NEUROPHYSIOLOGICAL REGULATION OF TEMPERAMENT IN SHEEP

K.A. DRAKE[A], *D.M. FERGUSON*[A], *G.N. HINCH*[B] *and C.J. COOK*[C]

CRC for Cattle and Beef Quality
[A] CSIRO Livestock Industries, FD McMaster Laboratory, Chiswick, Armidale, NSW 2350
[B] Department of Rural Studies, University of New England, Armidale, NSW 2351
[C] BioEngineering Technology, HortResearch, Hamilton, New Zealand 2001

Selection of animals with amicable temperament can provide improvements in animal management, productivity, meat quality (Burrow 1997; Reverter *et al.* 2003) and, potentially, animal welfare. Temperament in ruminants is typically assessed using tests that measure escape and/or avoidance behaviour. Although such tests are practical, a better understanding of the neurophysiological mechanisms affecting temperament may increase our capacity to improve accuracy of selection with respect to temperament. We hypothesised that 2 major neurotransmitters, γ-amino-butyric acid (GABA) and serotonin (5-HT), and their pathways, are responsible for temperament differences in livestock. These neurotransmitters are associated with anxiety in humans and animals (Haller 2001). Our objective was to investigate the role of GABA and 5-HT in the stress response of sheep using pharmacological agents that either increase (agonist) or decrease (antagonist) neurotransmitter action.

Restraint and isolation can be a fear-eliciting stressor in sheep, giving an indication of temperament. The isolation box test (IBT) w developed to measure the degree of agitation when sheep are isolated. The IBT is an accurate and highly repeatable measure of sheep temperament (Murphy *et al*. 1994), which involves placing an animal in a 1.5 m x 1.5 m box for 1 min and recording the number of movements of the animal with an electronic meter. Thirty-five Merino sheep (~18 months) were used to study each neurotransmitter. Within each neurotransmitter study, there were 7 treatment groups, each comprised of 5 animals, where 1 animal from each group was challenged daily over 5 days. Thirty minutes before the IBT, animals were administered treatments at 1 of 3 doses (see Table 1).

Table 1. Agonist and antagonist dose rates (mg/kg) for GABA and 5-HT studies.

Pathway	Agonists	Low	Med	High	Antagonists	Low	Med	High
GABA	Diazepam	0.3	0.6	0.9	GABA:Pentylenetetrazol	1	5	10
5-HT	8-hydroxy-DPAT hydrobromide	0.2	0.5	0.7	5-HT:*m*-CPP hydrochloride	0.5	1	2

Table 2. Effect of agonist and antagonist treatments (means ± sem of raw data) on the isolation box score. Higher numbers indicate higher agitation.

Drug	Effect	Control	Low	Medium	High
GABA	Agonist	36 ± 8.2^{a}	32 ± 6.6^{a}	25.6 ± 6.5^{ab}	13.8 ± 5.4^{b}
(n=35)	Antagonist		46.4 ± 13.2^{a}	37.6 ± 17.1^{a}	30 ± 7^{a}
5-HT	Agonist	15 ± 3.1^{a}	34 ± 8.2^{bc}	37 ± 3.8^{b}	29 ± 10.6^{abc}
(n=35)	Antagonist		28.8 ± 10.6^{abc}	23.6 ± 6.7^{abc}	20 ± 4.6^{ac}

Values with the same superscript are not significantly different (P<0.05) within each drug treatment

Relative to the control, the GABA treatments influenced IBT score in an expected manner; the agonist decreased agitation dose dependently, while the antagonist increased agitation only at low and medium doses, thereby allowing quantification of agitation (Table 2). Both 5-HT treatments increased agitation relative to the control group (Table 2), however, the effect of the 5-HT agonist was contrary to expectations. The variable dose response, particularly for 5-HT, may be due to a lack of sensitivity to the IBT, notwithstanding the complexity of the neurotransmitter action. Analysis of additional physiological data will provide a more complete assessment of the effect of the treatments and, therefore, the role of these neurotransmitters, in the behavioural response to isolation.

BURROW, H.M. (1997). *Anim. Breed. Abstr.* **65**, 477-495.
HALLER, J. (2001). *Physiol. and Behav.* **73**, 337-342.
MURPHY, P.M., PURVIS, I.W., LINDSAY, D.R., LE NEINDRE, P., ORGEUR, P. and POINDRON, P. (1994). *Proc. Aust. Soc. Anim. Prod*. **20,** 247-250.
REVERTER, A., JOHNSTON, D.J., FERGUSON, D.M., PERRY, D., GODDARD, M.E., BURROW, H.M., ODDY, V.H., THOMPSON, J.M. and BINDON, B.M. (2003). *Aust. J. Agric. Res.* **54**, 149-158.

Email: Kelly.Drake@csiro.au