INFLUENCE OF PRESLAUGHTER FASTING ON LIVE WEIGHT LOSS, CARCASS YIELD AND MEAT QUALITY IN RABBITS

Bianchi M.*, Petracci M., Venturi L., Cremonini M.A., Cavani C.

Department of Food Science, *Alma Mater Studiorum* – University of Bologna, Piazza Goidanich 60, 47023 Cesena, Italy
*Corresponding author: maurizio.bianchi@unibo.it

ABSTRACT

The study was carried out on forty-eight growing rabbits (77 days-old; 2.5 kg live weight), reared and slaughtered under commercial conditions. At the farm, the rabbits were divided into three groups (n=16 per group) and feed was removed at 0, 6 or 12 h before crating. Subsequently the rabbits were transported for 1.5 h and laired at abattoir for 1.5 h prior to slaughter so that the following three groups were obtained: short fasting (SF; total fasting: 3 h), medium fasting (MF; total fasting: 9h); long fasting (LF; total fasting: 15 h).

Rabbits fasted for short time had higher live weight both at crating and at slaughter ($P<0.05$) in respect with MF and LF. This result was determined by the lower live weight loss observed between feed removal and crating (0.00 vs. 2.38 and 2.82%; $P<0.01$) which produced a lower total live weight loss (from feed removal to slaughter) (2.25 vs. 4.55 and 5.15%; $P<0.01$). The incidence of full gastrointestinal tract exhibited a decrease ($P<0.01$) going from SF (21.2%) to MF (19.8%) and LF (18.6%), determining a lower ($P<0.05$) carcass yield in SF compared to MF and LF. Moreover, in comparison with MF and SF, the long fasting produced a lower percentage (4.45 vs. 4.83 and 4.95%; $P<0.01$) and a higher pH (6.00 vs. 5.94 and 5.96; $P<0.01$) of the liver, indicating a higher depletion of energetic substrates.

Concerning the meat quality traits, the duration of fasting did not significantly modify the rate of muscle acidification and depletion of energy stores as evidenced by both pH and R-value at 45 min *post mortem*. However, the rabbits fasted for short time exhibited a lower pH at 24 h *post mortem* (5.58 vs. 5.69 and 5.70; $P<0.01$), a lighter colour (L*, 55.0 vs. 52.2 and 52.9; $P<0.01$) and a superior cooking loss (29.6 vs. 28.1 and 27.5%; $P<0.01$) in respect to those submitted to medium and long fasting. The LF-NMR analysis of the T_2 distribution revealed that the differences in relative amounts of water populations were not significant.

Overall, the results obtained in this study confirm that preslaughter fasting allows to pursue the empty of the gut with the aim to reduce carcass faecal contamination during slaughtering. Moreover, it was established that a long preslaughter fasting can lead to an increase in muscle ultimate pH, higher water holding capacity and darker colour of the meat. However, the differences observed in meat quality traits are not so large to determine a deterioration of product quality so that it can be concluded that the application of a correct fasting protocol by the rabbit production chain can allow to pursue the emptying of the gut, improve carcass yield and maintain satisfactory meat quality.

Key words: Rabbits, Fasting, Live weight loss, Carcass yield, Meat quality.

INTRODUCTION

The events which occur before slaughtering are critical for several aspects of rabbit production chain and mainly influence animal welfare, slaughtering yield and meat quality. Removal of feed (with water available) before catching and live transport is a standard management practice that has been used by the poultry industry since years (Northcutt, 2001). The importance of fasting before slaughter has been stressed also in rabbit, in order to allow the emptying of the gastrointestinal tract and reduce carcass faecal contamination during evisceration (Jolley, 1990; Cavani and Petracci, 2004). However, rabbit fasting it is not even properly applied under commercial conditions since a standardized feed withdrawal protocol is lacking and each farmer tends to follow a different practice based on his own

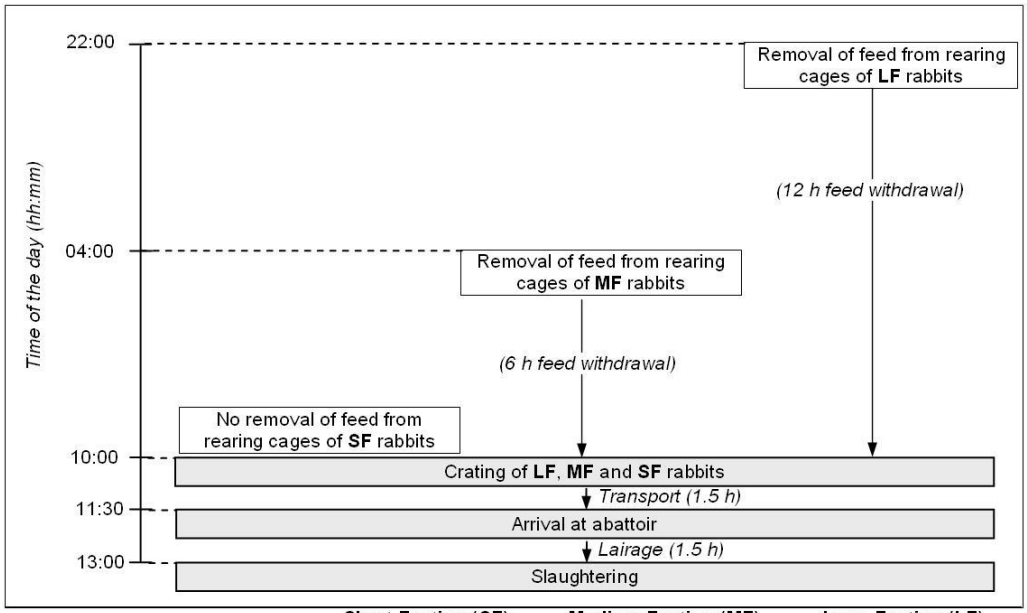
experience. For the correct evaluation of feed withdrawal it has to be considered the total length of time the animals are without feed before slaughtering, including the time they are without feed in the farm (water available), as well as the time they are in transit and in the live hold area at the abattoir (water not available) (Northcutt, 2001; Cavani and Petracci, 2004). Recommended length of fasting for rabbits before slaughtering is between 8 to 12 hours (Cavani and Petracci, 2004). Previous studies established that in the first 6 hours of fasting, the rabbit live weight loss is mainly due to emptying of the gut, while after 6 hours there is also loss in moisture and nutrients from body tissues, which can affect carcass yield (Masoero *et al.*, 1992; Szendro and Kustos, 1992; Trocino *et al.*, 2003). As regard to meat quality, it has been observed that preslaughter fasting increases the depletion of glycogen determining an increase in muscle ultimate pH leading to a higher water holding capacity and darker colour (Jolley, 1990; Luzi *et al.*, 1992; Xiccato *et al.*, 1994; Dal Bosco *et al.*, 1997; Lambertini *et al.*, 2006). However, in many of the previous studies, differences of fasting times among the experimental groups were determined by differences in the duration of transport between farm to abattoir and there is a lack of researches aimed at establishing the effect of fasting at the farm (with similar duration of live transport) on rabbit meat quality.

The aim of this study is to establish the effect of different preslaughter fasting times, by adopting the same time of transport and lairage, on rabbit live weight loss, carcass yield and meat quality.

MATERIALS AND METHODS

Data collection

The study was carried out on forty-eight growing rabbits of both sexes (2.5 kg live weight), reared and slaughtered under commercial conditions. The animals were weaned at 32 days of age, housed in pairs in wire net cages (flat-deck) and fed *ad libitum* during the whole fattening period (32-77 days of age) using a standard pelletted diet (per kg: 165 g crude protein, 155 g crude fibre and 9.83 MJ digestible energy). At the farm the rabbits were divided into three groups (n=16/group) and feed was removed at 0, 6 or 12 h before crating (Figure 1). Subsequently the animals were transported for 1.5 h and laired at abattoir for 1.5 h before slaughtering thus determining further 3 hours of feed and water outage on all groups. The trial was conducted on April 2006, with a mean outdoor temperature and relative humidity of 13.3°C and 72.8%, respectively. This experimental design allowed to obtain the following 3 experimental groups: short fasting (SF; total fasting: 3 h), medium fasting (MF; total fasting: 9h); long fasting (LF; total fasting: 15 h) (Figure 1). In order to evaluate the live weight losses during the fasting period, the animals were individually weighed before the beginning of fasting at the farm (weight "before fasting"), just before crating (weight "at crating") as well as just before stunning and hanging at the slaughtering line (weight "at slaughter"). The animals were subsequently slaughtered under commercial conditions and the weight of full gastrointestinal tract, chilled carcass and liver were determined according to Blasco and Ouhayoun (1996). Furthermore, 12 carcasses per group were randomly collected and the following measurements were taken on *L. lumborum* muscle: pH (iodoacetate method; Jeacocke, 1977) at 45 min and 24 h *post mortem*; R-value at 45 min and 24 h *post mortem* (Honikel and Fischer, 1977); colour (CIELAB; Minolta CR-400 colorimeter), measured on epymisial surface of the muscle; cooking loss (Combes *et al.*, 2003); and Allo-Kramer shear force after cooking (Bianchi *et al.*, 2007). Furthermore, the liver colour and pH at 24 h *post mortem* were determined. Finally, the water distribution of meat was determined by LF-NMR analysis of the transverse relaxation decay at the operating frequency of 20 MHz using the CPMG (Meiboom and Gill, 1958) pulse sequence with a Bruker Minispec PC/20 spectrometer. The relaxograms have been interpreted in terms of the two main protein pools as follows: (i) myofibrillar water (T_{21}) or water entrapped in the contractile protein reticulum; (ii) extra-myofibrillar water (T_{22}) or water located outside the protein network characterized by lower interactions with proteins and more susceptible to be lost as drip (Brown *et al.*, 2000).



	Short Fasting (SF)	Medium Fasting (MF)	Long Fasting (LF)
Feed withdrawal at the farm (h)	0.0	6.0	12.0
Transport (h)	1.5	1.5	1.5
Lairage (h)	1.5	1.5	1.5
Total fasting (h)	*3.0*	*9.0*	*15.0*

Figure 1: Experimental design and timetable of the trial

Statistical analysis

One-way ANOVA was performed to test the effect of fasting time (SF, MF and LF) on live weight losses, carcass and meat quality traits. Multiple comparison of means was performed by multiple range Duncan's test (SAS Institute, 1988).

RESULTS AND DISCUSSION

The influence of fasting on live weight, live weight losses during preslaughter time and carcass traits is reported in Table 1. The rabbits fasted for short time (SF) exhibited higher live weight both at the moment of crating and at slaughter in respect with MF and LF.

Table 1: The influence of fasting on live weight, live weight losses and carcass traits (n = 16/group)

	Short Fasting (SF; 3 h)	Medium Fasting (MF; 9 h)	Long Fasting (LF; 15 h)	Pooled sem	P
Live weight					
- before fasting (g)	2,535	2,515	2,510	15	ns
- at crating (g)	2,535 b	2,454 a	2,439 a	16	*
- at slaughter (g)	2,478 b	2,403 a	2,385 a	16	*
Live weight losses					
- between feed removal and crating (%)	0.00 a	2.38 b	2.82 c	0.20	**
- during transport and lairage (%)	2.25	2.11	2.24	0.12	ns
- total (%)	2.25 a	4.55 b	5.15 b	0.25	**
Full gastrointestinal tract percentage (% of live weight at slaughter)	21.2 c	19.8 b	18.6 a	0.28	**
Carcass yield					
- % of live weight at crating	55.1 a	56.2 b	56.7 b	0.33	*
- % of live weight at slaughter	56.4 a	57.4 b	58.0 b	0.25	*
Liver percentage (% of chilled carcass weight)	4.95 b	4.83 b	4.45 a	0.06	**

ns = not significant; * = P<0.05; ** = P<0.01. Means with different letters on the same row differ significantly (P<0.05)

This result was determined by the lower live weight loss observed between feed removal and crating (0.00 vs. 2.38 and 2.82%; P<0.01) which determined a lower total (from feed removal to slaughter) live weight loss (2.25 vs. 4.55 and 5.15%; P<0.01). However, no differences were found in weight

losses due to transport and lairage, indicating that the most important factor influencing the preslaughter live weight loss is the gut clearance which occurs during feed deprivation at the farm. This result is consistent with the incidence of full gastrointestinal tract which decreased (P<0.01) going from SF (21.2%) to MF (19.8%) and LF (18.6%), determining a lower carcass yield in SF compared to MF and LF both when calculating the yield based on live weight measured just before crating (weight "at crating") as well as just before stunning and hanging at the slaughtering line (weight "at slaughter") (Table 1). Furthermore, long fasting determined a lower liver percentage in respect with SF and MF (4.45 vs. 4.83 and 4.95%; P<0.01) and this could be due to a higher depletion of energetic substrates (i.e. glycogen) determined by fasting as pointed out by Jolley (1990).

The effect of fasting on meat quality traits is reported in Table 2. The fasting did not significantly modify the rate of muscle acidification and depletion of energy stores as evidenced by both pH and R-value (the ratio of low energy inosine to high energy adenosine compounds) at 45 min *post mortem*. However, the rabbits fasted for short time exhibited a lower pH at 24 h *post mortem* (5.58 vs. 5.69 and 5.70; P<0.01), a lighter colour (L*, 55.0 vs. 52.2 and 52.9; P<0.01) as well as higher cooking loss (29.6 vs. 28.1 and 27.5%; P<0.01) in respect to those submitted to medium and long fasting.

Table 2: The influence of fasting on meat quality traits (n = 12/group)

	Short Fasting (SF; 3 h)	Medium Fasting (MF; 9 h)	Long Fasting (LF; 15 h)	Pooled sem	P
L. lumborum					
pH at 45 min	6.36	6.37	6.37	0.04	ns
pH at 24 h	5.58 a	5.69 b	5.70 b	0.02	**
R-value at 45 min	0.87	0.86	0.87	0.00	ns
R-value at 24 h	1.36	1.37	1.37	0.00	ns
Lighness (L*)	55.0 b	52.2 a	52.9 a	0.40	**
Redness (a*)	1.15	1.32	1.24	0.12	ns
Yellowness (b*)	1.81	1.48	1.98	0.14	ns
Cooking loss (%)	29.6 b	28.1 a	27.5 a	0.26	**
AK-shear force (kg/g)	4.02	4.01	3.71	0.19	ns
LF-NMR					
T_{21} water pool (%)	94.5	95.1	96.0	0.09	ns
T_{22} water pool (%)	5.5	4.9	4.0	0.09	ns
Liver					
pH at 24 h	5.96 a	5.94 a	6.00 b	0.01	**
Lighness (L*)	33.3 a	37.2 b	37.0 b	0.50	**
Redness (a*)	18.5	18.4	18.3	0.22	ns
Yellowness (b*)	9.43 a	11.5 b	11.7 b	0.29	**

ns = not significant; ** = P< 0.01; Means with different letters on the same row differ significantly (P<0.05)

Overall these results are consistent with previous studies which considered the effect of fasting conducted at the farm and/or fasting determined by live transport from farm to abattoir (Jolley, 1990; Xiccato *et al.*, 1994; Dal Bosco *et al.*, 1997; Lambertini *et al.*, 2006), confirming that longer preslaughter fasting produces an increase in muscle ultimate pH, thus leading to higher water holding capacity and darker colour of the meat. No difference were found in redness (a*), yellowness (b*) and AK-shear force. The LF-NMR analysis of the T_2 distribution revealed that the differences in relative amounts of water populations were not significant (Table 2). However, a trend in the mean pattern of variation was observed, indicating that longer is the fasting, higher is the myofibrillar water (T_{21} pool) and lower is the extra-myofibrillar water (T_{22} pool) percentage. As for liver traits, long fasting produced a higher pH in respect with MF and SF (Table 2). This result is consistent with the lower liver weight observed in LF group (Table 1) and could be due to a higher depletion of energetic substrates (i.e. glycogen) as previously pointed out by Jolley (1990). Finally, SF determined lower values of liver lightness and yellowness in respect with MF and LF.

CONCLUSIONS

The results obtained in this study confirm that preslaughter fasting allows to pursue the empty of the gut with the aim to reduce carcass faecal contamination during slaughtering. Moreover, it was established that a long preslaughter fasting can lead to an increase in muscle ultimate pH, higher water holding capacity and darker colour of the meat. However, the differences observed in meat quality traits are not so large to determine a deterioration of product quality so that it can be concluded that the application of a correct fasting protocol by the rabbit production chain can allow to pursue the emptying of the gut, improve carcass yield and maintain satisfactory meat quality.

REFERENCES

Bianchi M., Petracci M., Pascual M., Cavani, C. 2007. Comparison between Allo-Kramer and Warner-Bratzler devices to assess rabbit meat tenderness. *Ital. J. Anim. Sci., 6(suppl. 1), 749-751*.

Brown R.J.S., Capozzi F., Cavani C., Cremonini M.A., Petracci M., Placucci, G. 2000. Relationship between 1H NMR relaxation data and some technological parameters of meat: a chemometric approach. *J. Magn. Reson., 147, 89-94*.

Blasco A., Ouhayoun J. 1996. Harmonization of criteria and terminology in rabbit meat research. Revised proposal. *World Rabbit Sci., 4, 93-99.*

Cavani C., Petracci M. 2004. Rabbit meat processing and traceability. *In: Proc. 8th World Rabbit Congress, 2004 September, Puebla, Mexico, 1318-1336.*

Combes S., Lepetit J., Darche B., Lebas F. 2003. Effect of cooking temperature and cooking time on Warner-Bratzler tenderness measurement and collagen content in rabbit meat. *Meat Sci., 66, 91-96*.

Dal Bosco A., Castellini C., Bernardini M. 1997. Effect of transportation and stunning method on some characteristics of rabbit carcasses and meat. *World Rabbit Sci., 5, 115-119*.

Honikel K.O., Fischer C. 1977. A rapid method for the detection of PSE and DFD porcine muscles. *J. Food Sci., 42, 1633-1636*.

Jeacocke R.E. 1977. Continuous measurement of the pH of beef muscle in intact beef carcasses. *J. Food Tech., 12, 375-386*.

Jolley P.D. 1990. Rabbit transport and its effects on meat quality. *Appl. Anim. Behav. Sci., 28, 119-134*.

Lambertini L., Vignola G., Badiani A., Zaghini G., Formigoni A. 2006. The effect of journey time and stocking density during transport on carcass and meat quality in rabbits. *Meat Sci., 72, 641-646*.

Luzi F., Heinzl E., Crimella C., Verga M. 1992. Influence of transport on some production parameters in rabbits. *J. Appl. Anim. Res., 15, 758-765*.

Masoero G., Riccioni L., Bergoglio G., Napoletano F. 1992. Implications of fasting and of transportation for a high quality rabbit meat product. *J. Appl. Rabbit Res., 15, 841-847*.

Meiboom S., Gill D. 1958. Modified spin-echo method for measuring nuclear times. *Rev. Sci. Instrum., 29, 688-691*.

Northcutt J. 2001. Preslaughter factors affecting poultry meat quality. *In: Alan R. Sams (Ed). Poultry Meat Processing. CRC Press, USA, 5-16.*

SAS 1998. SAS/STAT User's Guide (Release 6.03). *SAS Inst. Inc., Cary NC, USA.*

Szendro Zs., Kustos K. 1992. The effect of starvation on the carcass yield of New Zealand white rabbits. *J. Appl. Anim. Res., 15, 879-883.*

Trocino A., Xiccato G., Queaque P.I., Sartori A. 2003. Effect of transport duration and gender on rabbit carcass and meat quality. *World Rabbit Sci., 11, 32-43*.

Xiccato G., Parigi-Bini R., Dalle Zotte A., Carazzolo, A. 1994. Effect of age, sex and transportation on the composition and sensory properties of rabbit meat. *In: Proc. 40th ICoMST, August 1994, The Hague, The Netherlands, W-2.02.*