PE9.40 The Effect of Vehicle Vibration and Jolting during Transport on the Quality of Lamb Meat
367.00

Paula Monge (1) paulam@unizar.es, Erica Muela(1), Gerano Miranda de la Lama (1), Jose Luis Olleta (1), Carlos Sañudo (1), Gustavo María (1)
(1)University of Zaragoza

***Abstract*— Forty eight Rasa Aragonesa light lambs with an average carcass weight of 12.5 Kg (±1,64) were transported from the feed lot to the slaughterhouse on even roads (n=24) and rougher secondary roads (n=24). The journey lasted 2 hours, including two stops of about 5 minutes each. A triaxial accelerometer was connected to a multichannel data logger to measure the vehicle jolting. The lambs were slaughtered 30 minutes after being unloaded. The meat quality parameters analysed were: pH (24 hours after slaughter), water holding capacity, bruise score, texture (assessed both by shear-compression cell method and by using Warner Bratzler devices) and colour (after 24 hours' blooming). The meat was aged for three days. The lambs transported on rougher roads showed higher pH and bruising values and required higher compression (80%) and maximum stress. These lambs' meat also showed colour alterations, with higher tone and saturation values. The results lead to conclude that the type of road affects lambs' welfare -assessed by analysing meat quality components- but within a commercially accepted range. The type of road represents a critical point to be considered in the logistics chain of the lamb production system.**

P. Monge is with the Animal Production & Food Science Department. Veterinary Faculty of Zaragoza, 50013 Spain (phone: +34 976761000 ext. 4148; fax: +34 976761590; e-mail: paulam@unizar.es)
E. Muela is with the Animal Production & Food Science Department. Veterinary Faculty of Zaragoza, 50013 Spain (e-mail: 462065@unizar.es)
G. Miranda-de la Lama is with the Animal Production & Food Science Department. Veterinary Faculty of Zaragoza, 50013 Spain (e-mail: genaro@unizar.es)
J.L. Olleta is with the Animal Production & Food Science Department. Veterinary Faculty of Zaragoza, 50013 Spain (e-mail: olleta@unizar.es)
C. Sañudo is with the Animal Production & Food Science Department. Veterinary Faculty of Zaragoza, 50013 Spain (e-mail: csanudo@unizar.es)
G.A. María is with the Animal Production & Food Science Department. Veterinary Faculty of Zaragoza, 50013 Spain (e-mail: levrino@unizar.es)

***Index Terms*— lamb, welfare, transport, meat quality, type of road, logistics**

I. INTRODUCTION

THE modern logistics chain of lamb breeding includes cooperative centres of classification that concentrate member producers' lambs to complete the stages of fattening and commercialisation of the animals under a quality-certified brand name. Once the lambs reach the weight of their respective categories, they are transported to the slaughterhouse, usually on different types of roads. The aforementioned centres ensure a higher degree of homogeneity of the produce, simplify the management in the origin ranches, partly solving the problem of labour shortage in the sheep-breeding industry. Nevertheless, they entail a change in the logistics chain structure, including new sources of stress and the need for a better organisational standard. The above means that all the links of the chain must work properly, since they make up key aspects that can put at risk both animal welfare and the quality of the final produce. Transport is one of the most critical points in the chain because it is a source of multiple stressors and a process which is very visible to consumers. (Appleby et al., 2008). Deficient transport conditions can risk spoiling the breeders' work of months in few hours (Grandin 2000). Such factors as lambs' capacity to get used to a new medium, vehicle vibration and jolting, truck environment quality, animal density, kind of road and driver's skills must be taken into account if the underlying logistics chain is to be optimized (Gregory & Grandin, 2007). The purpose of this paper is to assess the impacts of the vehicle vibration and jolting caused by the kind of road on the parameters which make up the instrumental quality of the meat of Rasa Aragonesa Ternasco-type lambs.

II. MATERIALS AND METHODS

The test was conducted on 48 Rasa Aragonesa Ternasco-type male lambs of about 100 days old whose carcass weight averaged 12.5 kg (± 1.64), made up of 61% muscle, 13% fat and 21% bone. The journey from the classification centre (after 28 days' fattening) to slaughterhouse lasted 90 minutes. Two replications were performed with 12 randomly-selected animals. Two tests were carried out on pavement and dirt roads. A triaxial accelerometer connected to a multichannel data logger was used to record the vehicle jolting (Broom et al., 1996). The animals were slaughtered

about 30 minutes after unloading in an approved slaughterhouse. Meat characteristics such as texture, colour, final pH were assessed, and an analysis of the L. dorsi muscle was performed 24 hours after the slaughter, which included pH, water holding capacity, texture analysis by shear-compression cell method (raw meat) and through Warner Bratzler (WB) shear test (cooked meat). The colour was measured after 24 hours' blooming, determining the parameters L* (lightness), a* (redness) and b* (yellowness) of the L*a*b* system by using a CR-200b portable colorimeter. The tissue composition was determined through the carcass back dissection. The aging process lasted three days. The descriptive statistical data were estimated and the effect of the journey conditions was analysed through the least square method. A fixed-effect model was applied that included type of road (dirt and pavement) as the independent variable.

III. RESULTS AND DISCUSSION

The accelerometer revealed that the jolting that exceeded the limit set by Broom et al., 1996 ($P \leq 0.05$) was higher on dirt (19.1 ± 3.6) than on pavement road (1.4 ± 0.44). Table 1 shows the least square means of changes in meat quality. The last pH recorded was significantly higher in those lambs going through more vehicle vibration and jolting. Such lambs showed a higher bruise rate. As for the texture, it was only slightly affected by the type of road. When analysed through shear-compression cell method, the meat of the animals transported on poor-quality roads required maximum stress ($P \leq 0.01$) and higher compression (80%) than that of the animals transported on good roads. With regard to colour, it was also affected by the road quality, with levels of tone and saturation significantly higher ($p \leq 0.001$) in those lambs transported on dirt roads. The meat quality indicators instrumentally assessed revealed that the animal welfare is affected by the types of roads taken for the transport, which in turn affect the quality of the produce. As to pH, although its values changed, it always ranged within the limits accepted by the market under the current trade conditions, which do not take into account animal welfare as a component of meat quality.

IV. CONCLUSION

The results lead to conclude that the type of road affects lambs' welfare -assessed by analysing meat quality components- but within a commercially accepted range. The type of road represents a critical point to be considered in the logistics chain of the lamb production system.

ACKNOWLEDGEMENTS

This study was funded by CICYT AGL 2005-00208 Project. The authors thank Mercazaragoza and Oviaragón for their collaboration in this study, as well as the rest of the members of the Produce Quality Research Team for their help in sampling and sample analyses.

REFERENCES

[1] M.C. Appleby, V. Cussen, L. Garcés, L.A. Lambert, and J. Turner. *"Long distance transport & welfare of farm animals"* U.K. Ed. CABI Publishing, 2008

[2] D.M. Broom, J.A. Goode, S.J.G. Hall, D.M. Lloyd, and R.F. Parrott. "Hormonal and physiological effects of a 15 hour journey in sheep: comparison with the responses to loading, handling and penning in the absence of transport," *Br. Vet. J.*, vol. 152, pp. 593-604, 1996

[3] T. Grandin, *"Livestock handling & transport"* Ed. CABI Publishing. UK, 2007.

[4] N.G. Gregory, *"Animal Welfare & Meat Production"* Ed. CABI Publishing. UK, 2007.

Table 1. Least square means ± standard error and significance levels for the impact of the type of road on lamb meat instrumental quality parameters

Parameter	Pavement road	Dirt road	p
pH (24 hours after slaughter)	5.63 ± 0.01	5.78 ± 0.01	***
WHC	18.39 ± 0.44	18,22 ± 0.44	ns
Bruises	0,13 ± 0.14	0,41 ± 0.14	*
Texture: shear-compression cell test (N/cm^2)			
C20	7.98 ± 0.49	7.87 ± 0.49	ns
C40	19.46 ± 1.18	17.45 ± 1.18	ns
C60	28.18 ± 1,38	28.21 ± 1.38	ns
C80	34.26 ± 1.83	42.40 ± 1.83	**
Maximum stress	43.66 ± 2.14	55.92 ± 2.14	**
Texture: Warner Bratzler (WB) shear test (Kg/cm^2)			
Maximum load	5.48 ± 0.30	4.84 ± 0.29	ns
Hardness	1.90 ± 0.11	1.53 ± 0.11	*
Colour (CIE L* a* b* scale)			
Lightness (L*)	38.62 ± 0.33	37.51 ± 0,33	*
Redness (a*)	10.95 ± 0.23	11.03 ± 0.23	ns
Yellowness (b*)	6.31 ± 0.20	10.81 ± 0.20	***
Saturation	12.66 ± 0.28	15.45 ± 0.28	***
Tone	30.03 ± 0.57	41.41 ± 0.57	***

ns: no significant; *: $p \leq 0.05$; **: $p \leq 0.01$; *** $p \leq 0,001$. C20: compression at 20%; C40: compression at 40%; C60: compression at 60%; C80: compression at 80% of total.