Furthermore, it made use of umbilical girth, which was difficult to measure in the donkeys.

The equation of Eley and French (1993) for adult donkeys also consistently overestimated the liveweights of the Moroccan donkeys. Hard working donkeys, particularly in areas where the feed supply is irregular, are more likely to be in poor than in good body condition. Unfortunately Eley and French (1993) did not provide information on the liveweight or body condition of the animals they sampled. However, if, as is probable, their equation was produced from donkeys in good body condition, doing little work, it would be expected to overestimate the liveweight of donkeys in generally poorer condition, such as those in the present study. It is also likely that there were differences in the age distributions of the adult populations sampled to produce the prediction equations in the UK and Morocco, although it is doubtful whether they would have greatly influenced the effectiveness of the equation.

Surveys of working donkeys in other Mediterranean countries (Egypt, Tunisia and Turkey) by the International Donkey Protection Trust (Bliss 1989, Svendsen 1991) have indicated that the average life span of a working donkey in these areas is rarely over 12 years. The age range of the sample of donkeys measured in the present study suggests that in Morocco too the life span of donkeys is short, in comparison with the average life span of British donkeys of 37 years reported by Bliss (1989) and of Zimbabwean donkeys of about 20 years (E. M. Nengomasha, personal communication).

Although the equations derived in the present study for adult and young donkeys performed well on the data, this is to be expected because the equations were derived from measurements pertaining to those particular donkeys. The ultimate validation, therefore, must rest on testing other samples of working donkeys in other parts of the world.

Acknowledgements. – The authors are grateful for the financial support given by the International Donkey Protection Trust, and the British Overseas Development Administration, and the technical assistance of the Society for the Protection of Animals Abroad in Morocco, which made this work possible. They thank M. Bakkoury, A. Belemlih and A. Prentis for their assistance in Morocco, A. E. Hunter for statistical advice and P. R. Lawrence for making the nomogram.

References

BLISS, D. H. (1989) The Professional Handbook of the Donkey. Ed. E. D. Svendsen. 2nd edn. Sidmouth, The Donkey Sanctuary. p 95

BRODY, S. (1945) Bioenergetics and Growth. Baltimore, Waverley. p 634

BURT, A. W. A. (1957) *Journal of Dairy Research* **24,** 144

CARROLL, C. L. & HUNTINGTON, P. J. (1988) *Equine Veterinary Journal* **20,** 41

DAVIS, H. P., SWETT, W. W. & HARVEY W. R. (1961) *Research Bulletin of Nebraska Agricultural Experimental Station* **194,** 1

ELEY, J. L. & FRENCH, J. M. (1993) *Veterinary Record* **132,** 250

JOHANSSON, I. & HILDEMAN, S. E. (1954) *Animal Breeding Abstracts* **22,** 1

JOHNSON, D. W. (1940) Minnesota Agricultural Experimental Station Extension Folder. Minnesota Agricultural Experimental Station. p 70

JONES, R. S., LAWRENCE, T. L. J., VEEVERS, A., CLEAVE, N. & HALL, J. (1989) *Veterinary Record* **125,** 549

MILNER, J. & HEWITT, D. (1969) *Canadian Veterinary Journal* **10,** 314

NEALE, S. C. (1990) MSc thesis, University of Bristol School of Veterinary Science

SMITH, C. A. B. (1966) Biomathematics; the principles of mathematics for students of biological and general science. 4th edn. Vol 1. London, Charles Griffin. p 163

SVENDSEN, E. D. (1991) Donkeys, Mules and Horses in Tropical Agricultural Development. Eds D. Fielding, R. A. Pearson. Edinburgh, Centre for Tropical Veterinary Medicine. p 181

WANDERSTOCK, J. J. & SALISBURY, G. W. (1946) *Journal of Animal Science* **5,** 264

Short Communications

Behavioural and cortisol response of pigs and sheep during transport

R. H. Bradshaw, S. J. G. Hall, D. M. Broom

Veterinary Record (1996) **138,** 233-234

PIGS and sheep are usually transported during the course of their life. Various behavioural and physiological effects of the transportation process have been reported in both pigs (Warriss and others 1991, Geers and others 1994) and sheep (Douglas-Hudson and Waran 1993, Knowles and others 1993, 1994). Journeys to slaughter are frequently of relatively short duration (a few hours or less) and road conditions vary. In the present study the behavioural and cortisol response of pigs and sheep were compared during short road journeys in order to establish whether welfare guidelines should be species specific and whether different domestic species are sensitive to specific types of journey (such as the degree of 'roughness').

Four 80 kg pigs and four 60 kg sheep were used, each social group comprising individuals which were familiar with each other. Each species was transported on alternate days in a car-towed twin-axle horse trailer (195 x 160 cm) on journeys characterised as 'rough' and 'smooth' (by means of an accelerometer). The rough condition involved journeys on minor roads in Cambridgeshire while the smooth condition consisted of journeys on the motorway. Each group travelled a distance of 761 km comprising 16 40 minute journeys (eight rough and eight smooth). The first journey type (rough or smooth) was alternated daily, with a total of two rough and two smooth journeys being conducted each day. A 20 minute rest period was allowed between each journey during which time the trailer remained stationary. Pigs and sheep were also loaded on a separate day, each for four hours, but the trailer remained stationary (control). In all cases fresh straw was provided at the beginning of each day on the trailer floor.

Behaviour was recorded by means of a remote controlled video camera mounted in the trailer and saliva samples were taken at the beginning and end of each journey for analysis of cortisol. The total number of minutes either lying, standing or walking was recorded for each animal and a mean was then calculated for the four animals. This mean was then expressed as a percentage of the total journey time. Mean frequency of social interaction, retching and vomiting were also calculated for each type of journey. Salivary cortisol was measured using an enzyme-linked immunosorbent assay (ELISA) (Cooper and others 1989). Sheep were fed ad libitum up to the point of loading and pigs were fed at the beginning of each day three hours prior to loading.

Analysis of accelerometer data revealed that there were four times more acceleration events during rough journeys (mean num-

R. H. Bradshaw, S. J. G. Hall, D. M. Broom, Animal Welfare and Human-Animal Interactions Group, Department of Clinical Veterinary Medicine, Madingley Road, Cambridge CB3 0ES

TABLE 1: Mean percentage total time spent standing, lying and walking for pigs and sheep for each type of journey

	Behaviour					
	Lying		Standing		Walking	
	Pigs	Sheep	Pigs	Sheep	Pigs	Sheep
RO	67·8	0	26·0	70·2	6·0	29·7
SM	79·6	9·4	15·2	78·4	4·4	11·8
C	80·0	50·0	13·3	47·2	6·7	2·8

RO Rough, SM Smooth, C Control

TABLE 2: Concentration of salivary cortisol (nmol/litre) for individual pigs and sheep expressed as an average for each type of journey

Identity of animal	RO	SM	C
Pig 1	13·7	9·1	2·1
Pig 2	21·4	8·1	2·4
Pig 3	14·4	9·1	2·0
Pig 4	9·0	7·8	3·4
Sheep 1	15·1	6·2	2·0
Sheep 2	2·3	2·0	1·2
Sheep 3	12·1	3·6	3·4
Sheep 4	15·0	10·2	1·5

RO Rough, SM Smooth, C Control

ber of events = 100) compared with smooth journeys (mean = 25) indicating a substantial difference in the degree of roughness of the journeys.

The pigs in transit spent most of their time lying down while the sheep spent most of their time standing (Table 1) despite sufficient space for the animals to lie down together (3·12 m^2). Sheep walked considerably more than pigs (and also walked more on rough compared with smooth journeys) even though both species had sufficient space to move around freely. Pigs stood more on rough compared with smooth journeys. The mean frequency of social interactions revealed pigs engaged infrequently in social interactions compared with sheep (these interactions being mainly aggressive head butts) on both rough (pigs, 2·0; sheep, 25·7) and smooth (pigs, 1·2; sheep 7·5) journeys. Social interactions in the control experiment were infrequent (pigs, 1·8; sheep 1·5). All pigs retched and vomited during both journey types: on average all pigs vomited on any one rough journey while three vomited on smooth journeys. In contrast sheep showed no evidence of travel sickness.

This study revealed that the behaviour of pigs and sheep during short road transport journeys differed markedly. Pigs became very travel sick which suggested their welfare was poor. Behaviours which indicated the onset of travel sickness included repetitive chewing, a slight 'foaming' at the mouth and continual bouts of sniffing the air (often associated with standing) followed by the pigs lying down. It was also noted that pigs re-ingested their vomit within five minutes of the end of a journey (indicating recovery time was rapid) and travel sickness may therefore be overlooked if animals are not unloaded immediately. Further research is needed to establish whether pigs become travel sick when not fed prior to transit since usual commercial practice favours starving pigs overnight. Pigs spent most of their journey time lying down which supports the findings of others (Lambooy 1988). The fact that pigs stood more on rough journeys may have been to alleviate the effects of travel sickness. In contrast, sheep did not become travel sick. They tended to stand in both conditions which may make them susceptible to sudden vehicle movement. Since they also walked more and engaged in social interactions (mainly aggressive head butts) on rougher journeys they may be particularly susceptible to bruising. There was little evidence of habituation to journeys, although sheep generally tended to lie down more during later journeys.

Cortisol levels were higher for both pigs and sheep on rough journeys compared with smooth journeys and were much higher in both conditions compared with control (Table 2). This indicated that both pigs and sheep were sensitive to the particular 'roughness' of the journey.

While both species are sensitive to the 'roughness' of journeys they show a marked difference in their behavioural response to transport. Pigs are prone to travel sickness and may require space and a substrate in order to lie down, while sheep spend most of their time standing and also walk and socially interact (which may lead to bruising). These differences indicate that greater emphasis should be placed on developing welfare guidelines which are species specific.

Acknowledgements. – The authors would like to thank Mr P. Maltby, P. Carter and G. Maltby for their invaluable support throughout the study and particularly with all aspects of pig husbandry. Funding was provided by the EC grants AIR CT92-0262 and AIR CT92-0528.

References

COOPER, T. R., TRUNKFIELD, H. R., ZANELLA, A. J. & BOOTH, W. D. (1989) *Journal of Endocrinology* **92,** 13

DOUGLAS-HUDSON, C. & WARAN, N. K. (1993) *Applied Animal Behaviour Science* **38,** 78

GEERS, R., BLEUS, E., VAN SCHIE, T., VILLE, H., GERARD, H., JANSSENS, S., NACKAERTS, G., DECUYPERE, E. & JOURQUIN, J. (1994) *Journal of Animal Science* **72,** 2552

KNOWLES, T. G., MAUNDER, D. H. L. & WARRISS, P. D. (1994) *Veterinary Record* **134,** 44

KNOWLES, T. G., WARRISS, P. D., BROWN, S. N., RHIND, S. M., EDWARDS, J. E., AMIL, M. H. & DOLAN, S. K. (1993) *Veterinary Record* **133,** 286

LAMBOOY, E. (1988) *Animal Production* **46,** 257

WARRISS, P. D., BEVIS, E. A., EDWARDS, J. E., BROWN, S. N. & KNOWLES, T. G. (1991) *Veterinary Record* **128,** 419

Cryosurgical dehorning of calves: a preliminary study

B. Bengtsson, A. Menzel, P. Holtenius, S.-O. Jacobsson

Veterinary Record (1996) **138,** 234-237

DEHORNING of young calves in Sweden is usually done by burning the hornbud with a hot iron. The method is reliable and simple but apparently very painful, leading to the 1992 animal rights law which stated that dehorning by cautery should be done under anaesthesia and sedation. As alternatives to cauteric dehorning cryosurgical techniques have been described (Baer and others 1990, Menzel 1990a).

In cryosurgery the tissue to be removed is frozen to below –20°C. The freezing causes formation of intracellular ice crystals leading to cell destruction and eventually, after some weeks, the dead tissue sloughs off. A rapid freeze and a slow thaw and several freeze/thaw sequences gives the most reliable result (Seim 1980, Torre and others 1988). Discomfort in cryosurgery is said to be slight and treatment of superficial skin lesions, such as warts, generally requires no anaesthesia in human beings (Torre and others 1988). In companion animals similar operations can also be performed without anaesthesia or sedation (Rickards 1980).

The aim of the present study was to investigate whether cryosurgical dehorning was a reliable method for disbudding

B. Bengtsson, P. Holtenius, S.-O. Jacobsson, Department of Cattle and Sheep Diseases, Swedish University of Agricultural Sciences, Box 7019 750 07 Uppsala, Sweden

A. Menzel, Veterinary, Ambulatory and Obstetrical Clinic, Justus-Liebig University, Giessen, Germany

Dr Menzel's present address is Hochwaldstrasse 21, 54427 Kell am See, Germany