

# **New Research on Methods for Alleviating Pain in Farm Animals**

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## **Abstract**

Welfare attention on surgical husbandry practices for farm animals focuses on the fact that many of the procedures involve innervated tissues and are traditionally performed without anaesthesia or analgesia. There are several approaches available for addressing welfare concerns surrounding these procedures. These options include 1) cessation of the procedure in combination with altered management strategies; 2) breeding animals that do not require the procedure; 3) replacing the current procedure with a non-surgical alternative that has been shown to optimise welfare; or 4) performing the procedure without pain. This paper examines the fourth approach. Previous published research has examined analgesic strategies for the castration and dehorning of cattle and the castration of lambs. Recent published research by the CSIRO has examined the effectiveness of analgesic approaches for mulesing of sheep. The options included topical local anaesthesia and the administration of carprofen and flunixin- both non-steroidal anti-inflammatory drugs (NSAIDs). Currently, NSAIDs are not registered for use in sheep in Australia and the topical anaesthetic is available for sheep only under a minor use permit. The administration of NSAIDs alone provided some behavioural benefits but did little to reduce plasma cortisol. The administration of the topical anaesthetic alone had benefits in terms of reduced cortisol immediately after mulesing and less hunched standing compared with no treatment. Greatest pain relief, as indicated by the behavioural and cortisol responses to mulesing, was provided by the combined administration of the commercially-available topical local anaesthetic formulation and the long acting NSAID carprofen. In effect, this treatment showed that it is scientifically possible to abolish the pain responses occurring in the hours after mulesing.

## **Introduction**

During the past century, community views on animal welfare have moved from concern only with acts of wanton cruelty, to concerns about standards of animal care. An area of focus of this public concern for animal welfare has been industries where animals are kept for profit, such as agriculture. Accordingly, the standards of husbandry and welfare during animal production are becoming important factors influencing consumer perceptions in many markets. Failure to address the continued use of practices that

initiate market or public concerns may cause damage to the image and marketability of animal industry products.

Successful industry management of animal welfare requires from science the ability to: 1) evaluate the welfare status of farm animal husbandry practices and production environments; 2) address any issues with practices and environments that are revealed; and 3) provide assurance to markets, regulatory authorities and the general public of the welfare standards of the industry.

The ongoing or emerging animal welfare issues for today's animal production systems involve: practices that restrict the movement of animals; surgical husbandry practices that may cause pain; long-distance transport of animals for economic gain; and diseases or problems induced by the production environment.

Public attention on the welfare consequences of surgical husbandry procedures used on farm animals focuses on the conundrum that many of the procedures involve innervated tissues and are traditionally performed without anaesthesia or analgesia, in contrast to the requirement to perform similar procedures with anaesthesia in companion animals. There is little evidence to support a contention that the perception of pain in farm animals such as sheep or cattle is biologically less effective than in dogs, cats or horses.

Surgical husbandry procedures that may be utilised in sheep and cattle production include castration and tail docking (both species), mulesing (sheep), dehorning and spaying (cattle). There are several approaches available for addressing welfare concerns surrounding these procedures. These options include 1) ceasing the procedure altogether and addressing the current need for the operation through management strategies; 2) breeding animals that do not require the procedure; 3) replacing the current procedure with a non-surgical alternative that has been shown to optimise welfare; or 4) performing the procedure without pain. Specific examples of these approaches include breeding polled cattle (option 2), and farmers in lower fly risk areas who manage their unmulesed merino sheep through strategic inspections and larvicide treatments (option 1). In the future, option 3 may be achieved for castration by the development of long-acting pharmacological or immunological alternatives. The successful selection and dissemination of Merino sheep with lowered susceptibility to breechstrike (option 2) would obviate the need for any form of mulesing.

Although it is generally seen as preferable for the future to not have to perform surgery to achieve husbandry outcomes, there are several reasons why option 4 - anaesthesia and analgesia - should not be discounted. Firstly, genetic improvement takes time. Genetic progress in a quantitative trait such as the amount of wool and wrinkled skin on the hindquarters of a sheep, proceeds by small increments with each generation. Even for a trait such as polledness in cattle, where only a few genes control the polled condition, there would be a significant time lag following the identification of the gene(s) and development of a test before homozygous breeding animals were disseminated throughout the cattle population. There is also likely to be some time delay before the development and implementation of some of the non-surgical approaches currently

under investigation. It will also be very important to have evidence that a non-surgical alternative to a current procedure actually produces significantly better welfare for the animals. It would be unfortunate if a perceived need to move away from the perception and image issues surrounding surgery were to fail to result in any animal welfare improvements.

Previous published research has examined analgesic strategies for the castration of calves (Fisher et al., 1996; Stafford et al., 2002), dehorning of cattle (Stafford et al., 2003) and castration of lambs (Dinniss et al., 1997; 1999). For a comprehensive review of analgesic strategies and their effectiveness for castration and dehorning of cattle, the paper by Stafford et al. (2006) is recommended to the reader. Only recently has published research appeared on analgesic options for mulesing of sheep. This is somewhat surprising given that the extent of tissue affected by mulesing is arguably greater than that for other surgical husbandry procedures of livestock. Mulesing is a surgical procedure in which two strips of skin are cut from the hindquarters of Merino lambs in order to remove wool-bearing wrinkled skin, increase the perineal bare area and reduce the risk of breech strike throughout life thereafter. The operation is often performed in conjunction with tail docking during the first 12 weeks after birth, and is described in the relevant Australian Model Code of Practice for the Welfare of Animals (Primary Industries Standing Committee, 2006). Although, mulesing was originally highlighted for animal welfare benefits in reducing flystrike (Beveridge, 1984), the practice has more recently been the focus of campaigns by groups interested in animal rights.

A number of organisations representing the Australian wool industry announced in 2004 that the current practice of mulesing would cease by 2010 (Australian Sheep and Wool Industry Taskforce, 2004). Leading up to this date, there have been ongoing efforts to develop and introduce alternatives to the procedure, and to provide analgesia in association with the current practice. The CSIRO research reviewed in this paper examined the effects of a range of analgesic options for providing pain relief in association with mulesing. Although surgical mulesing itself may cease after 2010, the research also highlights the extent of pain relief, indeed pain absence, that can be achieved for surgical husbandry procedures of livestock.

## **Research**

As reviewed by Lee and Fisher (2007), mulesing produces a physiological stress response in sheep that persists for 24 to 48 hours, as measured by increases in blood concentrations of the hormone cortisol, which is secreted in response to stressors such as pain and surgery. Behavioural changes that may be indicative of pain and discomfort appear to resolve within 24 and 48 hr, respectively. Reductions in weight gain induced by mulesing may persist for 14 days. The acute stress response to mulesing is similar to that produced by shearing, castration and mild flystrike, but mulesing has a longer duration of stress response than shearing (1 hr) or knife castration (8-24 hr), while

flystrike can lead to death within a few days. The stress response to flystrike persists for the duration of untreated infection (Colditz et al., 2005).

In an experimental study published in the Australian Veterinary Journal, Paull et al. (2007) described in detail the pain responses of lambs to mulesing and examined the effectiveness of analgesic approaches. Because of the relatively extensive area of tissue that is traumatised by mulesing, pre-operative injection of local anaesthetics into all the potentially affected tissues is not easy to accomplish. Post-operative topical application of local anaesthetics is an option. This approach has been investigated in overseas research on tail docking (Graham et al., 1997) and has been made available for mulesing through the release of a proprietary product onto the Australian market, currently under a minor use permit from the Australian Pesticides and Veterinary Medicines Authority (Tri-solfen, Bayer Australia, NSW). Another option for the provision of analgesia for mulesing may be the pre-operative systemic administration of non-steroidal anti-inflammatory drugs (NSAIDs), such as flunixin and carprofen. Although there is relatively little published data on the use of NSAIDs in sheep, there were several reasons why NSAIDs were included in the research. The administration of NSAIDs, particularly in combination with local anaesthesia, has been shown to be an effective analgesic strategy for castration in cattle (Earley and Crowe, 2002; Stafford et al., 2002). In addition, NSAIDs may provide a longer period of analgesia than local anaesthetics alone. In sheep, carprofen is cleared slowly, with an elimination half-life of at least 30 hours (Welsh et al., 1992).

In the experiment of Paull et al. (2007), 64 Merino lambs were allocated to eight treatment groups:

- 1) sham mulesed control;
- 2) conventional surgical mules;
- 3) topical anaesthetic, incorporating lignocaine, bupivacaine, adrenaline and cetrimide, applied immediately after mulesing;
- 4) flunixin + topical anaesthetic, with flunixin administered 2.5 mg/kg s.c. 90 min before mulesing;
- 5) carprofen + topical anaesthetic, with carprofen administered 4 mg/kg s.c. 90 min before mulesing;
- 6) carprofen, administered as above;
- 7) flunixin, administered as above; and
- 8) carprofen + flunixin, administered as above.

The stress-responsive hormone cortisol was measured in blood samples taken at 0, 0.5, 6, 12 and 24 h relative to mulesing. Animal behaviour, including lamb posture, was recorded for 12 h after mulesing.

The results showed that conventionally mulesed lambs exhibited large increases in plasma cortisol, reduced lying and increased standing with a hunched back compared with unmulesed control animals. The application of the topical anaesthetic reduced the cortisol increase to mulesing seen at 30 min after the procedure. The application of the topical anaesthetic also reduced hunched standing, and increased lying compared with

conventionally mulesed animals, but generally did not result in values the same as those of control lambs. Carprofen, flunixin, and carprofen + flunixin treatments did not reduce the cortisol response to mulesing but substantially ameliorated some changes in behavioural postures. Flunixin + topical anaesthetic reduced the cortisol peak following mulesing and ameliorated changes in behavioural postures. The most effective strategy was provided by carprofen + topical anaesthetic, which abolished the cortisol peak following mulesing and substantially ameliorated most changes in behavioural postures. All mulesed animals lost weight in the week after mulesing regardless of analgesic administration, but there were no significant differences in growth rate between any of the eight treatment groups over the 3 weeks after mulesing. More information on the results is presented in Table 1.

Table 1. Plasma cortisol and hunched standing after mulesing and analgesic treatments

	Control	Conventional mules	Topical anaesthetic	Flunixin + topical anaesthetic	Carprofen + topical anaesthetic	Carprofen	Flunixin	Carprofen + Flunixin
Plasma cortisol (nmol/l)								
0.5 h							135.	
6 h	52.9	133.1	105.9	79.5	35.9	142.8	8	135.8
12 h	13.9	55.1	66.5	54.1	36.3	49.0	39.7	64.0
24 h	15.3	35.4	67.7	50.4	45.9	52.6	62.6	68.2
	20.0	53.4	51.9	67.9	46.6	52.4	78.9	68.1
Hunched standing (% of time)								
0-4 h	0	16	1.8	0.1	0	1.4	3.8	0.1
4-8 h	0	22	7.9	0.1	0.2	2.3	1.4	1.5
8-12 h	0	21	18	0	0.4	5.0	2.2	2.0

Paull et al. (2007)

## Conclusions

The research showed that analgesics can moderate the pain response of sheep to a surgical husbandry procedure with extensive tissue involvement such as mulesing. Greatest pain relief, as indicated by the behavioural and cortisol responses to mulesing, was provided by the combined administration of the topical local anaesthetic formulation together with the long acting NSAID carprofen. In effect, this treatment showed that it is scientifically possible to abolish the pain responses occurring in the hours after mulesing. The administration of the topical anaesthetic alone had benefits in terms of

reduced cortisol immediately after mulesing and less hunched standing compared with no treatment. The administration of NSAIDs alone provided some behavioural benefits but did little to reduce plasma cortisol. In terms of practical implications, it should be noted that the topical anaesthetic is currently only available as a non-registered product through a minor use permit for use under the supervision of a veterinarian, and that there are no NSAIDs currently registered for sheep. Nonetheless, it has been shown that it is scientifically feasible to perform surgical husbandry procedures in livestock in a manner that is not incompatible with good animal welfare principles. Whether and for how long such husbandry procedures continue, or are replaced by alternatives, remains to be seen.

## References

- Australian Sheep and Wool Industry Taskforce. Industry agreement on mulesing. [http://www.nff.org.au/pages/policies\\_printfiles/NR\\_TF\\_08\\_11\\_04\\_PETA.pdf](http://www.nff.org.au/pages/policies_printfiles/NR_TF_08_11_04_PETA.pdf). 2004. Retrieved 15 April 2007.
- Beveridge WIB. The origin and early history of the Mules operation. *Aust Vet J* 1984;61:161-163.
- Colditz IG, Walkden-Brown SW, Daly BL and Crook BJ. Some physiological responses associated with reduced wool growth during blowfly strike in Merino sheep. *Aust Vet J* 2005;83:695-699.
- Dinniss AS, Mellor DJ, Stafford KJ, Bruce RA, Ward RN. Acute cortisol responses of lambs to castration using a rubber ring and/or a castrating clamp with or without local anaesthetic. *NZ Vet J* 1997;45:114-121.
- Dinniss AS, Stafford KJ, Mellor DJ, Bruce RA, Ward RN. The behaviour pattern of lambs after castration using a rubber ring and/or castrating clamp with or without local anaesthetic. *NZ Vet J* 1999;47:198-203.
- Earley B, Crowe MA. Effects of ketoprofen alone or in combination with local anesthesia during the castration of bull calves on plasma cortisol, immunological and inflammatory responses. *J Anim Sci* 2002;80:1044-1052.
- Fisher AD, Crowe MA, Alonso de la Varga ME, Enright WJ. Effect of castration method and the provision of local anesthesia on plasma cortisol, scrotal circumference, growth and feed intake of bull calves. *J Anim Sci* 1996;74:2336-2343.
- Graham MJ, Kent JE, Molony V. Effects of four analgesic treatments on the behavioural and cortisol responses of 3-week-old lambs to tail docking. *Vet J* 1997;153:87-97.
- Lee C, Fisher AD. Welfare consequences of mulesing of sheep. *Aust Vet J* 2007; 85:89-93.
- Paull DR, Lee C, Colditz IG, Atkinson SJ, Fisher AD. The effect of a topical anaesthetic formulation, systemic flunixin and carprofen, singly or in combination, on cortisol and behavioural responses of Merino lambs to mulesing. *Aust Vet J* 2007; 85:98-106.

Primary Industries Standing Committee. Model Code of Practice for the Welfare of Animals. The Sheep. Second Edition. PISC Report 89. CSIRO Publications, Collingwood, 2006.

Stafford KJ, Chambers JP, Mellor DJ. The alleviation of pain in cattle: a review. CAB Reviews: Perspectives in Agriculture, Veterinary Science, Nutrition and Natural Resources, CAB, Wallingford, UK, 2006.

Stafford KL, Mellor DJ, Todd SE, Bruce RA, Ward RN. Effects of local anaesthesia or local anaesthesia plus a non-steroidal anti-inflammatory drug on the acute cortisol response of calves to five different methods of castration. Res Vet Sci 2002;73:61-70.

Stafford KJ, Mellor D, J Todd SE, Ward RN, McMeekan CM. The effect of different combinations of lignocaine, ketoprofen, xylazine and tolazoline on the acute cortisol response to dehorning in calves. NZ Vet J 2003; 51:219-226.

Welsh EM, Baxter P, Nolan AM. Pharmacokinetics of carprofen administered intravenously to sheep. Res Vet Sci 1992;53:264-266.