Animal welfare in lambs: ewe-lamb separation

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SUMMARY
The aim of the present paper is to review the literature on the separation of the ewe-lamb bond and its effects on behaviour, vocalisations and physiological indicators as mechanisms of acute stress in ewes and lambs. In all mammal species mothers constitute the most important social contact for their young during the first months of life, as they facilitate the acquisition of information on the physical and social environments. In sheep, soon after parturition, a mutual, lasting ewe-lamb bond is established. Mothers can identify their young through the use of different sensory modalities (olfaction, vision, hearing and direct contact), but the proper expression of adequate maternal behaviour is made more difficult by modern livestock-handling systems that in order to increase fecundity intensify demands on the mothering ability of ewes. In conventional dairy sheep production systems, weaning lambs are suckled by either their dams or surrogates. When the ewe-lamb bond is broken, frustration arising from maternal feeding deprivation and the absence of maternal care alter endocrine and behavioural responses and reduce growth, suggesting emotional disturbances in the lambs. Many authors have indicated that stressor factors on the farm, such as isolation or separation, alter the indexes of animal welfare, including hormonal, haematological and biochemical parameters. In the case of sheep, the fact that they are gregarious animals makes them highly sensitive to the stress of separation from the flock. The measurement of plasma constituents in blood samples can provide information about the stress that animals suffer during various handling operations. On the other hand, weaning, particularly at a young age, is also associated with perturbed growth rates and an increased susceptibility to disease. Disruption of the maternal relationship, therefore, is at least a transient source of poor welfare for lambs, and may disturb the acquisition of social and survival-related behaviours. The lambs manifested strong vocal responses when these periods of temporary separation were first imposed, but eventually became habituated to the procedure and then showed little response compared to lambs that had not experienced such temporary separations. The close mother-offspring relationship established during the first few minutes of life after birth is very important for the development and survival of newborns in practically all species, including sheep. To improve our understanding of the consequences of breaking the ewe-lamb bond, factors that contribute to the establishment of the mother-young relationship are discussed in the first part of this review. The second part deals specifically with the effects of separation on the ewe-lamb bond; namely, variables and measurements of behaviour, vocalisations, and blood profiles.

KEY WORDS
Ewe-lamb bond, sensorial signals, behaviour, separation, welfare, vocalisation.

INTRODUCTION

Under human management, the offspring of mammalian species are typically separated abruptly and permanently from their mothers at a relatively young age, often prior to the time of natural weaning. This strategy hastens a return to reproductive cycling by the mothers and enables animal breeders to enhance the yield of offspring from breeding populations. Yet, in doing so, the social bond between the mother and her offspring that developed within hours after parturition is disrupted. Illness, death and deficits in maternal care may also precipitate severance of the mother-young bond, resulting in a need for additional care by humans.⁵,₂⁰ Farm animals are often exposed to various stressors, such as social stress due to isolation, the formation of new social groups, or handling by humans.⁶ Stress may be mild with no physiological consequences, or severe, causing physiological alterations. But whether mild or severe, any form of stress that alters an animal’s normal physiology can reduce immune responses.⁸ In sheep subjected to restraint and isolation stress caused marked increases in plasma concentrations of ACTH and cortisol from the adrenal cortex,¹² which exert an immunosuppressor effect.¹³ Stress has direct consequences on the health, welfare and reproductive success of animals; for example, in mammals events occurring before birth and during the first weeks of life affect the behaviour of the offspring and their adaptation to the environment.¹⁴,¹⁵,¹⁶,¹⁷ In this regard, the separation of lambs from their mothers causes frustration due to maternal feeding deprivation and this,
in turn, results in altered endocrine and behavioural responses with reduced growth, all of which suggest emotional disturbances in the young. Therefore, the analysis of animal vocalisations may be useful in assessing welfare, health status and social adaptation. This is because animal vocalisations can convey information about context and events in the environment, as well as multiple items of information related to the sender, such as identity, physical characteristics, and emotional or motivational states.

To improve our understanding of the consequences of breaking the ewe-lamb bond, factors that contribute to the establishment of the mother-young relationship are discussed in the first part of this review. The second part deals specifically with the effects of separation on the ewe-lamb bond; namely, variables and measurements of behaviour, vocalisations, and blood profiles.

The aim of the present paper is to review the literature on the separation of the ewe-lamb bond and its effects on behaviour, vocalisations and physiological indicators as mechanisms of acute stress in ewes and lambs.

1. THE EWE-LAMB BOND

For parents, recognizing one’s own offspring prevents misdirected parental care, limits energy expenditures, and ensures reproductive success. For young animals, recognition of parents is essential to their survival since in most social or colonial species parents feed only their own newborns. There is evidence that parent-offspring recognition is especially important for colonial species, though the degree of recognition (i.e., mutual or unilateral) seems to vary among different species depending to some degree on environmental constraints. Mothers of all mammal species constitute the most important social contact for their young during the first months of life, because they facilitate the acquisition of information about the physical and social environments. At lambing, ewes (Ovis aries) tend to isolate themselves from the rest of the flock, an act that is believed to be beneficial for the early relationship with their young. Soon after parturition a mutual, lasting ewe-lamb bond is established. Later, they return to the flock and their lambs progressively interact with other conspecifics. Isolation without interference from other ewes is indeed of the utmost importance for the onset of the mother-young relationship and lamb survival, for it may facilitate mutual recognition and rapid access to the udder. Newborn lambs develop a preference for their mothers in less than one day.

Ewes must be able to recognize their offspring selectively to avoid separation which may be fatal for their young, and to avoid allo-suckling. As a consequence, maternal selectivity demands that the lambs recognize their mother very quickly after birth in order to access her milk. The process of recognition that allows the mother to identify her young is achieved through different sensory modalities. For example, there is evidence that the wax secreted by the inguinal glands, as well as the foetal fluids covering the udder, may act in combination with tactile stimuli to activate udder-seeking behaviour. For this to occur, olfactory examination is necessary before the young are allowed to suckle. In the case of lambs, and probably most other ruminants, offspring are attracted to their mother by both sight and hearing, and the first contact is made with her chest or flank. Thereafter, udder-seeking behaviour is guided by thermo-tactile and olfactory cues. Also, touching the face strongly activates oral exploration and orientation movements of the head, but the intensity of the response depends on the characteristics of the stimulus: that is, lambs respond preferentially to warm, smooth, non-woolly, intermediate yielding surfaces. The presence of these factors, together with good maternal care, can minimize the impact of detrimental environmental factors on lamb losses.

However, the proper expression of adequate maternal behaviour is made more difficult by modern livestock-handling systems, which in order to increase fecundity intensify demands on the mothering ability of ewes. In this regard, the amount and quality of the alitement provided in modern livestock-handling can be a determining factor in the establishment of the ewe-lamb bond, and even in the survival of the lambs. In relation to this topic, Dwyer et al. (2003) investigated the effect of a moderate reduction (35%) in nutritional intake by ewes during pregnancy on the expression of ewe-lamb bonding behaviours in primiparous Scottish Blackface ewes. They found that a moderate decrease in maternal nutrition during late pregnancy resulted in a measurable reduction in the expression of maternal behaviours, especially on maternal behaviour scores at parturition, under intensive indoor conditions (P<0.05).

On the other hand, the rapidity with which maternal behaviours are expressed to propitiate the development of the maternal bond can be affected by the ewes’ earlier experience and number of previous gestations (primiparous vs. multiparous). In this respect, Dwyer and Lawrence examined how the pattern of maternal behaviour shown by an individual animal changed across births in domestic sheep. Their study evaluated 69 ewes over a period of 4 years to record the maternal behaviour of individual animals of two breeds - Scottish Blackface and Suffolk - in the first 2 hours after lambing, and compare primiparous vs. multiparous ewes. For each year, the following behaviours were monitored: latency from birth to grooming the lamb; proportion of time spent grooming; frequency of withdrawal from the lamb; nosing; butting; pushing the lamb down or away; and responses to the lambs’ attempts to suckle (i.e., backing away, circling, moving forward, or standing still). They found that the principal effect of birthing was between inexperienced ewes (first birth) and experienced ones (2, 3, 4 births), as the primiparous ewes took longer to begin to groom their lambs after delivery, were more likely to butt or withdraw from them, and made more high-pitched vocalisations than multiparous ewes. In addition, primiparous ewes made significantly more backing and circling movements as the lambs attempted to suck, while the multiparous ewes had a higher rate of nosing their lambs than primiparous ones. In that study, the main change in maternal behaviour in individual ewes that came with experience was a reduction in negative maternal behaviours; whereas affiliative maternal behaviours (primarily grooming behaviours) were unaffected. Therefore, the maternal behaviour of primiparous mothers may be impaired because of their younger age, greater anxiety, and neophobia in the presence of the lamb, or due to a reduced neuroendocrine response in the primiparous animal.

In another study, Asante et al. used a series of scales to determine the effect of separation from the offspring and the
mother-lamb recognition ability of primiparous vs. multiparous ewes. Their results showed that primiparous ewes exhibited a significantly greater behavioural response to separation from their lambs than did their multiparous counterparts (P<0.05). Even though there were no statistically significant differences (P>0.05) between 12 h, 18 h and 24 h-old lambs in their ability to recognize their dams, there was a trend towards an increased ability on the part of lambs to make more correct choices as they grew older.

Another aspect that has been studied is the effect of the duration and difficulty of the birthing process on the expression of maternal and neonatal behaviour and their consequences for homeothermy and survival of the neonate lamb. In this regard, Darwish, R.A. and T.A.M. Ashmawi showed the effect of duration in a study of 61 Finnish Landrace X Rahmani crossbred (second generation) primiparous ewes and their single-born lambs. According to the length of parturition, the ewes were grouped into two groups: short birth (less than 32.5 min), and long birth (equal to or greater than 32.5 min). The data recorded included maternal and neonatal behaviours, lamb body temperature over the first 3 days of life, and survival rates of the neonate lambs during the first week after birth. Their work revealed that prolonged deliveries with difficult birthing were one of the main causes of death in large, single-born lambs, as these complications led to the expression of inappropriate behavioural responses on the part of both the ewe and the neonatal lamb, since ewes with prolonged labour and complicated deliveries failed to show good maternal care and abandoned their newborn lambs more frequently than those with short labour and unassisted births. It is also important to note that the lambs from prolonged, difficult births were significantly less voracious after birth and required more time to stand, reach the udder, and suck successfully.

2. BREAKING THE DAM-YOUNG BOND

2.1. Physical and physiological effects of ewe-lamb separation

Under human management, the offspring of mammalian species are typically separated abruptly and permanently from their mothers at a relatively young age, often prior to the time of natural weaning. This strategy hastens a return to reproductive cycling by the mothers and enables animal breeders to enhance the yield of offspring from breeding populations. Yet, in doing so, the social bond between the mother and her offspring that developed within hours after birth and or both seek to reunite.11 However, in conventional dairy sheep production systems weaning lambs are suckled by their mothers and either weaned (through surrogates) or slaughtered at an age of about 45-50 days; and in an increasing number of intensive sheep farms separation takes place at a very early age (just 0-2 days) and lambs are fed a milk replacer to increase the amount of milk available from their mothers for cheese-making. When artificial rearing is employed, lambs are often kept with their mothers for only 2 days, sufficient to allow the ingestion of maternal colostrum, but are then removed abruptly from their dams. This technique is referred to as artificial rearing and is also utilized, albeit less frequently, in meat-production systems to improve the reproductive performance of ewes; although in those settings weaning more often takes place at 3 months of age (early weaning).18

Many authors have indicated that stressor factors on the farm, such as isolation or separation, alter the indexes of animal welfare, including hormonal, haematological and biochemical parameters. In the case of sheep, the fact that they are gregarious animals makes them highly sensitive to the stress of separation from the flock. The measurement of plasma constituents in blood samples can provide information about the stress that animals suffer during various handling operations.6 Frustration arising from maternal feeding deprivation when the ewe-lamb bond is broken results in altered endocrine and behavioural responses and reduced growth; suggesting emotional disturbances in the lambs that can generate marked increases in plasma concentrations of ACTH and cortisol. Traditionally, researchers have used assessments of cortisol levels to determine the degree of response to the stress to which an animal is exposed.35,36 These results support the general concept that emotional stressors activate the hypothalamic-pituitary-adrenal axis (HPA), resulting in elevated serum cortisol concentrations that are proportional to the intensity of the stressor.13

In a separate study, Bornez et al.6 examined the effect of blood sampling time (farm, transport, lairage) on indicators of physiological welfare in two groups of different age/weight Manchega lambs. Ninety-six Manchega Spanish male lambs were used in that study. The animals were divided into two experimental groups of different slaughter weight (suckling vs. light). The suckling lambs (n=46) were raised exclusively on milk from their dams until the time of slaughter at 12.80 ± 0.20 kg live weight (30 days of age). This group remained with their mothers until they were loaded and transported to the slaughterhouse. The light lambs (n=50), in contrast, were weaned at 30 days after birth (12 kg live weight) and then fed a commercial concentrate and cereal straw ad libitum until slaughter at 25.10 ± 0.14 kg (70 days of age). This work showed that, in general, the age of the lambs affected (P<0.001) all of the farm
parameters; i.e., red blood cells (RBC), haemoglobin, hematocrit, mean corpuscular volume (MCV), mean cell haemoglobin (HbCM), concentration (CHbCM), and red cell distribution (RDW) (except the leucocyte count). The light lambs showed higher levels (P<0.001) of haematites (9.54 ± 0.13 1012/mm3), haemoglobin (10.77 ± 0.16 g/l), hematocrit (31.68 ± 0.52%) and CHbCM (34.11 ± 0.31%), and lower levels (P<0.001) of MCV (33.18 ± 0.20 fl) and RDW (16.44 ± 0.34%), than the sucking lambs. Also, age at the time of blood sampling affected (P<0.001) cortisol levels, as the younger animals presented higher means of cortisol concentration (407 ± 23 nmol/l) on the farm (P<0.001).4 However, other authors have suggested that cortisol17 and plasmatic lymphocytes levels are not altered during ewe-lamb separation.

2.2. Effects on behaviour after early ewe-lamb separation: vocalisations

Weaning, particularly at a young age, is also associated with perturbed growth rates and an increased susceptibility to disease. Disruption of the maternal relationship, therefore, is at least a transient source of poor welfare for lambs, and may disturb the acquisition of social and survival-related behaviours.15 Moreover, any separation of the lamb from its mother following the initial bonding process produced distress calls and hyperactivity in the mother that lasted for several days.7

On this issue, Orihuela et al.35 determined the effect of restricting suckling on the behaviour and welfare of sheep. In their study, 40 ewes and their 10-week-old lambs were assigned to one of four treatments for 10 days: T1=lambs free to suckle (control); T2=the ewes’ udders were smeared with faeces; T3= the ewes’ udders were covered; and T4=ewe and lamb were separated by a wire fence. The ewes in treatments T2, T3 and T4 vocalised more frequently than those in the control group (P<0.01). Among treatments, vocalisation frequency in T4 remained higher for a longer period (P<0.05) than in the other groups. No difference was found in the vocalisation frequencies of the lambs among treatments, but those in T1 tended to vocalise less (P>0.05) than the ones in the treatment groups. The authors concluded that restricting 10-week-old lambs from suckling during a 10-day treatment period induced minor, short-term distress, and broke the social bond in 70-80% of the ewe-lamb pairs. As the aforementioned study demonstrates, by allowing the non-invasive interpretation of stress patterns, the analysis of animal vocalisations may be useful in assessing welfare, health status and social adaptation.26 This is because animal vocalisations can convey information about context and events in the environment, as well as multiple items of information related to the sender, such as identity, physical characteristics, and emotional or motivational states.42 In addition, studies have found that the newborn animals of certain species develop an auditory memory as a result of the interaction of vocalisations with their congeners.16 This auditory memory later facilitates the recognition of signals from other individuals, groups, and the environment.28 Current estimates are that sheep have a similar auditory sensitivity to humans (around 10 dB), and that while their low frequency range is slightly higher (125 Hz) compared to us (20-40 Hz), their high frequency range extends well into the ultrasonic domain (42 KHz), which is somewhat above that of humans (20 KHz), and only marginally less than that of dogs (50 KHz).19 Panksepp et al.33 showed that even brief separations from the mother or siblings result in an increase in the number of vocalisations and in behavioural arousal; findings that suggest psychological stress. In contrast, Orgeur et al.26 point out that once the offspring adapt to the occasional periods of rupture in the mother-young bond, their vocalisations decrease in both frequency and intensity. In their study, these authors described one example of a rearing system for sheep that used forced periods of separation before weaning. There, the lambs were weaned when they were 4 months old, but from 3 weeks of age they were separated from the ewe, first for periods of 4- to 8-hours per day. The lambs manifested strong vocal responses when these periods of temporary separation were first imposed, but eventually became habituated to the procedure and then showed little response compared to lambs that had not experienced such temporary separations. Similarly, Schichowksi, et al.41 evaluated the effects of age at weaning in combination with different weaning procedures on 2 breeds of lambs (Merinoland, Roehenschaf). Those lambs were weaned at either 8 or 16 weeks of age in 2 stages, or following the traditional method of weaning by abrupt separation. In the 2-stage treatment, the lambs were prevented from nursing at their dams for 1 week (stage 1) before their separation (stage 2). Results of this study demonstrated that the lambs weaned using the 2-stage method vocalised less (P < 0.001) and showed fewer behaviours indicative of agitation after separation in comparison to the animals that were weaned by the traditional method of abrupt separation (P < 0.001).11

In their work, Cockram et al.4 demonstrated that short but continuous periods of withdrawal (3 h) of lambs from their mothers over 23 days did not cause endocrine or immunological changes in the mothers; although they did observe alterations in the ewes’ behaviour, including orientation towards the lamb, raised head, erect ears, and decreased lying, sleeping behaviours, and vocalisations. In another vein, when added to visual and auditory contact with the mother,40 the presence of other conspecifics in a group-feeding situation may also reduce the stress brought on by weaning or isolation.18 Porter et al.,39,40 showed that after separation from their mothers, lambs emit fewer distress bleats when paired with a familiar individual instead of a previously unknown lamb. In addition, 3-week-old lambs bleat more frequently following maternal separation when they are held in isolation, while if they are provided with an age-mate companion they vocalised less if the second lamb was their twin than if it was unfamiliar.40,49 In this regard, Villeneuve et al.,42 for example, suggest that a housing system in which individually-raised lambs are allowed visual, tactile and auditory contact with each other does not negatively impact their growth and behaviour compared to that of lambs housed in pairs. Thus, the presence of a social partner seems to have a positive effect on the behavioural activities of lambs following separation from their mothers. Indeed, lambs housed in pairs were generally more active than those that were penned alone. Their study demonstrated that the growth performance of lambs was unaffected by housing in pairs or alone, as long as visual, auditory and tactile contacts were permitted.42 It has also been demonstrated that difficult births can affect the quality of the care provided by mothers and the survival.
probability of neonates, evaluated on the basis of vocalisations. Darwish R.A. and Ashmawy T.A. (2011), meanwhile, observed that lambs which experienced prolonged and difficult births took less time to vocalise (47.58 ± 3.58 sec, P<0.0001) and tended to bleat more frequently (89.96 ± 5.46, P<0.001) compared to those born after short, unassisted births (186.31 ± 7.29 sec, and 67.29 ± 2.92, respectively). Thus, the changes in lamb bleating rates determined in that study were consistent with the idea that vocalisations by newborns are indicators of need, and lend support to the notion of a link between bleating and the quality of maternal care received.11

CONCLUSIONS

The close mother-offspring relationship established during the first few minutes of life after birth is very important for the development and survival of newborns in practically all species, including sheep. Any situation that produces stress in ewes and offspring - such as brief or definitive separations - can cause the rupture of the ewe-lamb bond and result in different degrees of affection of the animals' welfare. This rupture of the ewe-lamb bond can also be provoked by the implementation of procedures involved in the everyday handling of sheep on commercial ranches, as is the case of early weaning, which may lead to the deterioration of the welfare of the offspring due to separation from the mother at such an early age. This separation restricts alimentation by the mother's milk and contact with conspecifics, primarily the mother, and results in a reduction in the amount of sensorial signals received (auditory, visual and/or tactile).

As described earlier, the rupture of this bond activates the hypothalamic-pituitary-adrenal axis to trigger the release of a cascade of hormones, which act on target organs to produce physiological and behavioural responses, such as increased heart and respiratory rates, higher body temperature, and increased concentrations of certain metabolites in the plasma (physiological indicators). Analyses of these parameters has contributed to understanding the efficiency of gentling and feeding on the early establishment of the stockperson-lamb relationship. Appl Anim Behav Sci, 72: 89-103.

In addition to these invasive methods of evaluation, the efficiency of gentling and feeding on the early establishment of the

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