THE EFFECT OF TRANSPORT ON PH EVOLUTION OF DIFFERENT MUSCLES IN SUCKLING LAMBS

J. De La Fuente[2], C. Pérez[3], C. Vieira*[1], M. Sánchez[1], E. González de Chávarri[2], M.D. García[1], I. Álvarez[4] and M.T. Díaz[1]

*[1]Estación Tecnológica de la Carne, ITACyL, 37770 Guijuelo, Salamanca. *Email: viealtce@itacy.es [2]Departamento de Producción Animal, Facultad de Veterinaria, UCM, 28040 Madrid. [3]Departamento de Fisiología (Fisiología Animal), Facultad de Veterinaria, UCM, 28040 Madrid. [4]Departamento de Tecnología de los Alimentos, INIA, 28040 Madrid.*

Keywords: transport time, stocking density, suckling lamb, pH

Introduction

Animal transport is an important and necessary phase in all systems of meat production. There are great number of factors involved in animal transport such as stocking density, duration of transport, mixing of animals etc., which can affect animal welfare and also carcass and meat quality. The impact of transport on animals can be minimized ensuring that transport is carried out in the best of possible conditions (Warriss, 1998). pH is one of the main parameters used to measured meat quality and it can be affected by stress due to transport (Devine *et al.*, 1993). In fact, parameters as important in meat quality as colour, texture, and sensory properties are strictly related to pH. There are very few studies related to lamb transport and mainly related to transport of suckling lambs. Therefore, the aim of this study was to evaluate the effect of transport time and stocking density on pH evolution in several muscles of suckling lambs transported to slaughterhouse.

Materials and Methods

Forty-eight male suckling lambs (mean live weight 13.08 ± 0.17) were used in a 2 x 2 factorial design (two transport time: 30 minutes and 5 hours x two stocking densities: 0.12m^2/lamb and 0.20m^2/lamb). Lambs remained with their dams until they were loaded up into an experimental lorry to be transported to the slaughterhouse. Lambs were randomly assigned to four groups of transport; two groups were transported for 30 minutes with the two densities and two groups for 5 hours with the two densities. All the journeys were done on two consecutives weeks in April and occurred early in the morning with an environmental temperature of 10-12ºC. After transport, the lambs were unloaded and held in lairage less than 1 hour. Animals were, after electrical stunning, slaughtered and the carcasses were chilled at 4ºC. pH were measured immediately after slaughter (initial), and at 45 min, 3 h and 24 h postmortem using a penetrating electrode adapted to a portable pH meter in the *Semitendinosus* (ST), *Longisimus* (LD) and *Psoas major* (PM) muscles. All analyses were performing using Statgraphics Plus. 5.0, the pH values and drops were analysed statistically by analysis of variance.

Results and Discussion

The table 1 shows pH values and drops of the muscles *Semitendinosus*, *Longisimus* and *Psoas major*. In all muscles studied, the pH values found were in a normal range for lamb, and only one case of DFD meat was detected, pH at 24 h of 6.13, in ST muscle of a lamb transported for 30 min at low density (0.20m^2/lamb). According to Brown *et al.*, (1990) the incidence of DFD is low for young ruminants.

The pH at 3h and pH at 24 h in ST muscle were significantly affected by transport time and stocking density respectively ($P<0.05$). The transport time did not affect significantly to pH values and pH drop in LD muscle, however stocking density affected significantly pH values initially ($P<0.05$) and at 24 hours ($P<0.01$). On the other hand, transport time and stocking density affected pH values and pH drop in PM muscle. The different response of the muscles to the transport could be due to the different fibre types of the studied muscles. Muscles involved in movements (walking, standing up) such as ST and LD have a high proportion of alpha-white fibres with high glycogen storage (Gregory, 1998). Therefore the transport time did not affect them. However, PM has a high proportion of beta-red fibres with low glycogen storage (Gregory, 1998). In this muscle, lambs transported 30 min had a high initial pH, maintaining this high pH at 24 h. According to Sanz *et al.*, (1996), short journeys can be more stressful than longer ones, since in short journey animals had less time to adapt to the new situation and may have arrived with lower glycogen reserves and therefore high pHs.

Ultimate pH (pH 24 h) of ST, LD and PM were affected by stocking density showing animals transported at low stocking density (0.20m^2/lamb) higher values than those transported at 0.12m^2/lamb. Low stocking density increases the capacity of lambs for movement, and factors such as lorry movements might have caused them to move to retain their balance, producing a reduction on muscle glycogen and consequently high ultimate pH. This result agrees with Ibañez *et al.*, (2002) who found that suckling lambs transported at low stocking density (4 lambs/m^2) had higher lactate dehydrogenase (LDH) activity than lambs transported at high stocking density (8 lambs/m^2) because of the greater amount of exercise of the former lambs.

Table 1: Mean and ± standard error of pH values and drops of *Semitendinosus*, *Longisimus* and *Psoas major* initially, at 45 min, 3 h and 24 h postmortem according to transport time (T) and stocking density (De).

	Transport time (T)		Stocking density (De)		Significance		
	30 min	5 hours	0.12m²/lamb	0.20m²/lamb	T	De	T*De
Semitendinosus							
pH value							
Initial	6.50 ± 0.04	6.40 ± 0.04	6.46 ± 0.04	6.44 ± 0.04	NS	NS	NS
45 min.	6.28 ± 0.03	6.24 ± 0.04	6.27 ± 0.04	6.25 ± 0.04	NS	NS	NS
3 h.	6.03 ± 0.03	6.12 ± 0.04	6.09 ± 0.04	6.06 ± 0.03	*	NS	NS
24 h.	5.60 ± 0.03	5.62 ± 0.04	5.56 ± 0.03	5.66 ± 0.04	NS	*	NS
pH drop							
0-45 min.	0.22 ± 0.04	0.16 ± 0.04	0.19 ± 0.04	0.19 ± 0.04	NS	NS	NS
45-3 h.	0.26 ± 0.04	0.12 ± 0.04	0.19 ± 0.04	0.19 ± 0.04	*	NS	NS
3-24 h.	0.42 ± 0.04	0.74 ± 0.05	0.52 ± 0.04	0.64 ± 0.05	NS	NS	NS
Longisimus							
pH value							
Initial	6.70 ± 0.04	6.61 ± 0.04	6.71 ± 0.04	6.60 ± 0.04	NS	*	NS
45 min.	6.56 ± 0.04	6.48 ± 0.03	6.52 ± 0.03	6.52 ± 0.04	NS	NS	NS
3 h.	6.27 ± 0.04	6.25 ± 0.04	6.28 ± 0.05	6.24 ± 0.04	NS	NS	NS
24 h.	5.56 ± 0.02	5.50 ± 0.05	5.46 ± 0.03	5.59 ± 0.04	NS	**	NS
pH drop							
0-45 min.	0.14 ± 0.04	0.13 ± 0.06	0.19 ± 0.05	0.08 ± 0.05	NS	NS	NS
45-3 h.	0.29 ± 0.05	0.23 ± 0.04	0.25 ± 0.05	0.28 ± 0.04	NS	NS	NS
3-24 h.	0.70 ± 0.04	0.99 ± 0.07	0.81 ± 0.06	0.88 ± 0.05	NS	NS	NS
Psoas major							
pH value							
Initial	6.25 ± 0.05	6.08 ± 0.03	6.20 ± 0.05	6.16 ± 0.04	**	NS	NS
45 min.	5.96 ± 0.04	6.03 ± 0.04	6.06 ± 0.04	5.93 ± 0.04	NS	*	NS
3 h.	5.92 ± 0.04	5.84 ± 0.05	5.85 ± 0.04	5.91 ± 0.06	NS	NS	NS
24 h.	5.63 ± 0.02	5.52 ± 0.05	5.52 ± 0.03	5.63 ± 0.03	*	*	NS
pH drop							
0-45 min.	0.30 ± 0.05	0.05 ± 0.04	0.14 ± 0.05	0.21 ± 0.06	**	NS	NS
45-3 h.	0.03 ± 0.05	0.19 ± 0.04	0.20 ± 0.04	0.02 ± 0.05	*	**	NS
3-24 h.	0.29 ± 0.04	0.55 ± 0.06	0.33 ± 0.05	0.51 ± 0.06	NS	NS	NS

*$P<0.05$; **$P<0.01$; NS: not significance

Conclusions

PM muscle was more affected by transport time and stocking density than the other studied muscles, showing lambs transported short time the highest pH, initially and at 24 h. However the three muscles studied were affected by stocking density, displaying highest ultimate pH lambs transported at low stocking density.

References

Brown, S.N., Bevis, E.A. and Warriss, P.D. (1990) An estimate of the incidence of dark cutting beef in the United Kingdom. Meat Science, 27, 249.

Devine, C.E., Graafhuis, A.E., Muir, P.D. and Chrystall, B.B. (1993) The effect of growth rate and ultimate pH on meat quality of lambs. Meat Science. 35, 63-77.

Gregory, N.G. (1998) Animal welfare and meat science. 1st Ed. CABI Publishing, Wallingford, pp 298.

Ibañez, M., De La Fuent, J., Thos, J. and Gonzales De Chavarri, E. (2002) Behavioural and physiological responses of suckling lambs to transport and lairage. Animal Welfare. 11, 223-230.

Sanz, M.C., Verde, M.T., Saez, T. and Sañudo, C. (1996) Effect of breed on muscle glycogen and dark cutting incidence in stressed young bulls. Meat Science. 43, 37-42.

Warriss, P.D. (1998) Choosing appropriate space allowance for slaughter pigs transported by road. A review. The Veterinary Record. 142, 449-454.