

Welfare of bobby calves destined for slaughter

(adopted 04/10/18)

The policies and positions of the RSPCA referred to in this document represent the guiding principles to which we aspire in fulfilling our various roles. We are committed to giving effect to these principles wherever possible and practical.

For dairy cows to produce milk, they have to give birth to a calf every year. All bull calves (males) and about one quarter of heifer calves (females) are effectively surplus to dairy industry requirements: bull calves because they don't produce milk and heifer calves because they are not all required for dairy herd replacement. The vast majority of calves are separated from their dam within 12-24 hours of birth. Some bull calves may be raised for veal or beef, while some heifer calves may be grown on and impregnated at 13-15 months and then exported as pregnant breeding animals. The remaining calves (bobby calves) are usually sent for slaughter at five days old.

1. Introduction.....	2
2. General principles	2
3. Responsibility.....	2
4. Training and competency	3
5. Welfare of bobby calves on farm	3
6. Handling	4
7. Feed and water.....	4
8. Treatment of sick or injured calves	5
9. Euthanasia and humane killing.....	6
10. Transportation.....	6
11. Pick-up points, calf scales, saleyards and abattoirs	7
12. Audit	8
13. Legal considerations.....	8
14. Future considerations	9
15. Further reading.....	9
16. Bibliography.....	10

1. Introduction

1.1 This position paper must be read in conjunction with the following RSPCA policies and position papers:

- [Policy B Farm animals](#)
- [Policy F Transportation of animals](#)
- [Policy F4 Transportation of bobby calves](#)
- [Policy G Humane killing](#)
- [Position Paper B6 Welfare of livestock at saleyards](#)
- [Position Paper G3 Welfare of animals at abattoirs and knackeries](#)

1.2 For the purpose of this position paper, a bobby calf is a dairy or dairy cross-breed calf less than 30 days old that is not accompanied by its dam (mother) and destined for slaughter rather than herd replacement or rearing for veal or beef.

1.3 This position paper sets out principles and requirements underpinning the welfare of bobby calves throughout the supply chain: on farm, during transport, at saleyards and collection points, and at abattoirs¹. While the dairy industry continues to produce surplus calves, the good practice steps outlined in this position paper should be followed.

2. General principles

2.1 Every effort should be made to explore technologies and implement options to reduce the number of bobby calves. For example, sexed semen - used for artificial insemination of the dairy cow - has the potential to reduce the number of unwanted male calves born and, instead, allow more heifers to be raised.

2.2 Early separation of dairy cows and calves causes distress, particularly once a bond has formed between cow and calf. The dairy industry is strongly encouraged to invest in research to assist in the implementation of management strategies that avoid separation distress for cows and calves.

2.3 If calves are not destined for herd replacement or cannot be raised to produce dairy veal or beef, then the most humane way to manage calves that would otherwise be destined for slaughter is to humanely kill them on farm at birth.

2.4 If calves cannot be humanely killed on farm at birth, and are instead destined for slaughter, they must receive adequate nutrition, housing and care as per the good practice steps outlined in this position paper, and not be transported until they are at least 10 days old.

3. Responsibility

3.1 The person in charge of the facility where calves are kept, or their nominated representative, is responsible for ensuring the welfare of all animals from the

¹ For the purpose of this Position Paper, any reference to abattoirs also includes knackeries.

moment of birth or arrival at the facility up to the point of the animal's death or departure from the facility. In the case of the person in charge of a transport vehicle, this responsibility starts at the commencement of loading and finishes at the conclusion of unloading the vehicle and notifying the recipient of the animals of their arrival.

- 3.2 Contact details of the responsible person must be clearly displayed at and available throughout the facility to be used in case of emergency.

4. Training and competency

- 4.1 Persons at all facilities where calves are kept, including during transport, and who are responsible for the care and handling of animals must be appropriately trained and competent in their required tasks, including in the euthanasia and humane killing of calves. An understanding of animal behaviour and welfare and the ability to recognise abnormal behaviour and distress is particularly important.
- 4.2 Written procedures describing standard animal handling and management tasks must be in place at the facility and adhered to. Internal assessment and monitoring systems must be in place to ensure on-going compliance with these procedures. A copy of these written procedures must be accessible to relevant staff at all times. At all facilities where calves are kept (including during transport), records must be maintained of regular calf inspections and monitoring noting any problems identified and action taken to rectify the problem.
- 4.3 Records of staff training and induction should be maintained and staff must be assessed at least annually to ensure on-going competency in the required tasks.
- 4.4 Facilities and livestock transport companies should nominate a designated person (or persons) who is:
- responsible for the oversight of animal welfare
 - responsible for ensuring that animal welfare monitoring and assessment is part of the internal and external audit system
 - on site when bobby calves are being either (un)loaded, handled or slaughtered
 - knowledgeable in all facets of animal handling and slaughter (as appropriate)
 - responsible for ensuring that breaches of animal welfare legislation are reported to the relevant regulator.

5. Welfare of bobby calves on farm

- 5.1 The timing of separation of the calf from its dam should aim to minimise separation distress for cow and calf.
- 5.2 Strategies must be in place to minimise cow-calf separation distress. Such strategies may include one or more of the following:
- separation immediately following birth prior to the development of the cow-calf bond
 - ensuring the calf is fed to satiation

- allowing the calf to suckle intermittently from their dam or a foster cow
 - teat feeding and continued access to artificial teats
 - providing an alternative source of milk to the calf prior to separation
 - gradual separation with increasing time apart.
- 5.3 Calves must be kept in a clean, dry and sheltered environment that protects them from heat, cold, wind and rain. The area must be well ventilated while avoiding draughts at calf level. Floors should be well-draining and easy to clean and disinfect.
- 5.4 All calves must be provided with bedding which is maintained in quantities to allow all each calf to lie down in dry, clean bedding of sufficient depth to nestle in deeply and maintain body temperature.
- 5.5 Calves must be housed in groups with other calves of the same age and should not be penned individually unless required for treatment of injury or disease.
- 5.6 Stocking density must be such that all calves are able to lie down at the same time. The space provided should also allow for normal social and play behavior between calves.
- 5.7 Calves must be individually identified in a way that enables their exact age to be easily determined (e.g. by date of birth on an ear tag) at all times. Dryness of the umbilical cord is not a reliable indicator of age as factors such as the weight of the calf and the thickness of the cord at birth, weather conditions, cord sucking, and housing conditions can all impact on cord drying time.

6. Handling

- 6.1 Calves must be handled in a gentle, patient and quiet manner.
- 6.2 Calves must be handled in a manner that avoids pain, injury or distress. Where calves are to be lifted, they must be lifted by supporting the calf's full body weight. Calves must not be:
- lifted by the head, ears, neck, skin or by a single leg
 - thrown or 'dumped'
 - hit or kicked
 - dragged
 - prodded with any sharp instrument
 - tied by their legs.
- 6.3 Electric prodders (whether switched on or off), other goading devices, or dogs must not be used to move calves.

7. Feed and water

- 7.1 The provision of water and feed should take into account the physiological needs of the calf. For unweaned calves separated from their mothers, this effectively means feeding milk or milk replacer. Additional consideration should be given to calves that have been transported off farm to a holding facility or abattoir. These include, but

are not limited to, the length of time the calf has been at the facility, the time off water and feed (i.e. milk or milk replacer) prior to arriving at the facility and the local climatic conditions.

- 7.2 In order to achieve successful passive transfer of immunity, calves must receive sufficient quantities of good quality colostrum within 6 hours of birth and again over the next 18 hours of life. Even calves left to suckle from their mother should be given additional colostrum otherwise successful passive transfer of immunity cannot be guaranteed.
- 7.3 Calves should receive milk or milk replacer *ad libitum* allowing them to drink as much as they want when they want it. Otherwise, calves must receive milk or milk replacer in small quantities over several feeds a day following their day of birth. Quantity of feed should take into account milk quality, calf health and body condition. Providing around 20% of calf body weight in good quality milk (or equivalent in milk replacer) ensures the daily quantity consumed most closely resembles that consumed through natural suckling.
- 7.4 Care should be taken to minimise the occurrence of nutritional scours (diarrhoea) by ensuring adequate colostrum intake and avoiding stress caused by poor feeding management (e.g. irregular feeding or overfeeding, inconsistent milk temperature, poor quality milk powder, or unexpected change in concentration of milk replacer), overcrowding, or exposure to weather extremes.
- 7.5 Antimicrobials, including in-feed antimicrobials, should only be administered for therapeutic purposes under veterinary advice. Steps such as optimising the calves' environment and ensuring appropriate handling and management practices as well as good hygiene are in place should be undertaken to minimise stress in calves and prevent occurrence of disease.
- 7.6 Sufficient feeding stations must be available so that all calves are able to feed at the same time. Feeding systems incorporating teat feeders are the preferred method for milk feeding as they satisfy the calf's behavioural need to suckle and reduce the risk that calves will cross suck (suckle one another). Feeding systems must allow the calf to drink using a normal posture.
- 7.7 Calves should be gradually offered small quantities of good quality fibre by three weeks of age to promote rumen growth and development.
- 7.8 Clean, good quality water must be available to calves at all times.
- 7.9 Feeding and watering facilities must be kept clean and in working order at all times.

8. Treatment of sick or injured calves

- 8.1 Policies and procedures (including the keeping of treatment records) must be in place for the handling and care of sick or injured animals. Sick or injured calves must be identified and receive appropriate veterinary treatment without delay. This includes sick or injured calves arriving on a transport vehicle.

- 8.2 When necessary, sick or injured calves must be euthanased without delay by a competent person and out of sight of other animals. Sick or injured calves that are unable to walk or stand must be humanely killed *in situ*.
- 8.3 Sick or injured calves must be segregated in a hospital pen at a sufficient distance from healthy calves to prevent transfer of disease or risk of further injury.
- 8.4 Sick, injured or weak calves must not be assigned for sale, transport or slaughter.

9. Euthanasia and humane killing

- 9.1 Calves must be handled and killed in a manner that prevents pain, suffering or distress.
- 9.2 Calves must only be killed by a competent operator experienced in the technique.
- 9.3 Euthanasia (humanely ending the life of an animal when it is in the interest of the animal's welfare) and humane killing must be carried out using a rifle or penetrative captive bolt gun aiming at the midway point on an imaginary line joining each ear canal at the base of the calf's ears. The method must result in immediate loss of consciousness and subsequent death. Intravenous administration of a lethal dose of barbiturate by a registered veterinarian is also acceptable.
- 9.4 Regardless of the method of killing, calves must always be checked to ensure they are dead. The following signs of death must all be observed: lack of corneal reflex, fixed and dilated pupils unresponsive to light, relaxed jaw and limp tongue, and no rhythmic breathing.
- 9.5 Calves must not be killed using blunt force trauma.

10. Transportation

- 10.1 Calves should be at least 10 days old prior to being transported, including for sale or slaughter.
- 10.2 Only healthy, strong calves are to be presented for transportation. Calves which are 'dopey', lethargic or cannot stand or walk unassisted, must not be presented for sale or transport.
- 10.3 Calves destined for slaughter must be transported directly to the abattoir rather than through saleyards or other collection points in order to reduce the inherent stress associated with loading, transport and unloading. The use of licensed mobile slaughter units for the on-farm slaughter of calves is encouraged to remove the stress experienced by calves during the transport process.
- 10.4 Calves must be fed prior to transport within 4 hours of leaving their property of origin. This feed should be equivalent to at least half of the calf's daily ration. The time of feeding should be recorded and accompany the calves to their final destination.
- 10.5 The total time off feed and water must not exceed 12 hours.

- 10.6 Calves should be inspected within 30 minutes of departure of the transport vehicle and every two hours thereafter throughout the journey. Any problems identified, including unfit animals, must be promptly reported to the consignor or recipient, whichever is appropriate.
- 10.7 Transport vehicles must provide a sheltered environment to protect calves from heat, cold, wind and rain during transport.
- 10.8 Non-slip flooring and thick bedding must be used on the floor of the truck.
- 10.9 Vehicles must be designed so that calves have sufficient headroom to travel in a natural standing position and are contained within the vehicle.
- 10.10 Young calves prefer to lie down during transport and stocking density on vehicles must be such that all calves are able to lie down at the same time with their legs outstretched.

11. Pick-up points, calf scales², saleyards and abattoirs

- 11.1 While the RSPCA position is that calves are consigned directly to an abattoir, the operation of saleyards, calf scales, calf pick-up points and other holding facilities and the transport of calves for slaughter should be coordinated to permit slaughter of these animals within 12 hours of their last feed.
- 11.2 Holding facilities must be constructed to permit the safe loading and unloading of calves. Ideally, the loading bay should allow calves, particularly young calves, to walk straight into or out of the vehicle without the need for a ramp. Where a ramp is used, the angle of the ramp must be no greater than 12 degrees.
- 11.3 Holding pens must provide calves with roofed shelter at all times to protect them from heat, cold, wind and rain. Holding pens should have solid walls to protect calves from prevailing wind and rain as well as draughts.
- 11.4 Holding pens must be constructed to provide floor surfaces that are dry, non-slip and be able to be cleaned effectively. Calves in holding pens should be provided with suitable bedding.
- 11.5 Sufficient room must be provided to allow all calves within a pen to move around and lie down without difficulty.
- 11.6 Water must be available to calves at all times.
- 11.7 Calves which are not collected from holding facilities within 12 hours of their last feed, must be fed appropriate and sufficient liquid feed (milk or milk replacer) by the person in possession of the calves at that time. Provision of electrolytes to calves destined for transport should be considered. Calves destined for slaughter which are not slaughtered within 12 hours of their last feed must be fed again and at 12 hour intervals thereafter if slaughter is delayed for any reason.

² **Calf scales** are a public delivery and collection point used exclusively for the sale and purchase of calves.

- 11.8 Calves must be slaughtered prior to other animals so that they are not held any longer than necessary.
- 11.9 Any calves that are awaiting slaughter when an unforeseen delay in processing occurs, e.g. at the outbreak of an industrial dispute or major mechanical breakdown, must not be kept alive and must be immediately humanely killed (see 'Euthanasia and humane killing' section above) by a competent person or by arrangement with normal slaughterers. Written procedures describing standard animal handling and management tasks in the event of an unforeseen delay should be in place at the facility and adhered to.
- 11.10 All public and commercial holding facilities should be registered with the state/territory Department of Agriculture or its equivalent.

12. Audit

- 12.1 An independent and external third party must audit holding facilities, transporters and abattoirs, including their animal welfare provisions, at least annually. The audit process should also include annual unscheduled audits. Participation in and compliance with third party audits should form part of the facility's licensing and operating conditions.
- 12.2 An audit process must be in place to ensure that facilities are audited against their documented standard animal handling and management procedures. An animal welfare checklist must be in place that allows effective assessment of compliance with these animal welfare procedures.

13. Legal considerations

- 13.1 State and territory animal welfare legislation places certain responsibilities on those in charge of an animal's wellbeing. Legislation requires that a person:
- not commit an act of cruelty upon an animal;
 - provides an animal with proper and sufficient food, water and shelter;
 - provides an animal with treatment for disease and injury; and
 - not abandon an animal.
- 13.2 The *Model Codes of Practice for the Welfare of Animals* and the *Standards & Guidelines for the Welfare of Animals*, including those for the transport of livestock, provide basic principles for the care of farm animals. In general, compliance with the relevant Model Code (or animal welfare Standard) will ensure compliance with animal welfare legislation unless a state/territory has chosen to implement a higher standard. Achieving a level of animal welfare that goes beyond compliance with minimum standards is strongly encouraged.
- 13.3 The animal welfare standards described in relevant *Model Codes of Practice* or *Standards & Guidelines* for holding facilities, transporters and abattoirs must be mandatory and allow for independent oversight and audit. Key animal welfare standards should be clearly identified on signage throughout facilities, also noting the penalties for non-compliance.

- 13.4 Staff must report instances of cruelty or other breaches of legislation to the authorised enforcement agency as well as the person in charge of the facility within a reasonable time. Appropriate action must be taken to prevent and/or alleviate further animal suffering. Instances of cruelty, other breach of legislation and failure of staff to report animal welfare issues must result in appropriate disciplinary measures, and review of staff training, induction and other relevant procedures.

14. Future considerations

- 14.1 Every effort must be made to reduce the number of bobby calves destined for slaughter in their first week of life and to provide calves with a life worth living.
- 14.2 Technologies that can lead to milk production without the need for the cow to be physically pregnant and deliver offspring should be explored.
- 14.3 Technologies that could lead to increased duration of lactation should be explored. Lengthening the cow's lactation period could significantly reduce the number of calves born.
- 14.4 Raising excess dairy calves for veal or beef is one way in which the value of an animal that would otherwise be destined for slaughter at five days old can be increased. By increasing their value and providing an alternative market, there is real potential to improve the welfare of bobby calves.
- 14.5 Regardless of their value, bobby calves should always receive the same level of care as calves not destined for slaughter. Where care and management of calves cannot guarantee good welfare, e.g. through the provisions outlined in this position paper, then calves should be humanely killed on farm at birth.

15. Further reading

- 15.1 This position paper must be read in conjunction with the following:

RSPCA policies:

- [B1 Farm animals](#)
- [F1 Transportation – general principles](#)
- [F2 Transportation of livestock for slaughter](#)
- [F4 Transportation of bobby calves](#)
- [G1 Humane killing](#)
- [GP2 Animal welfare legislation](#)
- [GP3 Standards, codes of practice and guidelines](#)
- [RSPCA Policy F3 Export of live food animals](#)
- [RSPCA Policy F4 Export of live animals for purposes other than slaughter](#)

RSPCA position papers:

- [B4 Invasive farm animal husbandry procedures](#)
- [B6 Welfare of livestock at saleyards](#)
- [G3 Welfare of animals at abattoirs and knackeries](#)

- [PP GP1 Animal welfare legislation](#)
- [PP GP2 Development of animal welfare standards](#)

RSPCA Approved Farming Scheme [standards](#):

- Dairy veal calves

RSPCA Knowledgebase articles:

- [What happens to bobby calves?](#)
- [Why are calves separated from their mother in the dairy industry?](#)
- [Why is colostrum feeding important for calves?](#)
- [How much milk should dairy calves be fed?](#)
- [Is group housing preferable to individual housing of dairy calves?](#)
- [What are the animal welfare issues associated with weaning nose rings and other anti-suckling devices for calves?](#)
- [How do young calves cope with transport?](#)
- [What is veal?](#)

16. Bibliography

- Adams-Progar A, Pereira R, Moore DA (2015) Group housing preweaned dairy calves: Socialization versus disease transmission. *ag animal health spotlight: Veterinary Medicine Extension*, October 2015. Washington State University.
- American Veterinary Medical Association (2013) AVMA Guidelines for the Euthanasia of Animals: 2013 Edition.
- Animal Health Australia (2014) Australian Animal Welfare Standards and Guidelines for Cattle. Edition 1. www.animalwelfarestandards.net.au.
- Animal Health Australia (2016) Johnes's Disease spread and prevalence. www.animalhealthaustralia.com.au.
- Bergman MA, Richert RM, Cicconi-Hogan KM et al (2014) Comparison of 52 selected animal observations and management practices used to assess welfare of calves and adult dairy cows on organic and conventional dairy farms. *Journal of Dairy Science* **97**(7): 4269-4280. doi: 10.3168/jds.2013-7766.
- Buchli C, Raselli A, Bruckmaier R et al (2017) Contact with cows during the young age increases social competence and lowers the cardiac stress reaction in dairy calves. *Applied Animal Behaviour Science* **187**:1-7.
- Burgstaller J, Wittek T, Smith GW (2017) Invited review: Abomasal emptying in calves and its potential influence on gastrointestinal disease. *Journal of Dairy Science* **100**:17-15.
- Chua B, Coenen E, van Delen J et al (2002) Effects of pair versus individual housing on the behavior and performance of dairy calves. *Journal of Dairy Science* **85**:360-364.
- Cobb CJ, Obeidat BS, Sellers MD et al (2014) Improved performance and heightened neutrophil responses during the neonatal and weaning periods among outdoor group-housed Holstein calves. *Journal of Dairy Science* **97**:930-939.
- Conneely M, Berry DP, Murphy JP et al (2014) Effect of feeding colostrum at different volumes and subsequent number of transition milk feeds on the serum immunoglobulin G concentration and health status of dairy calves. *Journal of Dairy Science* **97**:6991-7000.
- Costa JHC, Daros RR, von Keyserlingk MAG et al (2014) Complex social housing reduces food neophobia in dairy calves. *Journal of Dairy Science* **97**:7804-7810.
- Dairy Australia (n.d) Bovine Johnes Disease (BJD): Dairy farm guidelines for BJD control: Best practice recommendations for managing the risk of BJD in Australia dairy herds. www.dairyaustralia.com.au.
- Dairy Australia (2011) Rearing Healthy Calves manual. www.dairyaustralia.com.au.
- Dairy Australia (2014) Euthanase livestock. www.dairyaustralia.com.au.
- Dairy Australia (2017) Dairy welfare, we care: Animal husbandry survey 2016. www.dairyaustralia.com.au.

- Dairy Australia (2017) Rearing Healthy Calves manual. 2nd edition. www.dairyaustralia.com.au.
- de Passillé AM (2001) Sucking motivation and related problems in calves. *Applied Animal Behaviour Science* **72**:175-187.
- de Paula Vieira A, de Passillé AM, Weary DM (2012) Effects of the early social environment on behavioral responses of dairy calves to novel events. *Journal of Dairy Science* **95**:5149-5155.
- Ellingsen K, Coleman GJ, Lund V et al (2014) Using qualitative behaviour assessment to explore the link between stockperson behaviour and dairy calf behaviour. *Applied Animal Behaviour Science* **153**:10-17.
- Fisher AD, Stevens BH, Conley MJ et al (2014) The effects of direct and indirect road transport consignment in combination with feed withdrawal in young dairy calves. *Journal of Dairy Research* **81**:297-303.
- Flower FC, Weary DM (2001) Effects of early separation on the dairy cow and calf: 2. Separation at 1 day and 2 weeks after birth. *Applied Animal Behaviour Science* **70**(4):275-284.
- Frøberg S, Gratte E, Svennersten-Sjaunja K et al (2008) Effect of suckling ('restricted suckling') on dairy cows' udder health and milk let-down and their calves' weight gain, feed intake and behaviour. *Applied Animal Behaviour Science* **113**(1-3):1-14.
- Hernandez D, Nydam DV, Godden SM et al (2016) Brix refractometry in serum as a measure of failure of passive transfer compared to measured immunoglobulin G and total protein by refractometry in serum from dairy calves. *The Veterinary Journal* **211**:82-87.
- Hides SJ, Hannah MC (2005) Drying times of umbilical cords of dairy calves. *Australian Veterinary Journal* **83**(6):371-373.
- Hulbert LE, Moisé SJ (2016) Stress, immunity, and the management of calves. *Journal of Dairy Science* **99**:3199-3216.
- Godden SM (2008) Colostrum management for dairy calves. *Veterinary Clinics of North America: Food Animal Practice* **24**(1):19-39.
- Godden SM, Fetrow JP, Feirtag JM et al (2005) Economic analysis of feeding pasteurized nonsaleable milk versus conventional milk replacer to dairy calves. *Journal of the American Veterinary Medicine Association* **226**:1547-1554.
- Grandin T (2007) Livestock Handling & Transport, 3rd edition. CABI International.
- Grondahl AM, Skancke EM, Mejdell CM et al (2007) Growth rate, health and welfare in a dairy herd with natural suckling until 6-8 weeks of age: a case report. *Acta Veterinaria Scandinavica* **49**:16.
- Hulbert LE, Moisé SJ (2016) Stress, immunity, and the management of calves. *Journal of Dairy Science* **99**:3199-3216.
- Jensen MB, Weary D (2013) Group housing and milk feeding of dairy calves. *WCDS Advances in Dairy Technology* **25**:179-189.
- Jensen MB, Larsen LE (2014) Effects of level of social contact on dairy calf behavior and health. *Journal of Dairy Science* **97**(8):5035-5044.
- Jensen MB, Duve LR, Weary DM (2015) Pair housing and enhanced milk allowance increase play behavior and improve performance in dairy calves. *Journal of Dairy Science* **98**(4):2568-2575.
- Johnsen JF, Zipp KA, Kälber T et al (2016) Is rearing calves with the dam a feasible option for dairy farms?—Current and future research. *Applied Animal Behaviour Science* **181**:1-11.
- Johnsen JF, Mejdell CM, Beaver A et al (2018) Behavioural responses to cow-calf separation: The effect of nutritional dependence. *Applied Animal Behaviour Science* **201**:1-6.
- Jongman EC, Butler KL (2013) Ease of moving young calves at different ages. *Australian Veterinary Journal* **91**(3):94-98.
- Jongman EC, Butler KL (2014) The effect of age, stocking density and flooring during transport on welfare of young dairy calves in Australia. *animals* **4**:184-199.
- Kälber T, Barth K (2014) Practical implications of suckling systems for dairy calves in organic production systems—a review. *Applied Agricultural Forestry Research* **64**:45-58.
- Khan MA, Weary DM, von Keyserlingk MAG (2011) Invited review: Effects of milk ration on solid feed intake, weaning and performance in dairy heifers. *Journal of Dairy Science* **94**(3):1071-1081.
- Khan MA, Bach A, Weary DM et al (2016) Invited review: Transitioning from milk to solid feed in dairy heifers. *Journal of Dairy Science* **99**:885-902.

- Klein-Jobstl D, Iwersen M, Drillich M (2014) Farm characteristics and calf management practices on dairy farms with and without diarrhea: A case-control study to investigate risk factors for calf diarrhea. *Journal of Dairy Science* **97**:5110-5119.
- Knowles TG, Warriss PD, Brown SN et al (1997) Effects on calves less than one month old of feeding or not feeding them during road transport of up to 24 hours. *The Veterinary Record* **140**:116-124.
- Krachun C, Rushen J, de Passillé AM (2010) Play behaviour in dairy calves is reduced by weaning and by a low energy intake. *Applied Animal Behaviour Science* **122**:71-76.
- Lürzel S, Münsch C, Windschnurer I et al (2015) The influence of gentle interactions on avoidance distance towards humans, weight gain and physiological parameters in group-housed dairy calves. *Applied Animal Behaviour Science* **172**:9-16.
- Maunsell F, Donovan GA (2008) Biosecurity and risk management for dairy replacements. *Veterinary Clinics of North America: Food Animal Practice* **24**:155-190.
- Miller-Cushon EK, Bergeron R, Leslie KE et al (2014) Competition during the milk-feeding stage influences the development of feeding behavior of pair-housed dairy calves. *Journal of Dairy Science* **97**:6450-6462.
- Miller-Cushon EK, DeVries TJ (2015) Invited review: Development and expression of dairy calf feeding behaviour. *Canadian Journal of Animal Science* **95**:341-350.
- Mintline EM, Stewart M, Rogers AR et al (2013) Play behavior as an indicator of animal welfare: Disbudding in dairy calves. *Applied Animal Behaviour Science* **144**(1-2):22-30.
- National Farm Animal Care Council (2016) Code of practice for the care & handling of veal cattle: Review of scientific research on priority issues. NFACC, December 2016.
- Newberry RC, Swanson JC (2008) Implications of breaking mother-young social bonds. *Applied Animal Behaviour Science* **110**:3-23.
- Phipps AJ, Beggs DS, Murray AJ et al (2018) A survey of northern Victorian dairy farmers to investigate dairy calf management: colostrum feeding and management. *Australian Veterinary Journal* **96**(4):101-106.
- Roland L, Drillich M, Klein-Jöbstl D et al (2016) Invited review: Influence of climatic conditions on the development, performance, and health of calves. *Journal of Dairy Science* **99**:2438-2452.
- Rosenberger K, Costa JHC, Neave HW et al (2017) The effect of milk allowance on behavior and weight gains in dairy calves. *Journal of Dairy Science* **100**:504-512.
- Rushen J, Wright R, Johnsen JF et al (2016) Reduced locomotor play behaviour of dairy calves following separation from the mother reflects their response to reduced energy intake. *Applied Animal Behaviour Science* **177**:6-11.
- Scientific Committee on Animal Health and Animal Welfare (2002) The welfare of animals during transport (details for horses, pigs, sheep and cattle). European Commission, Health & Consumer Protection Directorate-General.
- State of Victoria, Department of Primary Industries (2008) Nutritional scours in milk-fed calves: causes and treatment by John Moran. Agriculture Notes AG0578.
- Stewart M, Shepherd HM, Webster JR et al (2013) Effect of previous handling experiences on responses of dairy calves to routine husbandry procedures. *animal* **7**(05):828-833.
- Thomas TJ, Weary DM, Appleby MC (2001) Newborn and 5-week old calves vocalise in response to milk deprivation. *Applied Animal Behaviour Science* **74**:165-173.
- Todd SE, Mellor DJ, Stafford KJ et al (2002) Effects of food withdrawal and transport on 5- to 10-day-old calves. *Research in Veterinary Science* **68**:125-134.
- Trunkfield HR, Broom DM (1990) The welfare of calves during handling and transport. *Applied Animal Behaviour Science* **28**:135-152.
- Vasseur E, Borderas F, Cue RI et al (2010) A survey of dairy calf management practices in Canada that affect animal welfare. *Journal of Dairy Science* **93**(3):1307-1315.
- Von Keyserlink MAG, Weary DM (2007) Maternal behavior in cattle. *Hormones and Behavior* **52**:106-113.
- Wagner K, Barth K, Palme R et al (2012) Integration into the dairy cow herd: long-term effects of mother contact during the first twelve weeks of life. *Applied Animal Behaviour Science* **141**(3-4):117-129.
- Weary DM, Chua B (2000) Effects of early separation on the dairy cow and calf: 1. Separation at 6 h, 1 day and 4 days after birth. *Applied Animal Behaviour Science* **69**(3):177-188.

- Weary DM, Jasper J, Hötzel MJ (2008) Understanding weaning distress. *Applied Animal Behaviour Science* 110(1-2):24-41.
- Whalin L, Weary DM, von Keyserlingk MAG (2018) Short communication: Pair housing dairy calves in modified hutches. *Journal of Dairy Science* 101(6):5428-5433.