

Organization: The secondary articles are first and are organized from most general to most specific to give a broad overview of the topic before getting into the technical studies. The primary articles are organized into studies of physiology (cow milk yield, parity (number of previous offspring), sex and calf age), qualitative observational studies of two-stage weaning methods and finally, endocrine studies to quantify weaning stress.

Secondary References

Reference:

von Keyserlingk, M. A. G., & Weary, D. M. (2007). Maternal behavior in cattle. *Hormones and Behavior*, 52(1), 106–113. <https://doi.org/10.1016/j.yhbeh.2007.03.015>

Summary:

Weaning occurs through the removal of maternal care from a cow to her calf. This gradual process involves a decrease in the milk yield and nursing frequency to force the calf to be more nutritionally and socially independent. In the beef and dairy industry, calves are separated from their mothers at an age earlier than in nature through a process called abrupt separation. The cow-calf bond is an important part of maternal behaviour, which is broken during weaning.

The objective of this paper is to review and better understand maternal behaviour in cattle to provide the knowledge needed to address practical problems in the cattle industry. This article was conducted by reviewing the current knowledge of many different maternal behaviours. It discusses examples of current research that add to or contradict this knowledge. It covers the topics of nesting, licking, placentophagy, the CCB, vocalizations, suckling and weaning. The section about weaning is the topic of focus.

The research was conducted to observe behaviour after separation to qualify calf stress. It was found that calves increased their vocalizations and activity after weaning, and this is an abnormal behaviour that can indicate stress. These results were likely due to the calf's attempt to reunite with the mother.

Some strategies are used to try to reduce weaning stress. There are two-stage weaning methods involving fence lines and nose clips. Fences physically separate the cow and calf but allow visual, auditory and olfactory connections. Nose clips allow physical contact and only prevent nursing. Studies have shown a decrease in stress-related behaviours such as vocalization when using these methods. This could indicate that calves experience less stress than traditional weaning. Future research should reconduct the experiments described above. The experiments were done with small sample sizes. Better experimental designs are needed to form stronger conclusions.

Contribution:

This review was included in my literature review because it provides an in-depth description of the weaning process and the cow-calf bond, which is broken during weaning. It discusses the process of weaning in the beef industry and how it is more stressful (shown by abnormal behaviours) than natural weaning. This article is important because it notes studies that have researched weaning to give a broad understanding of the field. It mentions the different strategies that are used to try to reduce weaning stress and the contradictory results that some of these studies have presented.

Reference:

Enríquez, D., Hötzel, M. J., & Ungerfeld, R. (2011). Minimising the stress of weaning of beef calves: A review. *Acta Veterinaria Scandinavica*, 53(1), 28. <https://doi.org/10.1186/1751-0147-53-28>

Summary:

The cow-calf bond (CCB) is an important part of maternal behaviour, which influences weaning. Weaning is a maternal behaviour performed by cows to decrease the frequency of nursing as the calf gets older. In the beef industry, weaning occurs by abruptly separating the cow and calf. Abrupt separation suddenly breaks the CCB, exposing calves to many new social and environmental stressors. The objective of this review was to discuss and assess the effectiveness of new weaning methods (nose-clips and fence lines) to improve calf welfare. Two strategies were used to try to reduce weaning stress: fence line separation and nose clips. Fence lines physically separate the mother and calf. This prevents nursing while allowing visual contact. Nose clips prevent nursing, but they maintain a physical bond between the calf and the cow. Studies found that using nose clips decreased stress-induced behaviours such as walking, vocalizing. The frequency of normal behaviours such as eating and resting increased. The use of fence lines, however, is contradictory. Some studies found that fence lines may reduce stress. Other studies found that calves showed more signs of stress during fence line separation than when they are abruptly separated. These findings may suggest that nose clips positively influence calf welfare by reducing stress. The results may also indicate that fence line separation does not significantly reduce stress during weaning.

Further research is needed to increase the welfare of cattle in the beef industry. This includes learning about the physiological mechanisms that control natural weaning. Also, more research is needed to determine how pregnancy, milk yield, food availability and metabolic rate influence weaning. More research is needed to determine if the current weaning strategies (especially fence line separation) reduce calf stress.

Contribution:

This review article provides an in-depth description of the stress that is induced during weaning. It assesses the use of fence lines and nose clips to reduce stress during weaning in the beef industry. This article is important because it analyses different studies to determine if fence lines and nose clips reduce weaning stress. This article gives an overall description of the current knowledge in this field by discussing the findings that support and contradict one another. In some cases, fence lines and nose clips decreased stress, and in others, there was no effect.

Primary References

Reference:

Ungerfeld, R., Quintans, G., Enríquez, D. H., & Hötzel, M. J. (2009). Behavioural changes at weaning in 6-month-old beef calves reared by cows of high or low milk yield. *Animal*, 49(8), 637–642.
<https://doi.org/10.1017/S1751731116000793>

Summary:

Weaning is a maternal behaviour to decrease the frequency of nursing as calves get older. The cow-calf bond (CCB) is an important part of maternal behaviour, which influences weaning. The beef industry weans calves by abruptly separating (AS) them from the cow. AS causes abnormal behaviour, such as increased walking and vocalization and decreased resting and eating. The objective of this study is to observe and contrast behavioural responses and ADG (average daily weight gain) of calves weaned from mothers of high milk yield (HMY) or low milk yield (LMY). It is assumed that calves with HMY mothers will have a stronger cow-calf bond than those with LMY mothers. The experiment was performed by abruptly separating calves from their mothers by over 1000 meters. After separation, the milk yield of cows was measured and the top five and bottom five cows were used in the experiment. The six-month-old calves' behaviour was observed three days before five days after separation from their mothers. Calves were observed for walking, standing, resting, pacing, grazing, ruminating, and vocalizing. Observations were made every 36 times a day. Data was recorded through direct visual instantaneous sampling. Calf body weight was also measured 24, 11 days before weaning, the day of weaning and 7, 21 days after weaning to compare HMY to LMY calves. The data was analyzed using ANOVA.

This study found that HMY calves had higher body weight, reduced grazing, increased walking, less standing, less laying and greater ruminating than LMY calves. These findings may suggest that milk yield affects the stress of their calves at weaning. This study had a few conflicting results which could indicate the need for further research in this field or replication of this study to determine if HMY calves have stronger bonds, resulting in greater weaning stress.

Contribution:

This study advances knowledge in the effects of weaning on the stress of calves based on the milk yield and therefore the cow-calf bond shared with their mothers. This article supports previous studies that suggest the stronger the cow-calf bond, the more stress/distress caused by weaning. This article was included in my literature review because it is an example of the current research to reduce weaning stress. It identifies how individual calves are affected differently by weaning stress and allows industries to support calves on a more individual basis to improve cattle welfare.

Reference:

Stěhulová, I., Valníčková, B., Šárová, R., & Špinka, M. (2017). Weaning reactions in beef cattle are adaptively adjusted to the state of the cow and the calf. *Journal of Animal Science*, 95(3), 1023–1029. <https://doi.org/10.2527/jas.2016.1207>

Summary:

Weaning is a maternal behaviour to decrease the frequency of nursing as calves get older. The beef industry weans calves by abruptly separating (AS) them from the cow. AS causes sudden breaking of the cow-calf bond, which results in abnormal behaviour, such as increased walking and vocalization.

The objective of this study is to test whether cows and calves have stronger reactions to weaning if they are younger, female, have higher parity (number of previous offspring) and if their calf has a higher daily weight gain. The experiment was conducted by instantaneously sampling walking behaviour and continuously sampling vocalization. Samples were collected three times a day for two hours, and data was collected in three-minute intervals. Walking was recorded any time all four legs were moving, and vocalizing was recorded after a single call followed by intake of breath.

Young calves and their cows showed increased vocalizing and walking compared to older cows. This is likely because younger calves would benefit from further maternal care. Calves with higher daily weight gain vocalized more frequently, likely because these calves received a larger milk supply. Cows with the highest parity showed less walking when compared to cows of lower parity. This may be because younger cows (often have lower parity) are generally more agile. Female calves vocalized more than male calves. Female cows stay together in family groups long after weaning, and therefore it is predicted that abrupt separation during weaning causes more stress. Further studies should determine calf sex affects other aspects of maternal care during weaning.

Contribution:

This study advances knowledge of the effects of AS on the different sexes, ages and body conditions of calves and cows in the beef industry. The article is the first on cattle, but it shows similar data to other research about the effect of age on weaning stress in other artiodactyls. This article was included in my literature review because it is an example of the first research about the effect of abrupt weaning on calves based on their sex, body weight, parity, and age. It identifies areas of weaning stress that can be targeted to improve animal welfare.

Reference:

Haley, D. B., Bailey, D. W., & Stookey, J. M. (2005). The effects of weaning beef calves in two stages on their behavior and growth rate. *Journal of Animal Science*, 83(9), 2205–2214.
<https://doi.org/10.2527/2005.8392205x>

Summary:

Weaning is a maternal behaviour to decrease the frequency of nursing as calves get older. The beef industry weans calves by abruptly separating (AS) them from the cow. AS causes abnormal behaviour, such as increased walking and vocalization and decreased resting and eating.

A new method of weaning occurs in two stages (TS). The first stage uses nose clips to prevent nursing, and the second stage separates calves from their mothers. The objective of this study is to observe and contrast behavioural responses and ADG (average daily weight gain) of calves weaned in TS and by AS. Four trials were performed with three treatments each. Treatment one was short TS weaning over three days, and treatment two was long TS weaning over 14 days. The final treatment was a control (AS). Trial one observed walking, laying/resting, eating and vocalizing behaviours, as well as the proximity of calves to their mothers. Trial two and three recorded calf body condition by weighing calves before and after separation. Trial four quantified walking behaviour by attaching a pedometer (to count steps) to the leg of calves before, during and after separation.

Calves in the short TS treatment were in the closest proximity to their mothers. Calves that were long without nursing (long TS treatment) were in closer proximity than other treatments. Calves weaned in TS vocalized, and walked significantly less, and were resting and eating significantly more after separation. These findings may suggest that TS weaning results in less stress because it shows more natural behaviours. There was no significant finding in ADG over the entire experiment. This could indicate the need for further research of TS weaning on calf ADG while controlling the length of nursing and food quality after separation. Further studies should determine how decreasing weaning stress affects calf health.

Contribution:

This study advances knowledge in reducing weaning stress/distress experienced by calves in the beef industry by focusing on two-stage weaning. This article supports previous cow-calf proximity observations that were yet to be quantified. The behavioural observations were also similar to other published works. Calves increased feeding and resting while decreased walking and vocalizing after weaning. This article was included in my literature review because it is an example of the current research to reduce weaning stress. It shows a positive impact on calves in the beef industry and identifies new research to improve cattle welfare.

Reference:

Enríquez, D. H., Ungerfeld, R., Quintans, G., Guidoni, A. L., & Hötzel, M. J. (2010). The effects of alternative weaning methods on behaviour in beef calves. *Livestock Science*, 128(1–3), 20–27. <https://doi.org/10.1016/j.livsci.2009.10.007>

Summary:

Weaning is a maternal behaviour to decrease the frequency of nursing as calves get older. The beef industry weans calves by abruptly separating (AS) them from the cow. Abrupt separation causes increased weaning stress and abnormal behaviours. A new method of weaning occurs in two stages (TS). The first stage prevents nursing, and the second stage separates calves from their mothers.

The objective of this study was to observe the behavioural responses and weight changes in calves weaned using either AS or TS weaning strategies. In treatment one, calves were abruptly weaned. Treatment two calves were separated from their mothers by a fence line. In treatment three, calves were fitted with nose flaps to prevent suckling. Observations of lying, walking, grazing, ruminating, drinking, suckling, playing, pacing, seeking, and vocalizing was collected by instantaneous sampling. Observations were collected from three weeks before weaning until five days after weaning. Calves were weighed for weeks before weaning, on the day of separation, and weeks after weaning.

No significant difference was observed between the abrupt separation and TS weaning treatments. Calves in all treatments increased vocalizations, pacing, and walking while decreasing grazing, lying and play. All of these behaviours could be associated with increased stress during weaning. Calves also experienced weight loss during TS weaning. The results could indicate that TS weaning does not decrease weaning stress. Further studies should consider environmental conditions that influence weaning stress, including milk production, climate, and calf age.

Contribution:

This study advances the knowledge of reducing weaning stress experienced by calves in the beef industry by focusing on TS weaning. The article does not support previous articles. Two-stage weaning did not reduce stress in calves. No significant difference was found between the behavioural observations from Abrupt separation and Two-stage weaning. This article was included in my literature review because it is an example of the current struggles to reduce weaning stress. It shows that more research is needed to determine if Two-stage weaning positively impacts calves in the beef industry.

Reference:

Ungerfeld, R., Quintans, G., & Hötzel, M. J. (2016). Minimizing cows' stress when calves were early weaned using the two-step method with nose flaps. *Animal*, *10*(11), 1871–1876.
<https://doi.org/10.1017/S1751731116000793>

Summary:

Weaning is a maternal behaviour to decrease the frequency of nursing as calves get older. The beef industry weans calves by abruptly separating (AS) them from the cow. Abrupt separation causes abnormal behaviour, such as increased walking and vocalization, which decreases resting and eating. A new method of weaning occurs in two stages (TS). The first stage uses nose flaps to prevent nursing, and the second stage separates calves from their mothers. Nose flaps are plastic devices that are placed in the nose. They prevent calves from nursing while allowing them to graze normally. The objective of this study is to contrast the behavioural responses and weight gain of calves weaned using nose flaps, calves weaned through AS and nursing calves.

There were three treatments of twelve cow-calf pairs. Treatment one used nose flaps. Treatment two used AS, and treatment three was the control of nursing calves. Nose flaps remained on the calves for six days before they were separated. Calves in treatment two were AS after five days.

Direct instantaneous sampling was used to record the lying, standing, nursing, grazing, pacing, and walking behaviour. Samples were recorded 50 times/day during two data collections. Vocalization was measured using zero/one sampling for 30-second intervals every ten minutes. Calves were weighed ten days before weaning and multiple days after weaning.

Bodyweight was not significantly different among the treatments. There was a decrease in pacing, walking and vocalizing, grazing, resting and standing in the two-stage treatment compared to the AS treatment. These results may indicate that calves experience less stress when nose flaps are used compared to abrupt separation. Further studies should determine if calf bodyweight is maintained during TS weaning with greater access to food. Further studies should determine if calf bodyweight is maintained during TS weaning with greater access to food.

Contribution:

This study advances the knowledge in reducing weaning stress by focusing on two-stage weaning using nose flaps. The behavioural observations were similar to other published works. Calves with nose flaps increased their feeding and resting while decreasing their walking and vocalizing after weaning. This article was included in my literature review because it is an example of the current research to reduce weaning stress. It shows a positive impact on calves in the beef industry and identifies new research to improve cattle welfare.

Reference:

Price, E. O., Harris, J. E., Borgwardt, R. E., Sween, M. L., & Connor, J. M. (2003). Fenceline contact of beef calves with their dams at weaning reduces the negative effects of separation on behavior and growth rate. *Journal of Animal Science*, *81*(1), 116–121.

<https://doi.org/10.2527/2003.811116x>

Summary:

Weaning is a maternal behaviour to decrease the frequency of nursing as calves get older. The beef industry weans calves by abruptly separating them from the cow, immediately breaking the cow-calf bond. This causes abnormal behaviour, such as increased walking and vocalization and decreased resting and eating.

A new method of weaning uses fence lines to separate the calves and cows. This allows visual, auditory and olfactory contact between the cows and calves but prevents calves from suckling. The objective of this study is to observe eating/grazing, walking, vocalizing, and proximity to the fence behaviours. Instantaneous sampling was used to test the hypothesis that fence lines reduce the weaning stress and prevent a temporary reduction in weight gain. Calves were observed in five treatments. Treatment one used fence line separation between calves and cows. Treatment two was a total separation in a pasture, treatment three was totally separated in a hay lot. In treatment four, calves were totally separated in a lot without hay, and treatment five was an unweaned control. Calves were weighed every week for ten weeks.

Calves separated with fence lines were observed spending more time eating, less time walking, and less time vocalizing compared to the total separation treatments. This is likely because there was not a complete breaking of the cow-calf bond, and calves could remain in visual, auditory and olfactory contact with their mothers. Fenceline separation showed a level of stress behaviours most similar to the unweaned control. Calves spent most of the time three meters from the fence. Calves separated by fences also lost less weight after separation than other calves. This could be because calves spent more time eating and resting instead of walking and vocalizing. Fence lines were found to reduce weaning stress when compared to totally separated calves.

Contribution:

This study advances knowledge in reducing weaning stress/distress experienced by calves in the beef industry by focusing on fence line separation. This article supports other fence line research, and some of the behavioural observations were also similar to other published works. Calves increased feeding and resting while decreased walking and vocalizing after weaning. This article was included in my literature review because it is an example of the current research to reduce weaning stress. It shows a positive impact on calves in the beef industry and identifies new research to improve cattle welfare.

Reference:

Lefcourt, A. M., & Elsasser, T. H. (1995). Adrenal responses of Angus x Hereford cattle to the stress of weaning. *Journal of Animal Science*, 73(9), 2669–2676.
<https://doi.org/10.2527/1995.7392669x>

Summary:

Weaning is a maternal behaviour to decrease the frequency of nursing as calves get older. The beef industry weans calves by abruptly separating them from the cow. Abrupt separation causes increased stress for both the cow and calf, which can be quantified by measuring adrenal hormones.

The objective of this study is to quantify the stress experienced by calves and cows after they are abruptly separated during weaning. This was done by measuring adrenal hormones (norepinephrine, epinephrine and cortisol) in the blood. Higher than normal levels of these hormones in the blood indicate elevated levels of stress. During this experiment, blood was collected from eight calves and cows right before and after they were abruptly separated. As well as the following day. More blood was collected before and after the pairs were reunited again. Blood was also collected from control calves and cows that remained together through this time. The blood samples were analyzed to compare the levels of adrenal hormones (norepinephrine, epinephrine and cortisol).

The results of this study found that norepinephrine concentration in calves significantly increased after separation from their mothers and decreased again when they were reunited. Epinephrine concentration significantly increased in both calves and cows after separation and decreased again when they were reunited. These two findings may suggest that cows and calves experience increased stress during weaning by abrupt separation. This stress probably occurs because of the sudden breaking of the cow-calf bond during abrupt separation. Cortisol concentrations only saw a small (insignificant) increase in calves throughout the experiment. The greatest hormone elevation changes occurred in the first twenty-four hours and dropped again once cows and calves were reunited. Further studies should look into the changes in cortisol during weaning and why there was no change.

Contribution:

This study advances knowledge in quantifying weaning stress experienced by calves and cows through analyzing blood hormones. This article supports previous studies on the catecholamine changes in lactating dairy cows and their calves. This study shows similar results. There was an increase in epinephrine and norepinephrine, with no significant change in cortisol concentration. This article was included in my literature review because it is some of the only research that uses proximate endocrine analysis to quantify weaning stress. It indicates that calves and cows experience stress from weaning in the beef industry, and this knowledge can improve cattle welfare.

Reference:

Pérez, L. I., Orihuela, A., Galina, C. S., Rubio, I., Corro, M., Cohen, A., & Hernández, A. (2017). Effect of different periods of maternal deprivation on behavioral and cortisol responses at weaning and subsequent growth rate in zebu (*Bos indicus*) type cattle. *Livestock Science*, 197, 17–21. <https://doi.org/10.1016/j.livsci.2016.12.006>

Summary:

Weaning is a maternal behaviour to decrease the frequency of nursing as calves get older. The beef industry weans calves by abruptly separating (AS) them from the cow. AS causes stress which can be quantified by measuring the concentration of blood cortisol in cows and their calves.

The objective of this study was to quantify the stress experienced by calves that were temporarily separated from their mothers before they were AS during weaning. This was done by measuring cortisol adrenal hormone concentration in the blood. Higher than normal levels of cortisol in the blood indicates elevated levels of stress. During this experiment, there were four treatment groups. Treatment one was a control group where calves stayed with their mothers and were weaned by AS. Treatment two, three and four were calves that were temporarily separated from their mothers before abrupt weaning by a fence line for 24, 48 and 72 hours respectively. Cortisol concentration was measured by taking blood 24, 48 and 72 hours after weaning. Grazing, body weight, vocalizing and distance from the fence line were also recorded and showed similar results to many other studies in the field (results were not worth mentioning).

The results of this study found that all calves that were temporarily separated from their mothers showed lower levels of cortisol three days after weaning than the control calves that were AS. These results can indicate that the treatment calves experience less stress at weaning than the control calves. This may be because temporary separation allows calves to become more independent and gets them used to time spent away from the mother before weaning. Therefore, decreasing their weaning stress. Further studies should look into the emotional stress caused by mother deprivation and how this negatively affects cattle welfare.

Contribution:

This study advances knowledge in quantifying calf weaning stress by analyzing blood cortisol. This article fills in knowledge gaps and questions that other research on cortisol blood concentration could not answer. This study shows similar results to the two-step and fence-line weaning strategies. It showed decreased stress when calves were allowed to maintain some contact with their mothers but were not allowed to nurse as frequently. This article was included in my literature review because it uses (uncommon) proximate cortisol analysis to quantify weaning stress. It inspires new methods of weaning to reduce calf stress and increase cattle welfare.