of all farms in Bavaria: 5.9%, in Saxony: 6.2%, in NRW: 3.6%, Statistisches Bundesamt, 2010b). However, the self-appraisals of the farmers are difficult to disentangle from a possible regional influence. The performance of cows in the alpine environment of the Allgäu group, for example, was determined in the past by limited feed supply, rough climates and steep terrain. To be a successful farmers in that region meant to have adapted, robust cattle. The farmers from the group Allgäu stated that their home region is still dominated by permanent pasture and not by the cultivation of high energy forage crops. The focus on healthy, charismatic and robust cows seems to sustain to the present day in alpine regions, at least in that group of farmers, that preferred regional breeds like e.g. Brown Swiss. For some reasons these characteristics seem to be associated with the horns, which makes horned cows look prettier in the view of these farmers, who disapprove disbudding as an inevitable procedure to adjust the animals to the housing system. From the farmers’ point of view, disbudding itself causes pain to the calves, which has to be avoided. Beyond

that, adult cows also need their horns for different reasons. They are all convinced that keeping horned cattle in loose housing is possible and desirable for the animals' health, if the farmer is willing to accept additional efforts. These farmers (from the Allgäu group) did not perceive their own qualities as skilled farmers through the high performance of their animals in the first place, but through their abilities to handle and manage the animals.

In regions further north, in contrast, the milk yield was rather limited genetically despite rich feed supply and less by the ability to survive under poor conditions.

Farmers from the NRW group mostly appeared to perceive their cows as an economic means to feed their families in the first place. As in the group from Saxony, the main reasons mentioned for disbudding were farmers' safety, an easier handling during treatments and the risk of injuries amongst the cows in housing facilities with limited space allowances. Disbudding itself was not regarded as a topic worthwhile any discussion. Successful farming was put on a level with a high performance of the cows, which is connected with the breed Holstein Friesian. The statements from the NRW group give the impression that in order to be accepted as a modern successful dairy farmer, their cows have to be dehorned. This image is also reflected in the farmers' notion, that dehorned cows are perceived as "just prettier".

However, since farmers keeping horned cattle perceive "horned cows as much prettier", it is obvious that these images are not impartial, but shaped by the surrounding environment (e.g. breeding associations, traditions, cattle markets, cattle shows, stable equipment suppliers, advisors etc.). That this kind of preference for the one or the other is influenced by visual habits is also reported from Italy and France. Whereas Italian Friesian and Prim'Holstein cows are never horned and farmers are used to it as their common look, farmers dehorning Saler cows, explained that they are badly considered by their neighbours, because it is not yet usual for that breed (Kling-Eveillard et al., 2009). In addition, visual preferences may also play a role in economics, since in some regions, like Limousin, dehorned animals are the norm, and bulls without horns get a better price than with horns (Kling-Eveillard et al., 2009) which was also confirmed by farmers from the Saxon group.

The farmers in the Saxon group also named economic success in the first place, when asked about their relationship to the cows and what it means for them to be a farmer.

They were proud of the good performances of their animals on cattle shows, but no one referred to good welfare or a good relationship to the cows as relevant for their self-appraisal as a successful farmer. It appears, on the contrary, to be a distinct feature of the successful management of a suckler herd, to handle them as sparsely as possible. Some farmers of that group had very high numbers of suckler cows, although their main income was crop production and the cows were just a means to use unfavourable residual areas like flood plain. To save the work of disbudding, they preferred polled cattle, but it was also their aim for the future to improve polled genetics. It may be by coincidence, but the fact, that only the farmers from the Allgäu spontaneously named quite a variety of works they do with pleasure (milking, brushing the cows, putting them on pasture) might also indicate that the work with the cows is not perceived as a mere means to achieve success, but important for them in itself. This in turn might lead to a different – less negative - weighting of the additional work associated with horned cows. Farmers, who disbud, however, appear to associate farmers keeping horned cattle with a distinct image, being antiquated and not willing to implement modern practices on their farms. One farmer from the Saxon group explicitly associated horned cattle with bad herd management and inefficient farming.

The farmers with horned herds in the Allgäu group did quite know about their bad image in the view of most other farmers. They did not like the fact that they always have to defend themselves for not mutilating their animals by keeping the horns. It was a commonly shared view that agriculture should adjust to the needs of animals and not vice versa. They did not see problems with farmers' safety, but underlined the need for finding solutions in order to minimize the risk of injuries amongst the cows. This makes them reflect their practices and housing and management conditions quite often. The examples of the farmers from the Allgäu group show that in fact “more considerations” and not “no considerations” may lead to the conscious decision to keep the horns - at least when the cows are kept in loose housing. Considering their readiness to learn more about the cows and to adjust the management practices and housing facilities to the animals' needs, the image that farmers keeping horned cows are just unable to change things becomes quite preposterous. Many of the farmers from the Allgäu group practised disbudding in the past and invested great efforts to change things. The decision to stop disbudding and to keep the horns requires the

willingness to invest these efforts. The question is, what makes some farmers do that and others not.

Possibly one reason lies in the perception and interpretation of animals' pain during disbudding. Farmers keeping horned cows regarded the procedure of disbudding as extremely painful for the calves - irrespective of the applied method - and therefore they felt uneasy to apply such a procedure. The majority of the dairy farmers practising disbudding with hot iron (NRW group), on the contrary, evaluated the pain inflicted by this method as negligible. In this light, it is quite astonishing that one farmer from this group reported that he once tried to use a caustic stick, but stopped it after a short time, for he found it too painful for the calves. In contrast, one farmer from the Saxon group praised the caustic stick as the "most humane method" to disbud calves.

It is a general problem to interpret behavioural indicators of pain in calves, since in cattle, as a prey species, low overt responsiveness has evolved as a way of concealing vulnerability towards potential predators (Broom, 2001). When farmers do not notice the inconspicuous signs of pain, it does not necessarily mean that there is no suffering.

Farmers who practise disbudding argue that the short pain of the burning is definitely less severe than the one adult cows may suffer from during their whole life due to horn-related injuries. Although this may be true under certain conditions, a weighting of the impacts for animals welfare is questionable for several reasons. First, the amount and quality of pain and stress associated with horn caused injuries amongst cows, with injuries of the horns themselves and, on the other hand, with bruises caused by thrusts with hornless heads is not yet scientifically investigated. Secondly, the extent of pain and stress related to the presence of horns will closely be related to the actual housing and management conditions. In fact, more restrictive housing and management conditions, as they are possible in hornless cows, may give rise to increased social stress, although with less physical indications of it. On the other hand, it cannot be ruled out that under such conditions stress does not increase to the same extent as it would in horned cows, as cows might perceive other cows without horns less threatening. Further comparative investigations are clearly necessary to better determine the welfare consequences of the presence or absence of horns.

4.4.3. Changes in the current practice

One aim of the group discussions was to investigate the potentials of different approaches to contribute to a turn away from the current disbudding/dehorning practice without pain relief. All three alternatives, keeping horned cattle, keeping polled cattle and applying anaesthesia and analgesia during and after dehorning turned out to bear some problems, but - depending on individual attitudes and ethical framework - also appeared to be feasible.

The keeping of horned cows is a mandatory option for farmers convinced of the importance of the horns for the animals. This may be triggered by adherence to biodynamic principles, by examples from other farmers as well as by thoughts about naturalness and about ethics relating to the issue of integrity of the animals. Moreover, horns may serve as identification symbol of a certain agro-societal culture. However, even if adequate housing facilities and the willingness to invest more efforts in the herd management are existent, it is not an easy choice, since disbudding is strongly recommended by veterinarians, cattle dealers, breeding associations and insurances. In the professional training of farmers it is commonly not conveyed that it is possible to keep horned cows in loose housing. Also Menke (1996) describes that farmers who want to keep horned cattle, have to consciously decide against official recommendations and opinions of their colleagues which turns them into outsiders. In addition, these farmers have to face additional financial expenditures which will not pay off in terms of a higher prize for the milk compared to other farmers (conventional or organic) practising disbudding. Therefore, farmers keeping horned cows would welcome an increased discussion about the disbudding practice in public, for it might be possible that customers knowing about the pain and other issues associated with disbudding may be willing to pay higher prizes for milk of horned cows. Furthermore, the actual amount of expenditure in terms of work load and financial input into adjustments of housing facilities should be evaluated economically, to estimate the required elevation of the milk prize.

All farmers from the Allgäu group agreed that it is probably more difficult and maybe even not possible to keep the horns in herds bigger than 100 animals. Against the background of increasing herd sizes in Germany (Statistisches Bundesamt, 2010) and an average herd sizes of currently 158 cows per herd in the Eastern Federal States

(ADR, 2010), it is obvious that this alternative is no option for all dairy farms in Germany.

In contrast, the keeping of polled cattle appears to be especially attractive for farmers with (big) suckler herds with very extensive management, rare handling and annual changes from extensive pastures to rather crowded stables in autumn. For the farmers interviewed in the Saxon group, animal welfare arguments played a very minor role, whereas the opportunity to save the additional work of disbudding had a higher weight than the current problem of a potentially lower quality of carcasses. The quality problem was also described by Lamminger (1999) for the breed Simmental in Germany. He found higher breeding values relating to amount and form of muscles in polled bulls compared to horned bulls, but carcass values were lower due to decreased daily weight gains in polled bulls. However, the participants of the Saxon group were confident that systematic breeding will bring about substantial improvements of the quality in the near future. In contrast, dairy farmers with large high performance herds like the ones of the NRW group likely do not regard polled cattle as a promising alternative in the near future, because saving the additional work of disbudding is not perceived as an adequate incentive to accept possible lower milk yields at the beginning of the breeding process. In fact, regarding the top 100 of all Holstein breeding bulls available for artificial insemination, the breeding values of polled bulls are clearly lower (Windig and Eggen, 2009). However, to broaden the genetic foundation of polled dairy breeds and thus to improve their performance related qualities, an increased use of polled bulls would be necessary (Windig and Eggen, 2009). The possible further argument for using polled cattle, animal welfare considerations, may not play a major role in this group of farmers. However, it is not quite foreseeable what would happen in a situation in which disbudding becomes more expensive due to stricter welfare rules, a situation to which the majority of farmers in the NRW group were clearly opposed.

The general opposition towards an obligatory pain relief during and after disbudding in both focus groups with farmers applying this procedure indicates that an improvement of the disbudding procedure in this regard cannot likely be achieved on a voluntary basis due to insights into animal welfare consequences. The only exception was the organic dairy farmer with a dehorned herd in the NRW group who acknowledged the wish to change the current practice, because of the demands of the

EU Regulation on Organic Agriculture (2008) to not perform disbudding on a routine basis. However, as he regarded his housing facilities to be inappropriate for horned cows, he will not change his practise in the near future. The results from the group discussions conform to the findings from the quantitative survey (chapter 3) that the majority of farmers being used to disbud are not aware of any discussion going on about their practice. Furthermore, members of the NRW group did not see any proper reason to discuss the topic at all, since consumers do not even know that cows have horns and are disbudded. The main reasons for opposing changes of current disbudding practices appear to be of economic nature. Farmers of the NRW group protested against legally inflicted increases of production costs due to costly anaesthetic and analgesic medication and additional payment of a veterinarian as long as milk prices and direct payments remain at the present level which they regarded too low. Additionally, the aspect of who is allowed to perform which procedure likely is an important point which relates to the societal acknowledgement of professional competences. Some farmers responded rather emotionally to the information that only veterinarians and not farmers are allowed to apply anaesthetics (Tierschutzgesetz, 2006) and emphasised their superior competence regarding the disbudding procedure. In order to induce a change in attitude towards more animal-friendly disbudding practices, it is important to communicate information about animals pain to underline the necessity of proper pain relief and, furthermore, to offer a cost-saving possibility to apply the needed medication, for example by allowing farmers to apply anaesthetic and analgesic medication, like it is practised in the UK and Switzerland (Medicines Act, 1968; Tierarzneimittelverordnung, 2004).

It became quite clear during the discussions that notions about disbudding and attitudes towards animals' pain are largely shaped by the actual practices each farmer has experienced. The possibility to experience successful practical examples of alternatives implemented by fellow farmers will therefore likely be an important and efficient way to induce consideration of alternatives to disbudding without pain relief.

4.5. Conclusion

Since most dairy farmers do not see any problem related to the current dehorning practice, it is very unlikely that improvements or alternatives will be accepted if they imply any economic disadvantage. The first step to alteration is a better transfer of

scientific knowledge to raise the farmers' awareness of the pain inflicted to the animals during disbudding. To reduce the costs associated with the use of medication during disbudding, farmers willing to improve their disbudding practice should be allowed to apply anaesthetic and analgesic medication after they have learned how to use it.

An example where alternatives may bring along economic advantages due to reduced labour demands are polled suckler herds with winter housing and extensive management. However, since on dairy farms calves are handled for several times anyway, farmers apparently do not perceive the saving of labour as important enough to accept possible economic disadvantages due to e.g. lower milk yields, which the interviewed farmers assumed when asked about their assessment of currently available polled genetics.

Also the third alternative, to keep horned cattle in loose housing, should be promoted, because many farmers might not even know that this is an option for loose housings. Furthermore, farmers deciding to keep horned cattle should receive more support and guidance to adjust their housing facilities and management properly. Veterinarians, cattle drivers and slaughter house personnel also need to be trained to handle horned cattle safely.

In addition, customers should be better informed about disbudding/dehorning, to allow them a deliberate choice for or against the milk from horned cows.

5. Influence of space allowance in the waiting area on agonistic interactions and the heart rate of high ranking and low ranking horned dairy cows

5.1. Introduction

When the decision has been taken to keep horned dairy cows, it is important to provide them with appropriate housing conditions. Since horns are potentially harmful if used in agonistic interactions, the risk for stress and injuries increases in situations when the animals are not able to keep the intended inter-individual distances due to limited space allowances (Menke and Waiblinger, 1999; Baars and Brands, 2000; Eilers et al., 2005; Schneider, 2008). Horned cows are expected to have greater inter-

individual distances than dehorned ones (Sambraus, 1978). In the waiting area of the milking parlour cows are commonly gathered under crowded conditions twice daily in order to facilitate the driving into the milking parlour. This transient space restriction might induce increased agonistic behaviours and skin injuries caused by horns. On the other hand, agonistic interactions might decrease when the space restriction passes a critical level and the cows are physically no longer able to act agonistically (Arave et al. 1974, Czako, 1978). However, the incapability to respect avoidance distances might be perceived as stressful by the animals and may thereby impair their welfare during the daily waiting periods. Low ranking animals might suffer from stress because they are not able to avoid high ranking ones, but high ranking animals might be similarly stressed when they perceive the crowded situation as a perpetual act of defiance, since low ranking animals cannot show their respect by giving way, not even after threats.

Menke et al. (1999) and Kondo et al. (1989) found a negative correlation between general space allowances per cow in the barn and agonistic behaviours. Very scarce information is available, however, about the effect of different space allowances in the waiting area, let alone on different individuals in the herd. Schneider (2010) compared a space allowance of 1.8 m² per cow in the waiting area with an uncrowded waiting situation in the whole loose housing stable (the cows were driven directly from their stable into the milking parlour, no space allowance is reported) and found a trend for less agonistic interactions in horned cows in the uncrowded situation.

Different practice recommendations can be found regarding space allowance in the waiting area for cows. For instance, Simon et al. (2007) recommend 1.4 to 2.0 m²/cow in organic agriculture and Eilers (2011) 2 m²/cow (not specified if horned or not), whereas an advisory service for welfare-friendly animal husbandry (BAT, 2010, personal communication) regards 2.5 m²/horned cow as a minimum. On this basis three different space allowances were tested in the current experiment: 1.7m²/cow is the middle of the recommended space range following Simon et al. (2007), 2.5 m² is the upper recommendation, and 4m²/cow was the largest space allowance possible on the experimental farm serving as a near optimum reference.

It was the aim of this study to assess the effect of these three different space allowances in the waiting area on the heart rates of horned higher and lower ranking focal cows, as heart rate is considered to be a good indicator of short-term stress

(Hopster and Blokhuis, 1994). In addition, the effect on social interactions, which might increase the risk of injuries (Menke, 1996), should be evaluated.

5.2. Animals, Material and Methods

5.2.1. Animals, Housing and Management

The experiment was conducted at the organic research farm of the University Kassel. At the time of the experiment, in September 2009, the farm kept 85 – 87 lactating dairy cows of the breed German Black and White Lowland Cattle. Except for some few older cows, the herd was horned.

The stable was designed for about 100 dairy cows, providing 100 feeding places (self-locking feeding racks, 0.8 m width per place, open to the top), 48 cubicles on one side of the barn, a deep litter lying area of 312.5 m² on the other side, concrete floor passageways in both systems, cleaned by automatic scrapers and full-time free access to an outside run (205.4m² = about 2.4m²/ cow). Between the two housing systems was free passage. Fresh water was supplied by four large self-refilling tubes.

The cows had about 5 hours pasturing daily and were additionally fed a mixed ration comprising grass and maize silage and potatoes. Concentrate was manually provided twice daily at the feeding gate.

Twelve rather high ranking and twelve rather low ranking focal animals were selected applying the following combined criteria: i) number of horn inflicted injuries (hairless areas, scratches and open wounds, Tab. 5.1), ii) agonistic index (number of active agonistic interactions divided by number of all counted agonistic interactions, Schrader, 2002) recorded during two different days for two hours each (Tab 5.1). If results according to these criteria were not clear-cut iii) age, iv) subjectively assessed size and weight, as well as v) social rank according to the stockman's judgement were taken into account, as well.

In addition, focal cows were required to be horned and free of lameness or of other visible health impairments. The higher ranking focal cows were between three and eight years old, the lower ranking between two and four years.

Tab 5.1: Number of injuries and agonistic index (Schrader, 2002) in higher and lower ranking focal cows

	Horn inflicted injuries per cow		
	mean	S.D.	minimum/maximum values
whole herd (n = 78)	2.4	2.0	0/8
higher rank (n = 12)	0.7	0.7	0/2
lower rank (n = 12)	5.1	1.9	2/8
Cows	agonistic index		
	mean	S.D.	minimum/maximum values
whole herd (n = 78)	0.5	0.3	0.0/1
high rank (n = 12)	0.8	0.2	0.3/1
low rank (n = 12)	0.1	0.1	0/0.5

S.D. = standard deviation

5.2.2. Experimental design and procedure

During the experimental period of three weeks, the whole herd including the focal cows was consecutively confronted with one of three different space allowances in the waiting areas: 4.0m²/cow (“4.0m²”), 2.5m²/cow (“2.5m²”) and 1.7m²/cow (“1.7m²”) per week. The figures of the different space allowances refer to the initial situation when all cows were gathered in the waiting area. Space allowance was not adjusted in the course of milking when the cows left the waiting area and went into the milking parlour. The experiment started with the largest area and ended with the smallest.

In each focal cow heart rate and behaviour were recorded during the whole waiting period twice before morning milking and twice before afternoon milking per week. Prior to the first measurement, the animals had six days to adjust to the new size of the waiting area in the outdoor run which had been enlarged using mobile fences. This led to some unavoidable differences to the usual situation before with a space allowance of 2.3m²/cow, when the cows had waited in one part of their deep litter area and the outdoor run: the return path from the milking parlour to the stable became long and narrow, and the floor did not comprise anymore a comfortable lying area but only the concrete area of the outdoor run and a new fenced area with crushed stones covered with low amounts of straw. For the two lower space allowances, each adaptation time was only two days, because the change in conditions was smaller. During the first six days adaptation time, the focal cows were also familiarized with

wearing coloured belts for three hours daily which served to fix the pulse monitor and to facilitate identification of the cows. During the experiment only one milker was milking the cows.

5.2.2.1. Heart rate measurement and behaviour sampling

Heart rate was measured in beat-to beat mode (Polar S810i Electro Oy, Kempele, Finland). The pulse electrodes were fixed to the focal cows 20 minutes before observations began. Using instantaneous scan sampling (Martin and Bateson, 2007) with an interval of two minutes, it was concurrently recorded whether the focal cows were standing, walking or lying. In addition, the agonistic interactions “pushing” and “being pushed”, defined as every single contact of a cows` horn (or both horns) with an other cow (including also apparent chance horn contacts without agonistic interactions but no contacts between horns) were continuously behaviour sampled in the focal animals (Martin and Bateson, 2007). The behavioural observations were tape recorded and transcribed later. All cows were observed simultaneously from up to five observers: The same person observed the main part of the waiting area in all three space allowances. Additionally, in 4.0 m², one out of four further persons alternately observed a similiary large part of the waiting area, which was not sufficiently visible for the main observer. Inter-observer reliability between the five observers was tested before (20 minutes observations on two different days) and once after the experiment with acceptable to very good results (Scan Sampling: $\kappa_{\text{Cohen}} = 0.702-0.985$, $n = 140-150$; ‘pushing and being pushed’: $r_{\text{Spearman}} = 0.748-0.935$, $n = 6$ or 7).

5.2.2.2. Analysis of data

The data from nine rather high ranking and nine rather low ranking cows were incorporated in the analysis. Data from four cows had to be excluded due to missing heart rate recordings, and from further two cows, because they became lame or were in heat during the experiment. The heart rate recordings were corrected with the polar precision software using the moderate filter with a minimum zone of protection of 6 S/min and cutting of the heights. The corrected data were edited with Microsoft Excel 2003 to produce the parameters defined in the following.

Average values for every 5 minutes heart rate recording were calculated covering the complete waiting period of every single focal cow for the heart rate “total”.The heart rate “standing”only included the scans without any activity. Excluded were all

“scans” including agonistic interactions and/or locomotion. The first 2 minutes (= one “scan”) following a “scan” with locomotion behaviour were also excluded.

The last time interval before entering the milking parlour was not included in the analyses either, since it mostly were no complete 5 minutes and the associated heart rates were probably influenced by the chasing of the milker. From these values an average value was calculated for every focal cow, one average value for the morning data collections and one value for the afternoon data collection per treatment. If one value was missing from the morning or afternoon measurements of a focal cow, the one remaining value was taken as the final value. From instantaneous scan sampling the proportions of observed time the focal cows spent standing and walking, respectively, were calculated for the whole waiting period. Average values were then calculated from the four behaviour observations per week and treatment for each focal cow, regardless of whether the associated heart rate data were usable for the analyses or not. An analysis of variance for repeated measures (SPSS Statistics 17.0) was carried out for the heart rate parameters and the agonistic interactions pushing and being pushed. The within-subject-factor with three levels was space allowance; the other within factor with two levels was time of measurements (morning and afternoon) and the between-subject-factor with two levels was social rank. In cases of non-sphericity, the degrees of freedom were corrected (Greenhouse – Geisser). Post-hoc tests (LSD) were carried out in case the models were significant. Activity data (standing and walking) showed no normal distribution and were tested for an effect of the space allowance by Friedmann-test with post-hoc pairwise comparisons by Wilcoxon-test. Further, a possible influence of the time of measurements (morning or afternoon) on agonistic interactions was tested using paired T- test and on walking activity using paired Wilcoxon-test.

5.3. Results

Focal cows waited between 0 and 120 minutes in the waiting area, with the majority (4.0m²: 69%; 2.5m²: 57%; 1.7m²: 76%) of cows waiting between 30 and 90 minutes.

5.3.1. Heart rate parameters

In 16.6 % of the average heart rate values only one morning or afternoon recording instead of two were available (8.34 % of all measurements of the included focal cows failed).

The time of the measurement had a significant influence on the heart rates (“total”: $p = 0.000$, $F = 55.32$; “standing”: $p = 0.000$, $F = 36.67$). The values measured in the morning were significantly lower than in the afternoon (Tab.5.2). The social rank of the focal cows had no significant influence on the heart rates (“total”: $p = 0.416$, $F = 0.697$; “standing”: $p = 0.545$, $F = 0.382$). However, heart rates significantly differed between space allowances both for the total waiting time ($p = 0.000$, $F = 9.74$) and the time spent standing ($p = 0.000$, $F = 11.12$, Tab. 5.2).”Total” and “standing” heart rates were significantly higher with 1.7 m² compared to the other space allowances (Tab. 5.2).

Tab. 5.2: Statistical results from the analyses of variance and post-hoc pairwise comparisons regarding heart rates “total” and “standing” and mean heart rates in bpm (\pm standard deviation), $n = 18$ (9 lower, 9 higher ranking focal cows), differing superscripts denote significant differences

waiting area		morning „total“	morning „standing“	afternoon „total“	afternoon „standing“
4.0m ² /cow	higher rank	69.84 (6.69)	68.91 (5.91)	79.56 (7.10)	78.47 (7.92)
	lower rank	68.05 (5.47)	68.61 (6.68)	78.72 (5.32)	76.51 (6.62)
	all	68.95 (6.00)^a	68.76 (6.12)^a	79.14 (6.10)^a	77.49 (7.15)^a
2.5m ² /cow	high rank	73.79 (6.81)	73.61 (6.95)	76.93 (4.05)	75.69 (4.15)
	Low rank	71.75 (4.59)	72.16 (4.66)	74.59 (3.31)	74.13 (3.95)
	all	72.77 (5.73)^a	72.89 (5.79)^a	75.76 (3.79)^a	74.91 (4.01)^a
1.7m ² /cow	high rank	76.77 (4.99)	76.51 (5.15)	79.16 (7.34)	78.34 (7.07)
	Low rank	73.80 (5.35)	74.11 (5.67)	77.85 (3.24)	77.52 (3.97)
	all	75.28 (5.25)^b	75.30 (5.40)^b	78.51 (5.54)^b	77.94 (5.57)^b
p-values of pairwise comparisons		a-b 2.5 vs. 1.7: 0.001 4.0 vs. 1.7: 0.001	a-b 2.5 vs. 1.7: 0.001 4.0 vs. 1.7: 0.000	a-b 2.5 vs. 1.7: 0.001 4.0 vs. 1.7: 0.001	a-b 2.5 vs. 1.7: 0.001 4.0 vs. 1.7: 0.000

5.3.2. Activity and agonistic interactions

Behavioural data comprised missing values of 4.7 % for 4 m², 3.8% for 2.5 m² and 5.2% for 1.7 m². The failure of data (agonistic interactions and activity) occurred when focal animals were missed during the behaviour sampling for one or more scans.

Most of the waiting time the animals were standing (86% - 93%, Tab. 5.3) and the highest percentage of walking time occurred in the largest space allowance (5.2%, Tab. 5.3). Some cows were also lying during the waiting times.

Average walking activity in the morning was only in 4.0 m² significantly lower than in the afternoon (p= 0.001, Z = 3.39), but not in the other space allowances (2.5 m²: p = 0.758, Z = 0.308; 1.7 m²: p = 0.327, Z = 0.980). The proportions of time spent walking for the morning and afternoon waiting periods taken together, differed significantly between the different space allowances, (p = 0.011, χ^2 = 9.0). This was not the case for standing (p= 0.056, χ^2 = 5.77).

Regarding agonistic interactions, frequencies of being pushed per cow and hour were significantly lower in the morning than in the afternoon in 1.7 m² (p = 0.001, T = 4.24), but not in the other space allowances (2.5 m²: p = 0.118, T = 1.64; 4.0m²: p = 0.058, T = 2.03). The frequency of pushing/cow and hour was not significantly different between higher and lower ranking animals (p = 0.070, F = 2.01), but lower ranking cows were pushed significantly more often than the higher ranking ones (p = 0.001, F = 7.72, Tab. 5.3). The average frequencies of pushing per hour and focal cow were not significantly different between space allowances in the waiting area (p = 0.150, F = 2.01), whereas a significant effect could be found on the frequencies of being pushed (p = 0.002, F = 7.72), with the highest number of interactions in the space allowance of 1.7 m² (Tab. 5.3).

Tab. 5.3: Mean percentages of standing and walking as well as mean frequencies of different agonistic interactions per cow and hour in the waiting area with different space allowances (\pm standard deviation), n = 18 (9 low ranking & 9 high ranking cows)

waiting area		standing	walking	pushing	being pushed
4.0m ² /cow	high rank	82.89 (14.57)	5.27 (3.13)	1.82 (.65)	0.30 (0.44)
	Low rank	90.01 (5.10)	5.09 (3.45)	0.89 (0.97)	2.28 (1.18)
	all	86.45 (11.43)	5.18 (3.26)^a	1.35 (.93)	1.29 (1.34)^a
2.5m ² /cow	high rank	86.21 (13.44)	3.71 (3.39)	1.66 (1.19)	0.85 (0.99)
	Low rank	89.24 (13.27)	2.27 (2.01)	1.11 (.99)	1.37 (0.75)
	all	87.73 (13.26)	2.99 (2.76)^{ab}	1.39 (1.10)	1.11 (0.89)^a
1.7m ² /cow	high rank	91.91 (4.95)	2.07 (2.35)	2.34 (1.36)	1.82 (1.21)
	Low rank	93.35 (1.93)	2.03 (1.61)	1.47 (1.46)	3.17 (1.92)
	all	92.63 (3.81)	2.05 (1.99)^b	1.91 (1.44)	2.45 (1.71)^b
p-values			a-b 4.0 vs. 1.7: 0.006		a-b 4.0 vs. 1.7: 0.011 4.0 vs. 2.5: 0.006

5.4. Discussion

Cows in the waiting area of the milking parlour with an initial space allowance of 1.7 m²/cow received more than twice as many pushes than cows having 2.5 m²/cow or 4.0 m²/cow available. Also the frequency of pushing increased numerically, but this did not reach significance level. Every physical interaction involves the risk of injuries in horned cows. In addition, lower ranking cows were pushed significantly more often than higher ranking focal cows, leading to an even higher injury risk for low ranking animals, as also described by Zeeb et al. (1990). Additionally, the results confirm that the focal cows had been properly assigned to the two rank groups.

Theoretically, as cows walked more in the largest space allowances, they potentially could have met more different cows, thus had more occasions to show agonistic interactions. In fact, it was observed that in this space allowance more displacements without physical contact occurred than in the other space allowances. However, this measure was not further used, because inter-observer agreement was insufficient. Nevertheless, it appears from these observations that the possibility to give way to threats, which was physically largely reduced in 1.7 m², allows low ranking cows to avoid pushes.

Considering the negative effect of the smallest space allowance, it should be taken in mind, that the cows were subjected to the initial space allowances only for 10 minutes in the beginning of the waiting period and after that time, the space allowances increased steadily. Consequently, most of the waiting time, the cows had more space allowance available. The result could have been different, if the space allowances would have been adjusted to the initial sizes per cow during the whole waiting time. In addition, the cows in the present study were relatively small with relatively small horns compared to cows of the breed Holstein Friesian.

There are only few further studies available recording agonistic interactions in the waiting area (Gorniak, 2008; Szabó, 2008 in goats; Schneider, 2010), but they similarly found significantly more agonistic interactions in smaller space allowances. All other studies investigating effects of space allowances on agonistic interactions (e.g. Donaldson et al., 1972; Arave et al., 1974; Kondo et al., 1989; Fisher et al., 1997; Weng et al., 1997; Turner et al. 2000; Remience et al. 2008) are not relevant for the present research question as they involve long-term conditions which are not given in the waiting area. It can be expected that the cows learn that the more crowded waiting

situation will change after a while of about an hour. On the other hand, the repeated short-term exposure might counteract a habituation effect possibly occurring in long-term conditions. Another aspect that probably relieves the crowded waiting situation is that no limitation of resources such as food or water is involved which otherwise is often the case when less space is offered (De Vries et al., 2004).

Regarding walking activity, also Arave et al. (1974) found that cows were less active (entered less squares) with long-term smaller space allowances (4 weeks). Although it is often described that physical activity in general results in higher heart rates (Eisermann, 1988 for rabbits; Price et al. 1993 for red deer; Baldock et al., 1988 for sheep) no such effect was found in the current study. On the contrary, heart rates over the whole day were highest in 1.7 m², where least walking activity occurred. Similarly, non-focal cows in heat (ten in 2.5 m² and two in 1.7 m²) apparently caused a higher level of activity in the herd, which was not reflected in higher heart rates. Thus, the amount and quality of walking activity and agonistic interactions shown during this experiment obviously did not significantly contribute to differences in heart rates. The focal cows in the present study were used to walk to pasture (on a hill) daily and in their free stalls and it is not astonishing that walking for just some meters in the waiting area was no sufficient physical activity to raise their heart rates noticeably. Webster and Jones (1998) also did not find clear differences in heart rates of piglets between standing and walking in pens. Using instantaneous scan sampling (Martin and Bateson, 2007) implies that cows may have also shown locomotion within “standing scans”. That might have contributed to the low differences between heart rates during standing and walking in the current study.

When looking at heart rates more closely, it is striking that there were clear differences between morning and afternoon milking. Heart rates in the afternoon were significantly higher than in the morning, probably due to heart rate and blood pressure increasing during the day (Hagen et al., 2005) and decreasing during the night (in humans: I-Fang Guo and Stein, 2003). However, afternoon heart rates may additionally have been more strongly affected by weather conditions, plaque of insects, the length of the ways to pasture, the time on pasture or occurrences such as claw trimming, visits of visitor groups etc. Thus, in the morning the cows always had six to seven hours rest in the calm stable before measurements began, without any interference and under similar climatic conditions, since -contrary to the afternoon-

differences in temperature and in the plaque of insects were marginal during the morning measurements. This may be a reason why differences between the different space allowances were more pronounced in the morning. At the same time, this is a critical aspect of the paired consecutive study design. It would have been advantageous to include repetitions of the treatments to allow some control of confounding factors such as those mentioned above. In the absence of such repetitions, probably the morning measurements are the most reliable. Nevertheless, when taking morning and afternoon measurements together, representing the whole day situation, still heart rates were highest in the lowest space allowance, reflecting enhanced stress on a certain level. However, the average values in 1.7 m² (about 77 bpm) were still in the range of the resting pulse rate for cattle (between 60 and 80 bpm, Rosenberger, 1990; Loeffler, 2002, p. 192). In comparison, average heart rates from 80 to 115 bpm were measured during the transport of dehorned cows (Schmeiduchs, 2002; Henke, 2003). Therefore, results may be interpreted as indicating mild stress in space allowances of 1.7 m² in the waiting area. An influence of the social rank status on the heart rates was anticipated because it was found for rabbits (Eisermann, 1992) and goats (Aschwanden et al. 2008). In the current study however, no significant differences were found between heart rates of lower ranking and higher ranking focal cows. The stress inducing effect appears to be independent of the rank status, although low ranking animals were pushed significantly more than high ranking animals.

5.5. Conclusion

Space allowances of 1.7 m² per horned cow in the waiting area cannot be recommended as they provoke significantly more pushes and higher average heart rates compared to space allowances of 2.5 or 4.0 m², implying a higher risk of injuries and mild stress. Providing 4.0 m²/cow instead of 2.5 m²/cow did not lead to a significant further reduction of agonistic interactions and not to a reduction of heart rate under the conditions investigated.

6. Can pasture access contribute to reduced agonistic interactions and relaxation in the loose housing barn in horned dairy cows?

6.1. Introduction

There is substantial evidence that access to pasture despite some associated health risks such as unbalanced feeding (Washburn et al., 2002; Boken et al., 2005) or infectious challenges (Borgsteede and Burg, 1982; Verbrugghe, 2012), predominantly exerts beneficial effects on dairy cow health. They mainly relate to udder and leg health (Washburn et al. 2002; Hernandez-Mendo et al., 2007; Olmos et al., 2009), but also longevity in general was found to be improved (Molz, 1989; Thomsen et al., 2006; Burow et al., 2011).

In addition, from a behavioural point of view a number of advantages are reported. For instance, walking and self-grooming on pasture can more securely and fully be performed than on the often slippery surfaces inside (Wlcek and Herrmann, 1996). The greater space allowances on pasture mean a greater freedom of choice of lying places, and lead to less disturbed lying down and standing up behaviour (Olmos et al., 2009), reduced agonistic interactions (Wierenga, 1984; Miller and Wood-Gush, 1991) and a higher synchrony of herd behaviour (Zeeb and Bammert, 1985; Krohn et al., 1992). Also lying periods were found to be longer (Olmos et al., 2009).

Taken altogether, it can be hypothesised that access to pasture leads to a relaxation in the cows, which in turn might be one factor contributing to the increased longevity found (Burow et al., 2011), for instance via the route of positive immunological effects of stress reduction (Dreau et al., 1999; Bailey et al., 2006; Freestone et al., 2008). However, no investigation is yet available testing the expected relaxation effect. Moreover, as in many countries dairy cows are usually kept at pasture only for a limited number of hours per day, it is the question whether a possible relaxation would only apply for times at pasture or beyond.

Measures to reduce agonistic interactions between cows are particularly important in horned dairy herds as the level of horn-related injuries is correlated with the level of agonistic interactions (Menke et al., 1999). While it is to be expected that access to pasture will lead to reduced agonistic interactions on pasture (Wierenga, 1984; Miller and Wood-Gush, 1991), it is not known, if such an effect may last longer, i.e. also during times when the cows are inside without the generous space allowances at

pasture. Indications of “carry over” effects may be seen in the results from Castro et al. (2011). They found that frequencies of agonistic interactions in an outdoor run increased with the length of interval between the exercises in the outdoor run. However, they recorded agonistic interactions in the outdoor run only, for the cows were otherwise kept in tie stalls.

The aim of this study was to find out, whether different extents of pasture access for horned dairy cows during the day affect the level of agonistic interactions and relaxation while the cows are inside their loose housing system. Indicators of relaxation or stress level were heart rate and heart rate variability as well as the latency to lie down and lying duration after milking in the evenings.

6.2. Animals, materials and methods

6.2.1. Animals, Housing and Husbandry

The experiment was conducted in spring 2011 at the research and demonstration farm of the University of Kassel, Germany. One week before measurements and observations started, a herd of horned dairy cows of the breed German Black and White Lowland Cattle was divided into four groups with 18 or 19 cows per group, respectively. As the existing herd was just separated within their familiar housing, no new animals were introduced and all cows could still see each other, this time was judged sufficient to allow adjustment to the new situation. Age distribution of the cows was balanced between groups (Tab. 6.1). The four groups were housed in four pens within the same building with each 23 self-locking feeding places which were 0.8 m wide and open to the top, one large self-refilling water trough (115 cm x 35 cm), concrete floor passageways cleaned by a scraper and no access to an outside run during the experiment. Two of the pens were equipped with each 24 deep bedded cubicles, two had a free deep litter lying area of each 156 m². All cows were used to both housing systems because usually they have access to both systems. During the experiment, each group changed between cubicle pen and deep litter pen after each milking due to organisational reasons related to milking. Thus, two groups were always in a deep litter pen during night and cubicle pen in the morning, and in the other two groups it was vice versa. The cows were milked twice daily in a 2 x 6 herringbone milking parlour.

A mixed ration comprising maize silage, potatoes and carrots was fed ad libitum once daily. Normally, the cows received no concentrate, but during the experiment small amounts were used to attract them into the feed lockers (2 - 4 times daily) for the attachment and removal of the heart rate monitors.

Based on the judgement of the stockpeople, six rather low ranking focal cows were selected in each group. They were between 3 and 9 years of age (Tab. 6.1) and free of lameness or other visible health impairments.

Two weeks before data collection began, the focal cows were accustomed to wearing a girth around their chest for at least twice 48 hours. The girths served for attachment of the heart rate monitors and for individual identification with coloured tapes.

Tab. 6.1: Characterisation of the experimental groups and the focal cows

	group 1	group 2	group 3	group 4
Average age	5.4	5.4	5.6	5.3
average number of lactation (range)	3.2 (1 - 7)	3.4 (1 - 8)	3.3 (1 - 7)	3.2 (1 - 6)
focal cows				
Average age (range)	5.3 (3 - 9)	4.3 (3 - 9)	5.0 (3 - 9)	4.2 (3 - 8)
average number of lactation (range)	3.5 (1 - 7)	2.7 (1 - 6)	2.7 (1 - 6)	2.0 (1 - 6)

6.2.2. Experimental design and procedure

The experiment was conducted at the beginning of the pasture season. At this time, the cows had been without pasture access for four months, but a concrete outdoor run had been accessible for all cows during the whole winter time. Cows were used to receive pasture access. In the experimental period of three consecutive weeks, the four groups were confronted with 0 hours (p0), 4 hours (p4) and 8 hours (p8) pasture access daily. The experiment started with p0 in the first week and ended with p8 in the third week. All groups went to pasture at the same time (12:30 in p4; 8:30 in p8) and always came in at 16:30 before afternoon milking. Every group had their own field of equal size (about 2 ha) and could see all other groups on their fields.

Heart rate measurements and behavioural observations were carried out according to Tab. 6.2 and are described in detail below.

Tab. 6.2: Study design regarding behavioural and cardiac recordings for each of the three study weeks

	Sun	Mon	Tue	Wed	Thu	Fri	Sat
Heart rate measurements with instantaneous scan sampling of 12 (of 24) cows in the evening	X	X	X	X			
Continuous behaviour sampling of 24 cows in the morning		X	X	X	X		
Change to new pasture management (all groups)						X	

6.2.3. Heart rate measurements and instantaneous scan sampling in the evening

During four evenings per week, heart rate was measured in 12 focal cows (3 of every group) with Polar S810i (Polar Elektro Oy, Kempele, Finland) in beat-to beat mode. Thus every focal cow was measured twice per week (Tab. 6.2). The girths with the pulse electrodes were fixed to the focal cows immediately after the afternoon milking. All cows of all groups remained locked in the feeding rack until all focal cows were equipped with the electrodes (all cows had access to TMR during this time).

Instantaneous scan sampling (Martin and Bateson, 2007) with a scan interval of five minutes was carried out recording lying or not lying in order to enable analysis of heart rate and heart rate variability during lying periods. The observer noted when lying scans were interrupted and interrupted scans were not included in the analyses of heart rate and HRV. Behavioural observations and heart rate measurements began directly after unlocking of the cows from the feeding rack and continued for at least two hours, but did not end before all focal cows had shown at least three consecutive undisturbed lying scans.

The two repeated heart rate measurements per treatment were summed up to one average value. If one value for one cow was missing (due to recording failure) the remaining value was used.

6.2.4. Continuous behaviour sampling in the morning

During four mornings per week, agonistic behaviour of the focal cows was recorded by continuous behaviour sampling (Martin and Bateson, 2007). On observation days, all 24 focal cows were equipped with a girth for identification before morning milking started. After the milking, all cows of one group were assembled in the waiting area and given access to the stable at the same time. The continuous behaviour sampling began as soon as all cows of one group had left the milking parlour and came into the

stable from the waiting area. During the time one group was observed in the stable, the next one assembled in the waiting area. Incidences of agonistic behaviour per focal cow were recorded continuously for 30 minutes in every group, comprising the following agonistic interactions: “being pushed” (a cow is forcefully touched by another cow with the horn(s)) and “being displaced” (cow moves forwards, sideways or backwards after a threat - without physical contact - from another cow by moving at least two legs) . The observations were tape recorded and transcribed later.

6.2.5. Processing and analysis of data

The heart rate recordings were processed by correcting artefacts (medium filter) and removing trend components (Tarvainen et al., 2002) with MATLAB Kubios HRV software version 2.0. The parameters listed in Tab. 6.3 were calculated using Microsoft Excel 2003 and subjected to analyses of variance with repeated measures (SPSS Statistics 18.0.3). Within-subject-factor with three levels was the time on pasture (p0, p4, p8) and the between-subject-factor with four levels was the group 1 - 4 (level of significance = 0.05; post hoc analysis LSD). Normality of distribution of the residuals and homogeneity of variances were visually checked (QQ Plot, Scale Location Plot, Residuals vs. Fitted). For the parameter RMSSD the data were subjected to a root transformation.

Tab. 6.3: Cardiac and behavioural dependent variables

Heart rate	Mean heart rate of each focal cow during the whole observation period of 2 hours, average from two recordings per week if available
Heart rate during lying	Mean heart rate of each focal cow during two consecutive undisturbed lying scans (= 10 min) successive to the first lying scan the cow showed at the evening of the observation, average from two recordings per week if available
Heart rate variability – SDNN	Standard deviation of the RR interval during two consecutive undisturbed lying scans (= 10 min), average from two recordings if available
Heart rate variability – RMSSD	Root mean square of successive differences between successive inter-beats intervals during two consecutive undisturbed lying scans (= 10 min), average from two recordings if available
Lying time	The percentage of scans with focal cow lying in relation to all scans during the first two hours observation over two recordings (when a cow showed no lying behaviour within the first two hours, the percentage was counted as 0, although heart rate data from later occurring lying time was included in the analyses of the heart rate parameters)
Latency to lie down	Mean time (minutes) until the first 15 minutes undisturbed lying from two recordings
Agonistic interactions	Mean frequency of being pushed and displaced per focal cow and 30 min over four recordings per week

6.3. Results

Altogether 288 heart rate measurements were accomplished, of which 116 could not be used because of recording failures, leading to 81% of means with only one instead of two values. At least one heart rate value per treatment, however, could be ascertained for every focal cow.

The focal cows showed significantly lower heart rates ($F = 9.374$, $p = 0.000$, Tab. 6.4) with 8 hours pasture access compared to 4 and 0 hours, whereas SDNN was only significantly different between p4 and p0, with higher variability in p4 ($F = 3.662$, $p = 0.035$, Tab. 6.4). No significant differences between treatments could be detected regarding RMSSD ($F = 2.76$, $p = 0.075$, Tab. 6.4).

During p4 and p8 the cows showed significantly less agonistic interactions/30min in the stable ($F = 23.724$, $p = 0.000$, Tab. 6.5) than during p0 and lay down significantly quicker ($F = 24.947$, $p = 0.000$, Tab. 6.5). The longest lying times were observed during p4, followed by p8 and then p0 ($F = 30.152$, $p = 0.000$, Tab. 6.5).

Tab. 6.4: Heart rate and heart rate variability with different daily times spent on pasture (p0 = 0 hours, p4 = 4 hours, p8 = 8 hours)

	heart rate in bpm during 2 hours		heart rate in bpm during 10 min lying		SDNN in ms		RMSSD in ms	
	Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.
p0	86.10 ^a	8.40	80.66 ^a	6.96	16.00 ^a	7.58	3.42 ^a	1.09
p4	85.68 ^a	5.36	80.66 ^a	5.37	20.36 ^b	11.60	3.98 ^a	1.64
p8	80.79 ^b	6.39	74.13 ^b	5.00	17.14 ^{ab}	7.75	3.73 ^a	0.82
p-values from the pair wise comparisons	a-b p0 vs. p8: 0.003 p0 vs. p4: 0.000		a-b p0 vs. p8: 0.000 p0 vs. p4: 0.000		a-b: p0 vs. p4: 0.006			

Tab. 6.5: Agonistic interactions and lying behaviour with different daily times spent on pasture (p0 = 0 hours, p4 = 4 hours, p8 = 8 hours)

	percentage of lying time during 2 hours		latency to lie in minutes		number of agonistic interactions received per focal cow in 30 min	
	Mean	S.D.	Mean	S.D.	Mean	S.D.
p0	32 ^a	18.6	96.7 ^a	45.7	8.5 ^a	4.7
p4	60 ^b	12.7	44.2 ^b	20.7	4.2 ^b	3.1
p8	48 ^c	14.4	50.5 ^b	28.6	3.2 ^b	2.9
p-values from the pairwise comparisons	a-b p0 vs. p4: 0.000 a-c p0 vs. p8 0.000 b-c p4 vs. p8: 0.004		a-b p0 vs. p4 p0 vs. p8: 0.000		a-b p0 vs. p4 p0 vs. p8: 0.000	

6.4. Discussion

Clear effects of pasture access on the cows' behaviour and physiological state indicative of relaxation were found in the stable. Similar other studies in dairy cows to our knowledge are not available, but for horses Werhahn et al. (2012) compared groups with time restricted group turnout to horses without turnout and found similar results also measured solely in the stable, with significantly longer lying times and higher heart rate variability (HRV) values in horses with turnout.

Only rather low ranking horned cows were investigated in the present study, because it can be expected that these are the ones that profit most from improved husbandry conditions. Indeed, a reduction of received agonistic interactions of more than 100 % during peak feeding time, regardless of the time spent on pasture, can be judged a substantial improvement. Strategies to reduce agonistic interactions are especially important in horned cows with their increased risk of injury related to social conflict, but they also contribute to improved welfare in dehorned cows as agonistic interactions are likely associated with social stress (Otten et al., 1997; Wascher et al., 2009).

The general level of agonistic interactions found appears rather high compared to figures from other studies. For example, Menke et al. (1999) found an average level of 0.25 physical interactions per animal and hour in 35 horned herds, and compared this with generally higher levels found in other studies with dehorned herds that

ranged from 0.33 to 4.6 interactions/animal and hour (Collis et al., 1979; Jonassen, 1991; Menke, 1996) The highest figure is comparable with the interactions found in p4. However, these figures do not reflect an especially quarrelsome herd, but the specific method of data acquisition in the present study. Firstly, the other data refer to physical interactions whereas physical interactions in the present study accounted only for about 33% of all recorded agonistic interactions. Secondly, the present study did not survey the whole group, but only low ranking animals that are likely to receive more pushes than the average of all herd members. In addition, the observed 30 minutes were during the main feeding time immediately after milking, when all cows crowded in front of the feeding rack. The observation period of 30 minutes was chosen because the number of interactions decreased rapidly after that time and the average value for one hour observation period would have been much lower than the doubling of the data found for 30 minutes.

The other behavioural and the cardiac parameters all pointed towards a relaxation effect of pasture access, although partly differentiated according to time spent on pasture. The time to lie down after afternoon feeding was closely related to the level of agonistic interactions. The focal cows needed about half of the time until first lying when the group had pasture access, regardless of duration. This is in line with a suggestion from Menke (1996) that the time low ranking cows need to lie down in the evenings might be an adequate indicator for the stress level within a herd.

In consequence of the later lying down and possibly also due to lower synchrony (see below), the percentage of time spent lying during the two hours observation time was also lower during p0, nearly half of the time during p4. However, here there was also a significant difference between p4 and p8 with slightly lower lying times during p8. This difference is difficult to explain. It can only be speculated that different weather conditions (see below) or increased habituation led to longer lying times on pasture during p8 and therefore to a smaller lying need in the stable. It is also possible that independent from weather or habituation the cows mainly grazed when they had only 4 hours available on pasture, but with 8 hours available they spent more of the time lying. However, lying times outside the two evening hours were not recorded. Therefore, it also remains unclear if the total lying time increased with pasture access or if the lying behaviour was just more synchronized and thus less disturbed by “not synchronized” animals. Indeed, Chapinal et al. (2010) could not find any influence of

pasture access during night on total lying time. Keyserlingk et al. (2008) in contrast, observed 24 h per day for 7 days and found a tendency of declined total lying times and a declined number of lying bouts due to stress after regrouping.

Heart rate was only significantly reduced during p8 by about 6 bpm in comparison to p0 and p4. This was similarly the case during the two hours evening observation and during ten minutes lying, only on an again 6 bpm lower level during the latter. Physical activity typically influences heart rate (Eisermann, 1988; Price et al., 1993). Therefore it is quite astonishing that despite the rather similarly decreased agonistic interactions and even greater increase in lying time in p4, heart rate is not similarly decreased in p4 during the two hours that include all activities of the animals. On the other hand, SDNN was significantly increased only during p4 compared to p0 and p8. A similar pattern arose for RMSSD, though differences did not reach significance level. Usually, heart rate is taken as a measure of acute stress rather than chronic stress (Lemaire and Mormède, 1995; Lefcourt et al., 1999; Rietmann et al., 2004; Gygax et al., 2008; Kostelanetz et al., 2009). In the present study, possible differences in heart rate were expected to relate to activity levels and the sum of acute stress responses due to agonistic encounters during the feeding period. However, the similar patterns for both activity and resting period suggest that the present results reflect more a general relaxation in p8 rather than stress responses during p0 and p4. Taking into account the results regarding HRV, it appears that during p8 this was mainly due to down regulation of the sympathetic rather than activation of the parasympathic. During p4 the increase of SDNN together with a constant heart rate level indicates an increased activation of both the sympathetic and parasympathic, the latter reflecting relaxation (Mohr et al., 2002; Langbein et al., 2004; Rietmann et al., 2004; Hagen et al., 2005; Gygax et al., 2008). Thus under both conditions, there were indications for relaxation, but with different underlying stimulations of sympathetic and parasympathic. Possible causes are unclear. Heart rate and heart rate variability are influenced by many factors, e.g. thermoregulation, (McCarty et al., 1995) insects and diarrhoea (Mohr et al., 2002). The incidence of diarrhoea was not systematically recorded, yet the change from silage to fresh grass caused transient likely non-infectious diarrhoea in some cows. Further, weather was characterized by rather cold temperatures during the first two weeks of the study (p0 and p4) (on average 10 and 8 °C in the evenings during the measurements, rainy at times), while evening

temperature in p8 was 12.5 °C with continuous sun during the days. Since cows are rather sensitive to warmer temperatures and have a high priority to seek shade (Schütz et al., 2009), it could have caused them physiological stress to be at pasture in the sun for eight hours without shade (some of them had still winter coat). To avoid confounding by weather, it would have been beneficial to subject the groups time shifted to the different treatments. This would also have avoided possible time effects (see below). However, since all cows could see each other within the stable, pasture access of just one group would have caused a considerable amount of stress in all groups remaining in the stable due the apparent attractiveness of pasture access to the cows, at least in the first days after the winter housing period. Therefore, this would have been an even greater confounder. Furthermore, pasture access also meant a change of feeding quality and the cows had to adapt slowly to the new situation, since it was not possible to feed fresh cut grass in the stable. This was another reason why a randomised succession of the treatments was not possible, in order to avoid digestive disorders. However, at the same time, this gradual change in feeding may have produced unwanted effects, even though no information is available on such possible effects. Another potential time effect is described in a human study. Curic et al. (2007) found that it matters whether the HRV is measured after a stressful or relaxing event. Whereas SDNN after a relaxing event was found to be only slightly higher than during a stressful event, it was higher after a stressful event than after relaxation or at rest. This could also have applied for SDNN in p8, because this treatment followed a relaxing situation (p4) with only slightly higher levels than during a rather stressful situation (p0). A last time effect may have been constituted by differences in the experience of novelty during pasture access. The first week of pasture access (p4) certainly involved more novelty than the second (p8) and it is reported that novelty may also trigger an increase of the heart rate variability (Désiré et al., 2004). Independently from these and other potential influencing factors which are partly difficult to control, SDNN and the RMSSD showed vast individual differences, as it was also found by Minero et al. (2001, 2006) for dairy cattle and horses. Because of the wide variation of values it is in general difficult to define a standard range for these parameters (Task Force of the European Society of Cardiology, 1996). Altogether, this calls for a careful interpretation of HRV results in relation to a distinct potential influencing factor.

In general, the question remains, what exactly caused the more relaxed situation in the stable when the cows had pasture access. One aspect which was not systematically investigated in the present study, but appears to play an important role, is the stimulation or allowance of increased synchrony of the herd on pasture (Zeeb and Bammert, 1985; Krohn et al., 1991). This might have “carried over” into the stable. It seemed to the observer that more cows lay down at the same time and no “running behaviour” was observed in the evenings when there was pasture access. In contrast, during p0 some cows always tried to run on the lying area during the evenings and thus stopped others cows from lying for a longer period. Many cows stood idle on the lying area during the evenings, whereas others moved along and chased up animals that had lied down. This also occurred in the cubicle pens.

Thus, another aspect apparently relates to the lack of physical activity when confined in the stable for a long time (four months). Cows ran and galloped when they received pasture access for the first time. Also after that time the opportunity and necessity for locomotion was largely increased at pasture. Thus, in addition, cows may have been tired after the time on pasture which may have increased their social compatibility.

Also the changed food supply in relation to the rather low performance status of the cows under investigation (average 16.5 kg per focal cow in the month, the study took place) could have played a role. The feed value of the grass on pasture and of the feed ration in the stable was not analysed in the present study, but as the milker reported an increase of the performance with the beginning of pasture access, it is likely that the grass early in spring was higher in protein and energy than the silage in stable (this is confirmed by DLG feed value tables, 1991). This could have led to decreased hunger in the evenings, but since agonistic interactions were observed in the morning only, this effect should have worn off during the night.

The current results can certainly not be generalized without reservation. It is possible that for herds with a higher performance status due to their higher nutrient demands relaxing effects are counteracted by nutritional stressors (Ketelaar-de Lauwere et al., 2000; Charlton et al., 2011a, b). Furthermore, it cannot be ruled out that in dehorned herds possible stress-reducing effects of decreased agonistic interactions are less marked than in horned herds. However, no comparative investigations on social behaviour are available in this respect. On the other hand, it should be stressed that

the cows in this experiment had very generous space allowances in the stable in terms of lying places as well as in terms of feeding places (24 cubicles for 18/19 cows or about 8 m² lying space on the deep litter area for every cow, 23 feeding places). During the time in stable, it was always possible for every cow to get a free lying or feeding place, as well as to keep ample inter-individual distances. The cubicles had generous dimension and were softly bedded with straw. Nevertheless, apparently pasture provided even better conditions in this regard. The effect of pasture access for cows kept under less generous housing conditions can be expected to be even higher.

6.5. Conclusion

The parameters percentage of lying time, latency to lie, heart rate variability and agonistic interactions indicated a relaxation in stable with 4 hours pasture access (p4) compared to no pasture access (p0). Comparing 8 hours pasture access (p8) with p4, parameters showed no clear trend. Agonistic interactions, which are a potential risk for horn inflicted injuries (Menke, 1996), however, were significantly reduced in the stable with 4 hour as well as with 8 hours pasture access compared to sole indoor housing.

7. General discussion

Disbudding was found to be a routine procedure in Germany (89 % - 91.2 % farms kept 70 %- 100 % of their herd dehorned) to ensure stockpeople's on-the-job safety and prevent injuries amongst the animals. Cautery (hot iron disbudding) was found the most prevalent method applied for disbudding, (farmers' survey: 88 %, experts' survey: 95 %). The operator is mostly the stockperson. Dehorning of adult cattle with wire saw, which is performed only to a very low extent in Germany (2.0 – 6.7 % of farms), is more often implemented by a veterinarian (experts' survey: 85 %, farmers' survey: 47 %), as legally required.

One major reason to question the disbudding practise is because the animals are exposed to considerable pain, which is reflected in an increase in the plasma cortisol level (Morisse et al., 1995; Stilwell et al., 2009) and behavioural indicators, e.g. struggling behaviours like scurrying, urging forward, head jerking and rearing, quick

tail wagging, dropping down (Taschke, 1995; Morisse et al., 1995; Graf and Senn, 1999; Faulkner and Weary, 2000). It is assumed that pain is most pronounced in surgical disbudding and even more in dehorning of adult animals (reviewed by Stafford and Mellor, 2005).

However, medication seems capable to ease the pain associated with the treatment, but only when administered as a combination of anaesthesia and analgesia. Local anaesthesia given alone might indirectly even enhance inflammatory pain in dehorned calves (McMeekan et al., 1998b). Likewise, ketoprofen or other NSAIDs given alone, will have little effect on the pain caused by the amputation itself (McMeekan et al., 1998b). Against this background, it is not appropriate to administer only the one or the other, as it is sometimes interpreted from the EU Regulations for Organic Agriculture (2008).

In contrast, the administration of ketoprofen in addition to lidocaine mitigates the pain of the treatment clearly (Milligan et al., 2004; Faulkner and Weary, 2000; Stafford and Mellor, 2005), even though calves were still found to show some head shaking and ear flicking. This treatment, however, did not reduce the frequency of head rubbing at all, whereas in sham disbudded control calves this behaviour was almost not found (Faulkner and Weary, 2000).

Although the German Welfare Act (Tierschutzgesetz, 2006) requires to minimize pain in animals as far as possible, the application of anaesthesia and analgesia during disbudding of calves below the age of 6 weeks is not mandatory. Therefore it was to be expected that such medication in disbudding is rather infrequently applied. Indeed, the recommended combination of anaesthesia in combination with an anti-inflammatory drug was only used in 0.7 - 3.7 % of the farms during hot iron disbudding, never for caustic paste disbudding and in 6.7 % for dehorning with wire/saw. Consequently, almost all animals disbudded in Germany are exposed to considerable pain and distress due to lacking or insufficient pain treatment. In addition, data from the farmers' survey indicate that most farmers (77 %) do not use disinfection after disbudding/dehorning, although incidences of infections after hot iron disbudding can reach 46 % (Taschke, 1995).

One of the causes of this situation is the farmers' assessment of animal pain. The farmers interviewed in the focal group discussions who were applying dehorning were

mostly sure that the procedure causes just little pain, when done at an early age, between the second and 8th week (focal groups “Saxony” and “NRW”, chapter 4). At least within the interviewed groups, there was no understanding and willingness to use pain alleviation for disbudding, especially against the background that anaesthetics had to be administered by a veterinarian, which would raise the costs for the disbudding procedure per calf. An improvement of the pain treatment on a voluntary basis thus seems no promising option.

Nonetheless, scientific knowledge concerning the pain associated with disbudding should more intensively be communicated to farmers as well as to customers buying milk products. An understanding of animals` pain may form a basis for improvements of disbudding practises in the future. A further option to make the use of medication more feasible for farmers, would be to allow them the application of anaesthetics and analgesics on their own, after they have proven necessary skills and knowledge. This would save them the costs for a veterinarian. However, the majority of farmers participating in the survey clearly expressed that they do not see any reason to change their practise by using pain alleviation or otherwise.

On the other hand, only 30 % of the farmers responding to the quantitative survey were not interested in alternatives to dehorning. A majority of 60 % of all surveyed farmers would welcome an alternative to save the work of disbudding, which namely could be the rearing of polled cattle (mentioned by 72 %). The dairy farmers asked in the focal group about their view on polled genetic, however, stated that they would only accept polledness as an additional trait, when performance related traits were not affected negatively.

Besides the fact that even with medication disbudding remains a stressful event for the calves, further aspects should be taken into account in the welfare assessment of disbudding/dehorning. Agonistic interactions in hornless cattle are slightly modified, as head to head pushing, although tried, is not really possible due to the permanent slipping of the foreheads. Thus, hornless cattle use the head more for hitting than pushing (Sambraus, 1978). According to results from Graf (1974) and Menke et al. (1999) it can be hypothesized that horned cattle show lower frequencies of physical agonistic interactions than hornless. More scientific evidence is needed on the possible extent of bruises caused in hornless cattle by those physical interactions, as well as on the associated pain in relation to horn inflicted wounds. Likewise, there is

insufficient knowledge about the actual social stress in hornless versus horned herds under different housing and management conditions. These questions deserve further investigation in the future.

Though not investigated scientifically yet, there are claims of even negative effects of the missing horns in dehorned and polled animals on the cows' health and fertility (Venge, 1959; Stranzinger, 1984 cited from Menke, 1996; Spengler Neff; 1997, Pilz, 2006, Ezenwa and Jolles, 2008). Farmers participating in the group discussions who were keeping horned herds reported similar experiences. However, these were not the only reasons for them to keep horned cows. They did not generally associate the horns with a higher risk of injuries for themselves, but emphasized that stockpeople and other persons handling the cows have to learn how to behave in the presence of horned animals.

In contrast, injuries amongst the animals were stated as a critical point and it was consistently seen as high priority to minimize agonistic interactions amongst the cows. In fact, when it comes to physical agonistic interactions in horned herds, the risk for injuries is higher than in hornless herds. For instance, Schneider (2010) found a mean of 10.1 supposedly horn-inflicted lesions per cow in 61 investigated dairy farms. One aspect mentioned in this connection was the space allowance for the cows in the stable. Largely independent from rank or other influencing factors it is expected that horned animals attempt to maintain greater inter-individual distances than dehorned ones which makes the keeping of horned cattle under restricted space conditions more difficult (Sambraus, 1978). However, scientific studies on spacing behaviour comparing horned and hornless cattle are lacking, and in goats an experimental study could not detect any influence of the presence of horns on social distances (Aschwanden et al., 2008).

The current study with horned cows only (chapter 5) showed, however, that reduced space allowance (1.7 m² per cow) in the waiting area of the milking parlour provoked significantly higher average heart rates and more pushes per dairy cow than in 2.5 or 4.0 m² per cow. This implies a higher risk of horn caused injuries and of mild stress in crowded situations. Providing 4.0 m²/cow instead of 2.5 m²/cow did not lead to a significant further reduction of agonistic interactions and heart rates under the conditions investigated.

Concerning quality and frequencies of physical and non-physical agonistic interactions, it would be worthwhile to undertake comparative studies on horned and dehorned herds with sufficient control of the possibly confounding factors such as breed/breeding line (Le Neindre and Sourd, 1984 ; Boivin et al., 1994 ; Plusquellec and Bouissou, 2001), housing conditions (Menke, 1996 ; Menke, et al., 2000 ; Schneider, 2010), herd size (Boe and Farevik, 2003) as well as management (Waiblinger, 1996; Menke, 1996; Boe and Farevik, 2003).

While Menke et al. (1999) found that generous general space allowances per cow contribute to reduced agonistic behaviours and horn-related skin injuries, the influence of the herd management, the problem solving ability of the farmer and the human-animal relationship is likely even stronger (Menke, 1996; Waiblinger, 1996; Menke et al., 1999). In general, a good human-animal relationship which is characterized by a low fearfulness of the cows should be aimed at (Menke and Waiblinger, 1999; Eilers et al., 2005; Schneider, 2008). Furthermore, stockpeople should be assertive and calm in all situations, maintain a clear communication with the animals and be predictable in order to reduce fear-related behaviour (Menke and Waiblinger, 1999; Schneider, 2008). This point was also highlighted by the farmers keeping horned cows in the focus group discussion “Allgäu”. One farmer even claimed that a good animal-human relationship can compensate suboptimal housing conditions.

Changing from dehorning to a horned herd is in general no easy step, because it is against the common notion that cows should be dehorned. In addition, the adjustment of the housing system and management to the special needs of horned cattle probably implies higher investment and labour costs and farmers may even suffer financial penalties when selling horned cattle (Rosenberger and Robeis, 2005). If the keeping of horned cows is regarded desirable, more economic information is necessary in order to identify needs for financial support for this alternative.

For instance, higher space allowances in the waiting area which can contribute to a more relaxed herd with lower amounts of agonistic interactions (chapter 5) are not common because of higher investment costs and higher labour demands for the herding into the milking parlour. Also other trends such as the decreasing use of pasture in dairy husbandry may have especially negative effects on horned herds. As shown in chapter 6, when cows had 4 or 8 hours pasture access compared to no

pasture access, they showed cardiac responses indicative of relaxation and less agonistic interactions in the stable. Thus, even a limited time under conditions without limited resources, potentially allowing synchronised feeding and lying behaviour as well as sufficient space allowances to retreat from threats, combined with an extensive stimulation of locomotion could improve the welfare situation of the horned cows including the time spent in the stable. In general, it can be concluded that meeting the species-specific needs of cattle concerning their housing and management might be a good basis to successfully keep the animals horned in loose housing.

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10. Annex

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Annex 1: Questionnaire about dehorning practise on dairy farms
(farmers`survey)

**FRAGEBOGEN ZUR ENTHORNUNG AUF
MILCHVIEHBETRIEBEN**

Bundesland
Landkreis

1) Informationen zur Person:

Geschlecht männlich weiblich

Position /Tätigkeit

Ausbildung

Alter

2) Informationen zum Betrieb:

Wie viele Milchkühe halten Sie?

Tiere

Welcher Anteil Ihrer Milchkühe ist enthornt?

- 100% 25-50%
 70-99% unter 25%
 50-70% 0%

Welcher Anteil Ihrer Milchkühe ist genetisch hornlos?

- 0% 50-70%
 bis 25% 70-99%
 25 -50% 100%

Welche Rassen verwenden Sie? Geben Sie bitte auch die jeweilige Anzahl der Tiere an!

Ihre Wirtschaftsweise ist... Konventionell Ökologisch

Falls Sie ökologisch wirtschaften, gehören Sie einem Verband an?
Wenn ja, welchem?

Sie halten Ihr Milchvieh im....

- Boxenlaufstall Anbindestall
 Tiefstreuastall/ Tretniststall

Ihre Tiere haben... (Mehrfachnennungen möglich)

- ...regelmäßig Weidegang (mindestens den ...zeitweise Weidegang

- ganzen Sommer jeden Tag)
- ...ganzjährig Zugang zu einem Auslauf ...zeitweise Zugang zu einem Auslauf

In welchen Haltungssystemen halten Sie ihr Jungvieh?(Mehrfachnennungen möglich)

- Tiefstreuastall / Tretniststall Boxenlaufstall
- Vollspalten Weidehaltung

Falls Sie NICHT ENTHORNEN, fahren Sie bitte mit Frage 9 fort!

3) Was sind Ihre Hauptgründe zu enthornen?

	sehr relevant	1	2	3	4	5	6	kaum relevant
Verletzungsgefahr für Betreuungspersonal verringern		<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	
Umgang mit den Tieren erleichtern		<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	
Verletzungsgefahr für andere Tiere verringern		<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	
Die Tiere an die bestehenden Stalleinrichtungen anpassen (z.B. Fressgitter)		<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	
Lederschäden vermeiden		<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	
andere Gründe		<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	

wenn andere, bitte angeben:

4) Die Enthornungspraxis

In welchem Alter enthornen Sie Ihre Tiere? (Mehrfachnennungen möglich)

	nie (0%)	selten (bis 25%)	manchmal (25%-50%)	oft (50%-75%)	sehr häufig (75%-99%)	immer (100%)
0-2 Wochen	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
2-6 Wochen	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
6-8 Wochen	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
älter als 2 Monate (erwachsene Tiere)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Welche Enthornungsmethode benutzen Sie? (Mehrfachnennungen möglich)

- Buddexgerät Säge/ Draht
- anderer Brennstab Anderes
- Ätztstift/ -paste
- Chirurgische Methode mit Spezialmesser

Fall Sie mehrere Enthornungsmethoden anwenden, schätzen Sie bitte den Anteil der Tiere, die jeweils damit enthornt werden.

Buddexgerät % der Rinder

Anderer Brennstab % der Rinder

Ätztift/-paste % der Rinder
 Chirurgische Methode mit
 Spezialmesser % der Rinder
 Säge/Draht % der Rinder

**Wer führt die Enthornung bei Ihren Tieren durch?
 Wählen Sie bei den von Ihnen benutzten Verfahren!**

	Tierarzt	Tierbetreuer	Andere	
Buddexgerät	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="text"/>
Anderer Brennstab	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="text"/>
Ätztift/-paste	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="text"/>
Chirurgische Methode mit Spezialmesser	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="text"/>
Säge/Draht	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="text"/>

Einsatz von Medikamenten:

* BM = z.B. Xylazin; Rompun(C)

** ÖB = Betäubung des Hornnervs z.B mit Lidocain oder andere
örtl. Betäubungsmittel

*** SM = z.B. Ketoprofen und ähnliche; Romefen(C)

Welche Medikamente setzen Sie bei Ihren Tieren bei der Enthornung ein?

Bitte kreuzen Sie bei den von Ihnen verwendeten Verfahren an.

	Keine	ausschließlich Beruhigungsmittel (BM*)	ausschließlich örtliche Betäubung (ÖB**)	ausschließlich Schmerzmittel (SM***)	BM + ÖB	BM + SM	ÖB + SM	BM + ÖB + SM
Buddexgerät	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Anderer Brennstab	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Ätztift/-paste	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Chirurgische Methode mit Spezialmesser	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Säge/Draht	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Behandlungsmaßnahmen nach der Enthornung

Bitte schätzen Sie die Anteile!

Keine % der Enthornungen
 Desinfektion % der Enthornungen
 Andere % der Enthornungen

wenn andere, bitte erläutern!

5) Kennen Sie spezielle Fortbildungsmöglichkeiten in Bezug auf die Enthornung?

nein ja

wenn ja, welche?

6) Überlegen Sie, Ihre derzeitige Enthornungspraxis zu verbessern? (z.B. Schmerzausschaltung, Entfernen der Hornanlagen statt der gewachsenen Hörner)

- nein ja

wenn ja, wie?

7) Wären Sie an Alternativen zur Enthornung interessiert? Wenn ja, an welchen?
(Mehrfachnennungen möglich)

- nein Andere, bitte angeben
 Zucht genetisch hornloser Tiere
 neuartige Aufstallungsformen

8) Besteht für Sie eine Verpflichtung zu Enthornen?
Wenn ja, bitte angeben (Mehrfachnennungen möglich):

- nein Voraussetzung für den Zugang zum Rindemarkt
Vorgeschrieben von der
 Berufsgenossenschaft (Deutschland) bzw. der
Versicherungsanstalt (Österreich) Andere, bitte angeben
 Vorgeschrieben von den
Schlachthöfen

9) Besteht für Sie eine Verpflichtung NICHT zu enthornen? Wenn ja, bitte angeben
(Mehrfachnennungen möglich):

- nein Voraussetzung für den Zugang zum Rindemarkt
Vorgeschrieben vom
 Zuchtverband (Herdbuch) Andere, bitte angeben
 Vorgeschrieben von
Qualitätsprogrammen

Frage 10 und 11 bitte nur ausfüllen, wenn Sie (auch) behornete Tiere halten!

10) Inwiefern kostet Sie die Haltung BEHORNTER Tiere besondere Aufmerksamkeit?
(Mehrfachnennungen möglich)

- kein besonderer Mehraufwand spezielle Stalleinrichtungen
 mehr Stallplatz mehr Vorsicht im Umgang mit den Tieren
 mehr Managementaufwand längere Arbeitszeiten

Mögliche Erläuterungen zu Frage 10

11) Was sind Ihre Hauptgründe behornete Tiere zu halten? (Mehrfachnennungen möglich)

- Spart die Enthornung Hörner gehören zu meiner Rasse
 Keine schlechten Erfahrungen mit
Behornung Tradition
 Hörner gehören zum Wesen der Kuh

Annex 2: Questionnaire about dehorning practise on dairy farms (experts` survey)

FRAGEBOGEN ZUR ENTHORNUNG IN MILCHVIEHBETRIEBEN

EU- Land Österreich Deutschland

Name:
Organisation:
Position /Tätigkeit:
Ausbildung:

Region, für die Aussagen gemacht werden (z.B. Landkreis)

Informationen zu den Betrieben, für die Aussagen gemacht werden können:

Wie hoch ist die Anzahl der Betriebe, zu denen eine Aussage gemacht werden kann?

 Betriebe

Die erfassten Betriebe sind welcher % Anteil aller Betriebe in der betrachteten Region?

 % aller Betriebe

Was sind die wichtigsten Rassen (nach Bedeutung geordnet)?

Weitere Charakteristika

1) Haltungssystem und Enthornung

Wie viel % der betrachteten Betriebe praktizieren welches Haltungssystem?

Laufställe (Tretmistställe, Boxenlaufställe, Tiefstreuställe): % der Betriebe

Anbindehaltung % der Betriebe

Wie hoch ist die DURCHSCHNITTLICHE Anzahl der Milchkühe auf Betrieben mit...

Laufstallhaltung: Tiere

Anbindehaltung Tiere

Wie hoch ist % Anteil der Betriebe, die enthornte Tiere halten? (als Betriebe mit enthornten Tieren gelten Bestände mit einem Anteil von enthornten Tieren von mehr als 70%)

in Laufstallhaltung % der Betriebe

in Anbindehaltung % der Betriebe

**Wie hoch ist der % Anteil der enthornten Tiere in der betrachteten Region?
(wenn bekannt oder alternativ, wenn keine Aussagen auf Betriebsebene möglich ist)**

in Laufstallhaltung: % der Tiere

in Anbindehaltung % der Tiere

Wie hoch ist der % Anteil der Betriebe (von allen betrachteten Betrieben) mit genetisch hornlosen Tieren? (mehr als 70% der Tiere auf dem Betrieb sind genetisch hornlos = Betrieb mit hornloser Genetik)

in Laufstallhaltung % der Betriebe

in Anbindehaltung: % der Betriebe

**Wie hoch ist der % Anteil genetisch hornloser Tiere in der betrachteten Region?
(wenn bekannt oder alternativ, wenn keine Aussagen auf Betriebsebene möglich)**

in Laufställen % der Tiere

in Anbindeställen % der Tiere

groben Schätzungen zuverlässigen Schätzungen erhobenen Daten

Die Angaben zu
Haltungssystem und
Behornung der Tiere
beruhen auf:



2) Produktionssystem und Enthornung

Wie viel % der betrachteten Betriebe wirtschaften...

konventionell % der Betriebe

ökologisch % der Betriebe

Wie hoch ist die durchschnittliche Anzahl der Milchkühe auf den betrachteten Betrieben?

konventionell Tiere

ökologisch Tiere

Wie viel % der Betriebe haben Anbindehaltung?

konventionell % der Betriebe

ökologisch % der Betriebe

Wie viel % der Betriebe enthornen ihre Tiere (als Betriebe mit enthornten Tieren gelten Bestände mit einem Anteil enthornter Tiere von mehr als 70%)

konventionell % der Betriebe

ökologisch % der Betriebe

Wie viel % der Tiere sind enthornt? (wenn verfügbar oder alternativ, wenn Aussagen zu Betrieben nicht möglich sind)

konventionell % der Tiere

ökologisch % der Tiere

Wie viel % der Betriebe halten genetisch hornlose Tiere (als Betriebe mit genetisch hornlosen Tieren gelten Bestände mit einem Anteil genetisch hornloser Tiere von mehr als 70%)

konventionell % der Betriebe

ökologisch % der Betriebe

Wie viel % der Tiere sind genetisch hornlos? (wenn verfügbar oder alternativ, wenn Aussagen zu Betrieben nicht möglich sind)

konventionell % der Tiere

ökologisch % der Tiere

Die Angaben zu Produktionssystem und Behornung der Tiere beruhen auf:

	groben Schätzungen	zuverlässigen Schätzungen	erhobenen Daten
	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

3) Was sind die Hauptgründe der Landwirte zu enthornen?

	sehr relevant	1	2	3	4	5	6	kaum relevant
Verletzungsgefahr für Betreuungspersonal verringern	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Umgang mit den Tieren erleichtern	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Verletzungsgefahr für andere Tiere verringern	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Die Tiere an die bestehenden Stalleinrichtungen anpassen (z.B. Fressgitter)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Lederschäden vermeiden	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
andere Gründe	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

bitte angeben:

4) Wird die Entscheidung für oder gegen Enthornung von folgenden Faktoren beeinflusst?

Rinderrasse nein ja

wenn ja, bitte erläutern

Geschlecht des Tieres nein ja

wenn ja, welche Tiere werden eher enthornt?

- männliche weibliche

Größe des Betriebes nein ja

wenn ja, bitte erläutern

Alter des Betriebsleiters nein ja

wenn ja, bitte erläutern

Ausbildungsniveau des Betriebsleiters nein ja

wenn ja, bitte erläutern

Lokale Traditionen nein ja

wenn ja, bitte erläutern

Andere
(bitte
angeben
und
erläutern)

5) Enthornungspraxis:

Zu welchen % Anteilen werden Hornanlagen bzw. die Hörner entfernt?

*(bis zum zweiten Lebensmonat = Entfernen der Hornanlagen
zu einem späteren Zeitpunkt durchgeführte Verfahren = Entfernen der Hörner)*

Bei wie viel % der Betriebe werden...

...die HORNANLAGEN entfernt % der Betriebe

...die HÖRNER entfernt % der Betriebe

Bei wie viel % der enthornten Rinder wurden...

...die HORNANLAGEN entfernt % der Rinder

...die HÖRNER entfernt % der Rinder

	groben Schätzungen	zuverlässigen Schätzungen	erhobenen Daten
Die Angaben zu dem Zeitpunkt der Enthornung der Tiere beruhen auf:	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Verfahren der Enthornung:

Enthornung mit dem BUDEXGERÄT:

Welcher % Anteil der enthornenden Betriebe? % der Betriebe
 Welcher % Anteil der enthornten Rinder? % der Rinder
 Durchschnittliches Alter bei Enthornung? Woche(n)

Enthornung mit dem BRENNSTAB:

Welcher % Anteil der enthornenden Betriebe ? % der Betriebe
 Welcher % Anteil der enthornten Rinder? % der Rinder
 Durchschnittliches Alter der Tiere bei Enthornung? Woche(n)

Enthornen mit ÄTZSTIFT/ -PASTE

Welcher % Anteil der enthornenden Betriebe? % der Betriebe
 Welcher % Anteil der enthornten Rinder? % der Rinder
 Durchschnittliches Alter der Tiere bei Enthornung? Woche(n)

Enthornung mit CHIRURGISCHEM METHODE mit Spezialmesser:

Welcher % Anteil der enthornenden Betriebe? % der Betriebe
 Welcher % Anteil der enthornten Rinder? % der Rinder
 Durchschnittliches Alter der Tiere bei Enthornung? Woche(n)

Enthornung mit SÄGE/DRAHT:

Welcher % Anteil der enthornenden Betriebe? % der Betriebe
 Welcher % Anteil der Rinder? % der Rinder
 Durchschnittliches Alter der Tiere bei Enthornung? Monate

Wie viel % der Betriebe enthornen mit bisher nicht genannten Methoden? % der Betriebe

bitte erläutern!

groben Schätzungen	zuverlässigen Schätzungen	erhobenen Daten
--------------------	------------------------------	-----------------

Die Angaben zu
Enthornungsverfahren
und Enthornungsalter der
Tiere beruhen auf:

Wer führt die Enthornung durch?

Enthornung mit dem BUDEXGERÄT:

Bei wie viel % der Betriebe enthornt...

...der Tierarzt % der Betriebe
...ein Tierbetreuer? % der Betriebe
...eine andere Person als
bereits genannt? % der Betriebe

bitte erläutern!

Enthornung mit dem BRENNSTAB:

Bei wie viel % der Betriebe enthornt...

...der Tierarzt % der Betriebe
... ein Tierbetreuer? % der Betriebe
...eine andere Person als
bereits genannt? % der Betriebe

bitte erläutern!

Enthornung mit ÄTZSTIFT/ -PASTE:

Bei wie viel % der Betriebe enthornt...

...der Tierarzt % der Betriebe
... ein Tierbetreuer? % der Betriebe
...eine andere Person als
bereits genannt? % der Betriebe

bitte erläutern!

Enthornung mit CHIRURGISCHEM METHODE mit Spezialmesser:

Bei wie viel % der Betriebe enthornt...

...der Tierarzt % der Betriebe
...ein Tierbetreuer? % der Betriebe
...eine andere Person als
bereits genannt? % der Betriebe

bitte erläutern!

Enthornung mit SÄGE/DRAHT:

Bei wie viel % der Betriebe enthornt...

- ...der Tierarzt % der Betriebe
...ein Tierbetreuer? % der Betriebe
...eine andere Person als bereits genannt? % der Betriebe

bitte erläutern!

Die Angaben zu Enthornungspersonen beruhen auf:

	groben Schätzungen	zuverlässigen Schätzungen	erhobenen Daten
	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Einsatz von Medikamenten im Rahmen der Enthornung.

- * **BM** = Beruhigungsmittel (z.B. Xylazin; Rompun(C))
** **ÖB** = örtliche Betäubung des Hornnervs (Lidocain oder andere örtl. Betäubungsmittel)
*** **SM** = Schmerzausschaltung durch Verabreichung von nicht steroidal entzündungshemmern (z.B. Ketoprofen und ähnliche; Romefen(C))

Enthornung mit dem BUDEXGERÄT:

Wie viel % der Betriebe verwenden im Rahmen der Enthornung...

- ...keinerlei Medikamente? % der Betriebe
...ausschließlich Beruhigungsmittel (BM)*? % der Betriebe
...ausschließlich örtliche Betäubung (ÖB)**? % der Betriebe
...ausschließlich Schmerzmittel (SM)***? % der Betriebe
... BM + ÖB? % der Betriebe
... BM + SM? % der Betriebe
...ÖB + SM? % der Betriebe
...BM + ÖB + SM? % der Betriebe

Enthornung mit dem BRENNSTAB:

Wie viel % der Betriebe verwenden im Rahmen der Enthornung...

- ...keinerlei Medikamente? % der Betriebe
...ausschließlich Beruhigungsmittel (BM)*? % der Betriebe
...ausschließlich örtliche Betäubung (ÖB)**? % der Betriebe

Die Angaben zur Medikation beruhen auf: groben Schätzungen zuverlässigen Schätzungen erhobenen Daten

Behandlungsmaßnahmen nach der Enthornung

Nach der Enthornung mit dem BUDEXGERÄT:

Wie viel % der Betriebe setzen.....

...Desinfektion ein? % der Betriebe

...andere
Behandlungsmaßnahmen ein? % der Betriebe

bitte erläutern!

Nach der Enthornung mit dem BRENNSTAB:

Wie viel % der Betriebe setzen.....

...Desinfektion ein? % der Betriebe

...andere
Behandlungsmaßnahmen ein? % der Betriebe

bitte erläutern!

Nach der Enthornung mit ÄTZSTIFT/ -PASTE:

Wie viel % der Betriebe setzen.....

...Desinfektion ein? % der Betriebe

...andere
Behandlungsmaßnahmen ein? % der Betriebe

bitte erläutern!

Nach der Enthornung mit CHIRURGISCHER METHODE mit Spezialmesser:

Wie viel % der Betriebe setzen.....

...Desinfektion ein? % der Betriebe

...andere
Behandlungsmaßnahmen ein? % der Betriebe

bitte erläutern!

Nach der Enthornung mit SÄGE/ DRAHT:

Wie viel % der Betriebe setzen.....

...Desinfektion ein? % der Betriebe

...andere
Behandlungsmaßnahmen ein? % der Betriebe

bitte erläutern!

	groben Schätzungen	zuverlässigen Schätzungen	erhobenen Daten
Die Angaben zu den Behandlungsmaßnahmen nach der Enthornung beruhen auf:	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

6) Gelten abgesehen von den gesetzlichen Bestimmungen noch weitere Richtlinien zur Enthornung (z.B. Qualitätsprogramme)

nein ja

wenn ja, welche?

7) Gibt es bestimmte Fortbildungsmöglichkeiten in Bezug auf die Enthornung?

nein ja

wenn ja, welche?

8) Gibt es Ansätze, momentan gängige Enthornungspraktiken zu verbessern oder werden diese diskutiert? (z.B. Schmerzausschaltung, Entfernen der Hornanlagen statt der gewachsenen Hörner)

nein ja

wenn ja, welche?

9) Gibt es Ansätze, Alternativen zur Enthornung zu entwickeln?(Mehrfachnennungen möglich)

- Zucht genetisch homloser Tiere Andere, bitte angeben
 neuartige Aufstallungsformen

10) Besteht eine Verpflichtung zu Enthornen?

nein ja

Annex 3 : Questionnaire for the participants of the 3 focal group discussions

Frage 1 :

Halten Sie Michvieh?

nein ja

Ist es enthornt ? ja nein

Erläuterungen :.....

Frage 2 :

Halten Sie Mutterkühe ?

nein ja

Sind sie enthornt : ja nein

Erläuterungen :.....

Frage 3 :

Halten Sie Mastvieh ?

nein ja

Ist es enthornt : ja nein

Erläuterungen :.....

Tierzahl :.....

Rasse(n) :.....

Stallsystem(e) :.....

Zahl der Arbeitskräfte auf dem Betrieb :.....

Enthornungsmethoden :

Frage 4 : Wann enthornen Sie die Tiere ?

Ich enthorne nicht

Ich enthorne nur Kälber (Tiere jünger als zwei Monate)

Ich enthorne meist Kälber und nur sehr selten erwachsene Tiere

Ich enthorne meist erwachsene Tiere und nur selten Kälber

Ich enthorne nur erwachsene Tiere

Frage 5 : Mit welcher Methode enthornen Sie ?

Wer führt die Enthornung durch ?.....

Setzen Sie Medikamente während der Enthornung ein ?

(Beruhigungsmittel, Betäubungsmittel, Schmerzmittel)

ja nein Was genau ?.....

Behandeln Sie die Tiere nach der Enthornung?

(z.B. Desinfektion)

ja nein Was genau ?.....

Zukunftsperspektiven :

Wenn Sie enthornen :

Frage 6 : Haben Sie vor, etwas an Ihrer Praxis zu ändern?

nein ja

Welche Änderungen:

Frage 7 : Beabsichtigen Sie zukünftig nicht mehr zu enthornen ?

nein ja

Erläuterungen :

Wenn Sie nicht enthornen :

Fragen 8 : Beabsichtigen Sie zukünftig zu enthornen?

nein ja

Erläuterungen :

Frage 9 : Wären Sie an genetisch hornlosen Tieren interessiert ?

nein ja

Erläuterungen :

Annex 4: Interview guide for the focal group discussions

Allgemeines Vorgehen bei jeder Frage:

Einleitung : 10'

- Kurz was zum Projekt sagen
- Erläutern wie wichtig die Meinungen der Landwirte dazu sind und vor allem das jede einzelne Meinung wichtig ist und nicht nur eine Einheitsmeinung
- Den Ablauf und die Aufnahmen erklären (z. B. dass immer nur einer reden soll, da man sonst auf dem Band nichts mehr versteht)

Kurze Vorstellung der Runde am Tisch : 10'

Name, woher jeder kommt, was für Tiere man hält (Milch, Mast, Mutterkühe), Tierzahl, Rasse, Stallsystem.

1- Offene Fragen 20-30'

Soll nicht direkt mit Enthornung zu tun haben, eher so was wie:

Was bedeutet es:

„..... für Sie Tiere zu halten?“

„..... für Sie ein Milchbauer zu sein“

„...für Sie mit Tieren zu arbeiten“

Was denken die Landwirte über die verschiedenen Arbeiten mit den Tieren (Stallhygiene, Impfungen, normaler Umgang mit den Tieren, Füttern, Enthornen, Kastrieren(?),...

Was sind für sie die Unterschiede zwischen den Arbeiten. Welche Arbeiten mögen sie/ mögen sie nicht (was ist leicht, was ist schwer)und warum.

(es soll herauskommen, woran sie Leid von Tieren erkennen und wonach sie Sympathien für die Arbeiten vergeben)

2- enthornte/ behornte Tiere halten : 30-45'

Diskussion :

Umgang mit behornten/enthornten Kühen /Bullen;

- Wie werden die unterschiedlichen “Rindertypen” gemanaged (Milchkühe, Mutterkühe, Bullen);
- Vorteile und Nachteile (siehe Tabelle)
- In welchen Situationen spielt es eine Rolle, ob die Tiere enthornt /behornt sind

Arbeitssicherheit, Ästhetik, Ethik, Schutz der Tiere....

(herauskommen soll, was genau die Entscheidung zur/gegen Enthornung beeinflusst, was sind die wichtigsten Entscheidungsfaktoren, wie unterscheidet sich das Management, welche Konditionen sind jeweils vorhanden und was sind Probleme)

Wichtigste Pros und Cons (Hörner oder nicht) in Gruppe diskutieren

Kauf/Verkauf von Tieren:

Kaufen die Betriebe behornte/unbehornte Tiere? Wie werden die Tiere verkauft?

Bei Landwirten die behornte Tiere halten: haben sie früher enthornt? (warum aufgehört?)

Bei Landwirten die enthornen: Haben sie schon mal behornte Tiere gehalten/ warum angefangen zu enthornen?

3- Enthornungsmethoden 30' –45'

Jeder, der enthornt, soll seine seine Enthornungspraxis beschreiben.:

- Methode
- Alter der Tiere
- Wer es macht
- Wie werden die Tiere fixiert/ bei Eingriff gehalten
- Welche Medikamente
- Welche Nachbehandlungen
- Welche Komplikationen (falls vorhanden...und wie oft ungefähr)

Diskutieren, welche Vor- und Nachteile jede Methode hat (welches ist für die einzelnen Landwirte subjektiv die beste Praxis)

Nach welchen Kriterien haben die Landwirte „ihre“ Enthornungsmethode ausgesucht.

z.B. spielen Empfehlungen, Vorschriften, ihre eigene Wahrnehmung des Tierschmerzens (sensitivity of farmer), Kosten der Enthornung/ der Enthornungsgeräte, Gegenwehr des Tieres usw. eine Rolle?) Erst spontane Antworten sammeln, und was nicht von selbst genannt wird noch mal anfragen.

In dem Teil soll auf jeden Fall der “Tierschmerz” thematisiert werden: denken die Landwirte, dass die Tiere während der Enthornung leiden /Schmerzen empfinden? Sehen sie das als normal oder ein Problem an. Denken sie, dass es möglich/nötig ist, Schmerzen der Tiere zu vermeiden

Kennen sie die gültigen Vorschriften zur Enthornung?

4- Zukunftsperspektiven und Alternativen 20-30'

Frage, ob sie sich Änderungen in ihrer Praxis vorstellen können/ oder vorhaben

Falls keine Antworten kommen- Vorschlägen machen: Alter der Tiere, Medikamenteneinsatz, hornlose Genetik

In Zukunft nicht mehr enthornen?

Warum würden sie am ehesten damit aufhören

und unter welchen Bedingungen könnten sie sich das vorstellen

In Zukunft beginnen zu enthornen?

Warum würden sie am ehesten damit anfangen

und unter welchen Bedingungen könnten sie sich das vorstellen

genetisch hornlose Tiere anschaffen?

Unter welchen Bedingungen könnten sie sich das vorstellen genetisch hornlose Tiere zu halten (Leistungen, Kauf/Verkaufspreise)

Könnten neue Regelungen (Staat, EU) sinnvoll sein...und wenn ja wofür?

Welche Anreize, Motivationen (Regulationen) könnten eventuell hilfreich sein (wirken)?

Abschluss: 15'

die Hauptpunkte aus der Diskussion noch mal zusammenfassen

Eventuell noch mehr zum Projekt sagen

Hiermit versichere ich, dass ich die vorliegende Dissertation selbständig und ohne unerlaubte Hilfe angefertigt und andere als die in der Dissertation angegebenen Hilfsmittel nicht benutzt habe. Alle Stellen, die wörtlich oder sinngemäß aus veröffentlichten oder unveröffentlichten Schriften entnommen sind, habe ich als solche kenntlich gemacht. Kein Teil dieser Arbeit ist in einem anderen Promotions- oder Habilitationsverfahren verwendet worden.