

## **HALAL SLAUGHTER AND ELECTRICAL STUNNING IN RABBITS: EFFECT ON WELFARE AND MUSCLE CHARACTERISTICS**

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### **ABSTRACT**

A total of 50 recently weaned Hyla rabbits (5 weeks old) were slaughtered in a commercial abattoir located 65 km away from the farm they were raised in. Their slaughter weight was determined after 20-30 min of lairage and, afterwards, the rabbits underwent slaughter following the standard procedure (electrical stunning and exsanguination after cutting the vessels of the left side of the throat; 30 rabbits, S group) or the halal muslim procedure (ritual cut of the throat performed by an appropriate person without pre-slaughtering stunning; 20 animals, H group). Some basic animal welfare features around slaughter were evaluated. Rabbits from H group had neither vocalization, spasms or movements during the hanging phase nor after slaughtering. Their bodies remained totally relaxed and floppy on the chain from the beginning. The rabbits from the S group also had not vocalizations or movements before slaughtering and one rabbit of this group arched and flexed its back for a moment after slaughtering. No cases of haemorrhages or broken bones were observed in either group. There were significant differences between groups with regards to the blood losses (calculated by the difference between the animal's weight and the hot carcass weight plus offal), which were higher in the H than in the S group (44.86 g and 37.10 g respectively,  $P < 0.01$ ). The external colour of carcasses, subjectively evaluated, was paler in the H than in the S group. Similar differences in colour were initially found at 0 minutes after transversal cuts of the *Longissimus dorsi* muscle: more luminous (L\*) and yellow (b\*) as well as higher h\* values in the H group, although the effect was no longer significant after 15 minutes of blooming. The lowest pH<sub>24</sub> values were found in the H group on both the *Longissimus dorsi* (5.67 vs. 5.78,  $P < 0.05$ ) and the *Biceps femoris* (5.69 vs. 5.82,  $P < 0.01$ ) muscles. There were no differences in water holding capacity determined on the *Biceps femoris* muscle. We conclude that under both slaughtering procedures, the parameters studied had normal values for rabbit meat and correct for meat in general.

**Key words:** Halal, Electrical stunning, Welfare, Bleeding, Meat.

### **INTRODUCTION**

In many countries regulations on animal protection during slaughtering have a specific consideration towards the ritual slaughter, particularly in the case of Jews or Muslims. Both religious codes recommend the slaughter by exsanguination after cutting off the carotids, jugular vessels, oesophagus and trachea in the throat, without any specific reference to pre-slaughter stunning. In relation with Muslims (halal slaughter) we know that some authorities accept stunning while others are inclined not to allow this practice except in those cases with reversible character.

In the course of a research on rabbit meat quality, the commercial stunner used in the slaughterhouse was damaged and a group of recently weaned rabbits could not be stunned. For hygienic reasons the rabbits could not come back to the farm and for welfare reasons they could not remain in the commercial plant until the next day. This rabbit group was finally halal slaughtered by a Muslim expert. The aim of this work was to compare basic observations on welfare, bleeding and meat quality characteristics between rabbits slaughtered either after electrical stunning or through the halal procedure.

## MATERIALS AND METHODS

A group of 20 rabbits (H, halal group) and another of 30 rabbits (S, stunned group), half males and half females in each group, were studied. All rabbits were Hyla line and born in an industrial farm. In order to reduce stress, rabbits were weaned at 5 weeks of age by mother separation. Thereafter, the young rabbits remained in their family group in their own cage, though some rabbits had to be mixed with others to equalize group size (7-8 rabbits/cage). The day after weaning the experimental rabbits were selected at random, individually weighed and put in special transport containers (floor partially perforated, plastic sidewalls without holes and wire top). They were transported to a commercial abattoir (65 km distance, approximately 1 h). Slaughter was carried out about 20-30 min after arrival.

Each rabbit was weighed just before slaughtering (SBW) and then handed in to the first operator who, without changing the rabbit's body position, had to perform one of the following procedures:

1. Electrical stunning by contacting the frontal region of the head with a serrated plaque (170 V) for 2 sec. Immediately the rabbit was hung on the chain and slaughtered by cutting the vessels of the left side of the throat (S group).
2. Suspension of each animal by one hind-limb in the chain and, without losing contact with it, rapidly slit the vessels, oesophagus and trachea from the centre to both sides of the throat (H group) in a single cut lasting approximately less than two seconds.

After slaughtering ten rabbits, two additional operators removed the skin, digestive tract and distal portion of the extremities (offal) which were weighed. Some basic animal welfare features around slaughter were determined by controlling the presence of vocalizations (yes or not), spasms (general or partial: head, neck, back, legs) and movements (yes or not) on the rabbit hung bodies. No other signs of welfare/insensibility were determined (e.g. eye or nose reflex) in order not to disturb the natural course of the procedure, specially the halal. The presence of haemorrhages (yes or not), broken bones (yes or not) and external colour (pale or pink) were evaluated on the carcasses. Then, the hot carcasses, including the head and viscera, were weighed. Bleeding was calculated as the difference between body slaughter weight minus hot carcass and offal weights (in grams or as a percentage of body weight). Carcasses were finally transferred to the laboratory of the Animal Production Unit of the Veterinary Faculty of the University of Zaragoza. They were then refrigerated at 4°C for 24 h.

Meat pH determination was carried out 24 hours after slaughtering in both the left *Biceps femoris* and the *Longissimus dorsi*, as is standard for this species (Blasco *et al.*, 1992). A portable Crisson, model 507 pH meter, with a penetration electrode, was used.

Water holding capacity (WHC) was analyzed by pressing 2250 g for 5 min on 5 g of fresh *Biceps femoris* minced meat and placed between two filters of tared paper (Albet 400, 15 cm Ø) (Grau and Hamm, 1953). The water holding capacity was expressed in percentage and was calculated as the difference between the initial and final weights of the sample over the initial weight. All observations were done in duplicate.

A Minolta series CR-200A colorimeter was used for measuring colour in the CIE L\*a\*b\* space, under a fresh surface of a slice of the *Longissimus dorsi* from each animal at 48 h post-mortem and measured at 0 and after 15 minutes of blooming. Lightness, L\*, and the chromatic coordinates, a\* and b\* (CIE, 1986) were measured. Chroma (C\*, saturation) and hue (h\*) values were calculated.

## RESULTS AND DISCUSSION

Rabbits from the H group had neither vocalization, spasms or movements during the hanging phase nor after slaughtering. Their bodies remained totally relaxed and floppy on the chain from the beginning. The rabbits from S group had not vocalization or movements before slaughtering, maybe because it was performed quickly after the stunning, even before the beginning of the tonic phase that is characteristic of this species when electrical stunning is applied (Anil *et al.*, 1996). After

slaughtering, one rabbit of group S arched and flexed its back for a moment. No cases of haemorrhages or broken bones were observed in either group.

**Table 1:** Signs of rabbit welfare observed on animals and carcasses

	Halal group	Stunned group
Vocalization	No	No
Spasm	General	No
	partial: head, neck, back, legs	Yes ( $n = 1$ )
Agitation or panting	No	No
Haemorrhages	No	No
Broken bones	No	No
External colour	Pale	Pink

Both groups had a very similar pre and post-slaughter response pattern and the absence of stunning in the H group seems not to have negative consequences on rabbit welfare. Even more, the H rabbits had no reaction to the throat cut and stillness was the subjective perception given for this group after slaughtering. Grandin (1994) observed that immediate collapse can be induced in over 95% of cattle if the ritual slaughter consists of a quick and deep cut. Likewise, this author observed that calm cattle lose sensibility and collapse more quickly than those with signs of agitation. More recently, Grandin and Smith (2004) literally indicated that “The most important factor determining whether a packing plant has good or bad animal welfare practices is the attitude of management personnel. As upper-management personnel change, handling and stunning improve or decline, depending largely upon the attitude of the new person”. In the same way, the quick slaughter and the careful management could explain the results of the present paper.

On the other hand, the body size of the animal can affect the performance of the slaughtering, at least after electrical stunning, since sensitivity depends on body weight in pork (Anil and Mckinstry, 1992) and in chicken (Wilkins *et al.*, 1998). It should be noted that in the present case, the animals weigh around 1 kg and the stunning machine is made for animals weighing around 2 kg. Particular species characteristics could also be an important factor because it has been shown that sheep lose consciousness more quickly than cattle after carotid arteries and jugular veins are cut bilaterally (Blackman *et al.*, 1986), maybe due to differences in the anatomy of their blood vessels (Grandin and Regestein, 1994). Indeed, the number of cut vessels is important since unilateral section maintains the blood flow to the brain for a longer period after slaughtering both in sheep and in chicken (Gregory and Wotton, 1984, 1986).

In relation to carcass and meat quality there were significant differences between groups regarding blood loss, which was higher in the H than in the S group (Table 2). Most slaughterhouse operators of Spanish rabbits believe that electrical stunning produces a poor bleeding. They also feel that halal slaughtered animals bleed better than the ones which are submitted to electrical stunning (personal communication). In the present study the differences were only a tendency when expressed as a percentage of slaughter body weight ( $P = 0.075$ ). However, the external colour of carcasses was paler in the H than in the S group, a subjective but perceptible difference. Likewise similar differences in colour were initially found at 0 minutes after cutting the *Longissimus dorsi* muscle: more luminous and yellow as well as higher  $h^*$  values in the H group, although the effect was no longer significant after 15 minutes of blooming (Table 3).

**Table 2:** Body, carcass and offal weights and blood losses

	Halal group		Stunned group		Probability.
Slaughter body weight (g)	964.00	± 72.72	913.67	± 97.18	n.s.
Hot carcass weight (g)	530.52	± 42.49	486.01	± 54.56	**
Offal (g)	389.04	± 33.51	393.54	± 42.58	n.s.
Bleeding (g)	44.86	± 9.17	37.10	± 9.94	**
Bleeding (% SLW)	4.64	± 0.90	4.06	± 1.14	n.s.

n.s. = non significant; \*\* $P \leq 0.01$

The lowest pH<sub>24</sub> values were found in the H group on both the *Longissimus dorsi* and the *Biceps femoris* muscles, which can be related with lower lactic acid content. This suggests a higher use of glycogen by the rabbits in this group or, maybe, a different pattern of glycogen kinetics as an effect of the slaughtering procedure.

Works analysing the pre-slaughter stunning method on rabbit meat quality mostly compare mechanical and electrical stunning and some effect is seen during the period following slaughter, but the differences do not remain after 24 h post-mortem (Civera *et al.*, 1989; Dal Bosco *et al.*, 1997, Hulot and Ouhayoun, 1999). However, as in the present work, it has been shown that pH<sub>24</sub> of muscles from rabbits submitted to mechanical stunning is lower than in those having received electrical stunning (Lafuente and López, 2000). These results suggest differences in meat conservation, favoring the one with a more acid pH.

We conclude that following either slaughtering procedure, the parameters here studied had normal values for rabbit meat being attractive and correct for meat in general.

**Table 3:** Rabbits muscles characteristics

		Halal	Electrical stunning	Probability
pH	pH <i>L. dorsi</i>	5.67 ± 0.17	5.78 ± 0.17	*
	pH <i>B. femoris</i>	5.69 ± 0.15	5.82 ± 0.16	**
Colour	L*0	61.82 ± 3.20	59.45 ± 3.05	*
	a*0	6.05 ± 1.43	6.12 ± 1.88	n.s.
	b*0	6.54 ± 1.96	4.84 ± 1.53	***
	h*0	46.73 ± 6.19	38.85 ± 10.39	**
	C*0	8.96 ± 2.22	7.94 ± 1.95	n.s.
	L*15	60.74 ± 2.50	59.28 ± 3.44	n.s.
	a*15	5.54 ± 1.02	6.08 ± 1.83	n.s.
	b*15	6.02 ± 1.50	5.39 ± 1.27	n.s.
	h*15	46.92 ± 6.79	42.29 ± 9.70	n.s.
	C*15	8.23 ± 1.55	8.24 ± 1.76	n.s.
WHC	%	12.82 ± 1.94	13.69 ± 2.86	n.s.

n.s.= non significant; \*= P≤0.05; \*\*P≤0.01; \*\*\*\*= P≤0.001

WHC : water holding capacity

The performance of the halal slaughter under adequate conditions does not negatively affect animal welfare or instrumental meat quality characteristics when compared with electrical stunning. The main differences appeared in the colour of the meat, where halal slaughtered animals show paler meat before blooming, although exposure to oxygen reduces all differences between the two studied methods. Additionally, pH<sub>24</sub>, which was more acid in halal rabbits, indicates not altered meat.

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## REFERENCES

- Anil M.H., Mckinstry J.L. 1992. The effectiveness of high frequency electrical stunning in pigs. *Meat Science*, 31, 481-491.
- Anil M.H., Mohan Raj A.B., Mckinstry J.L. 1996. Evaluation of electrical stunning in commercial rabbits. *In: Proc. 6<sup>th</sup> World Rabbit Congress, 1996 July, Toulouse, France, Vol. 2, 407-410.*
- Blackman N.L., Cheetham K., Blackmore D.K. 1986. Differences in blood supply to the cerebral cortex between sheep and calves during slaughter. *Research in Veterinary Science*, 40, 252-254.
- Blasco A., Ouhayoun J., Masoero G. 1992. Study of rabbit meat and carcass: Criteria and terminology. *In: Rabbit Production and Genetics in the Mediterranean Area. R. Rouvier, M. Baselga Eds. Options Méditerranéennes, A-17, 105-120.*
- CIE 1986. *Colorimetry*. CIE Publication 15 (2). Vienna: Commission Internationale de L'Eclairage.
- Civera T., Julini M., Quaglino G., Ferrero E. 1989. Influenza delle tecniche di stordimento sulla qualità della carne cunicola. *Industrie Alimentari*, XXVIII, 492-500.

- Dal Bosco A., Castellini C., Bernardini M. 1997. Effect of transportation and stunning method on some characteristics of rabbit carcasses and meat. *World Rabbit Science*, 5(3), 115-120.
- Grandin T. 1994. Euthanasia and slaughter of livestock. *Journal of American Veterinary Medical Association*, 204, 1354-1360.
- Grandin T., Regestein J.M. 1994. Religious slaughter and animal welfare: A discussion for meat scientists. *Meat Focus International*, 3, 115-123.
- Grandin T., Smith G.C. 2004. Animal welfare and humane slaughter. Available at <http://www.grandin.com/references/humane.slaughter.html> in September 2007.
- Grau R., Hamm R. 1953. A simple method for the determination of water binding in muscles. *Naturwissenschaften*, 40 (1), 29-30.
- Gregory N.G., Wotton S.B. 1984. Sheep slaughtering procedures. II. Time to loss of brain responsiveness after exsanguination or cardiac arrest. *British Veterinary Journal*, 140, 350-360.
- Gregory N.G., Wotton S.B. 1986. Effect of slaughter on the spontaneous and evoked activity of the brain. *British Poultry Science*, 27, 195-205.
- Hulot F., Ouhayoun J. 1999. Muscular pH and related traits in rabbits: A review. *World Rabbit Science*, 7(1), 15-36.
- Lafuente R., López M. 2000. Effects of stunning method on some instrumental and sensory qualities of rabbit meat. In: *Proc. 7<sup>th</sup> World Rabbit Congress, 2000 July, Valencia, Spain, Vol. B*, 545-551.
- Wilkins L.J., Gregory N.G., Wotton S.B., Parkman I.D. 1998. Effectiveness of electrical stunning applied using a variety of waveform - frequency combinations and consequences for carcass quality in broiler chickens. *British Poultry Science*, 39, 511-518.

