A CRITICAL APPRAISAL OF RABBIT PRESLAUGHTER CONDITIONS IN A COMMERCIAL PRODUCTION CHAIN

Petracci M.*, Bianchi M., Cavani C.

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

ABSTRACT

A study was conducted in order to assess the preslaughter conditions of rabbits in a commercial chain and to determine the effect of the season, journey (short: <220 min; medium: 220-320 min; long: >320 min) and lairage (short: <134 min; medium: 134-235 min; long: >235 min) on mortality, live weight loss, slaughter yield and carcass quality. A total of 831 flocks (average of 2,207 rabbits/flock) from 79 farms of 9-12 weeks-old growing rabbits shipped for slaughtering during the year 2006 towards a major Italian abattoir was considered. Transport and lairage at abattoir of the rabbits were mainly conducted during the night and early morning.
The overall average of mortality rate and live weight loss were found to be 0.082 and 3.39%, respectively. As for carcass evaluation, incidence of downgraded and condemned carcasses were 0.40 and 0.46%, respectively, while bruised carcass level was 2.22%. During the winter, it was observed lower ($P<0.01$) live weight loss (3.12%), while carcass yield (57.9%) was higher ($P<0.01$) during the summer. The shortest transport time (<220 min) exhibited lower mortality rate (0.053 vs. 0.080 vs. 0.113%; $P<0.01$) and live weight loss (2.43 vs. 3.47 vs. 4.26%; $P<0.01$) as well as higher slaughter yield (58.0 vs. 57.3 vs. 57.0%; $P<0.01$) in respect with medium and long transport times. Flocks laired for less than 150 min also exhibited a significantly lower mortality rate (0.065 vs. 0.075 vs. 0.105%; $P<0.01$) and higher carcass yield (57.8 vs. 57.4 vs. 57.1%; $P<0.01$) if compared to medium and long lairage times. Carcass bruising had the higher ($P<0.01$) incidence during the summer in respect with other seasons, while downgraded carcasses prevalence was higher ($P<0.05$) during the autumn. Longer journeys determined a higher ($P<0.01$) incidence of bruised carcasses, but did not influence downgraded and condemned carcass rates.
This study has shown that the preslaughter conditions of the rabbits in a commercial integrated chain production are rather satisfying as a consequence of the effective coordination of transport and lairage based on slaughtering daily programme. Main critical points are represented by long transport and lairage which can impair mortality rate, slaughtering yields and carcass quality. On the other hand, a minor role is played by the season probably because transport was mainly conducted during the night and early morning moderating the effect of high temperatures during the summer.

Key words: Rabbits, Preslaughter time, Mortality, Live weight loss, Carcass quality.

INTRODUCTION

The European farming industry has been concerned by the preslaughter conditions of animals for a long time because there is considerable potential for ensuring good carcasses and meat quality characteristics in the time between removing animals from farms for shipment to the abattoir and the time of slaughter (Le Neindre *et al.*, 2001). Particularly affected are mortality rate, live weight loss and carcass yield and quality grades, especially the proportion of carcasses downgraded because of quality defects (Cavani and Petracci, 2004). Moreover, nowadays an ever-growing consumer interest in the way farm animals are kept, transported and slaughtered has been observed. A consequence of that public concern in Europe has been the adoption of several regulations on the protection of animals during transport by the European Commission (EC, 2007). The main critical points deal mostly with the physical and environmental conditions (duration, temperature, space allowance, *etc*.) (EFSA,

2004). Several key factors have been identified and their effects have been analyzed, including deprivation of feed and water (Jolley, 1990), duration of the journey (Trocino *et al.*, 2003; Buil *et al.*, 2004; Lambertini *et al.*, 2006), stocking densities (De la Fuente *et al.*, 2004), crate floor (Jolley, 1990), and microclimatic environment (Luzi *et al.*, 1992; De la Fuente *et al.*, 2004; Liste *et al.*, 2006). In the near future it is likely that the European industry will have to define new techniques and logistic solutions in order to enhance animal conditions during *ante-mortem* period with the aim to improve both animal welfare and product quality characteristics. The aim of this study is to verify the organization of *ante-mortem* phases of rabbits in a vertically-integrated commercial production chain and to establish the influence of season, duration of journey and lairage on mortality rate, live weight loss, carcass yield and quality.

MATERIALS AND METHODS

Data collection

A total of 831 flocks of 9-12 weeks-old growing rabbits shipped for slaughtering during the year of 2006 was considered. These flocks were shipped from 79 farms. Before transport to the abattoir, rabbits were fasted approximately 5 h prior to crating and subsequently removed from the growing cages and loaded by hand into plastic wire crates measuring 100-110×50-60×22-30 cm (length×width×height). Stocking density varied according to environmental conditions: 15 and 16 animals/crate done during temperate (April to October) or cool (November to March) period of the year, respectively. After crating, rabbits were conducted using commercial lorries with two or three axles and a loading capacity ranging from 1,500 to 9,000 rabbits at the main commercial abattoir of Emilia-Romagna region (Italy) owned by a vertically-integrated company. Environmental temperature and relative humidity (mean±SD) were detected for each season (winter, 4.6±2.8°C and 63.4±17.5%; spring, 16.1±4.4°C and 63.4±17.4%; summer, 23.8±2.7°C and 64.0±10.8%; autumn, 13.9±4.5°C and 74.7±9.8%) (Emilia-Romagna Agency for Environmental Protection, Italy). After transport, the vehicles were unloaded and the crates were laired in an area equipped with a roof to protect the rabbits against weather phenomena. After lairage, the rabbits were removed from crates, electrically stunned, hung on shackles and killed by hand using a conventional unilateral neck cut. Commercial carcasses were obtained after bleeding, skinning, evisceration and chilling operations.

Before slaughtering, live weight at farm, flock size (rabbits/flock), crate stocking density (kg/m^2), journey distance and duration, live weight at arrival, live weight loss (by difference between the weights measured at catching and those at the processing plant arrival), lairage time (time spent in holding area), mortality during preslaughter time (Dead-On-Arrival, DOA, measured at slaughtering line hanging), were recorded for each flock. After slaughtering, the percentage of condemned (carcasses not passing the veterinary inspection or not prone for human consumption), downgraded (carcasses with defects such as blisters, tears, missing parts, discoloration, disjointed and broken bones, *etc*.) and bruised carcasses (carcasses with red discoloured haemorrhages) were also evaluated.

Statistical analysis

Data were processed by computing overall descriptive statistics (mean, standard deviation, minimum and maximum). Moreover frequency distribution of the periods of the day when rabbit flocks left the farm, arrived at abattoir and are slaughtered, respectively, were computed. Finally three-way ANOVA with their interactions was performed to test the effect of season (winter, spring, summer and autumn), journey (short: <220 min; medium: 220-320 min; long: >320 min) and lairage (short: <134 min; medium: 134-235 min; long: >235 min) duration on mortality, carcass yield and carcass defects (SAS Institute, 1988). For live weight loss, only the effects of season and transport duration were tested. Journey and lairage duration data were classified into three discrete classes according their distribution. Multiple comparison of means was performed by multiple range Duncan's test (SAS Institute, 1988).

RESULTS AND DISCUSSION

Main descriptive statistics for the variables are presented in Table 1. The flocks were averagely constituted by 2,268 rabbits weighing 2.57 kg at the farm and crated at 71.7 kg/m^2 stocking density. The mean live weight loss during transport was of 3.39%, while the average carcass weight was 1.48 kg (commercial carcass yield of 57.4%). The duration of journey and lairage showed a mean value of 273.4 and 204.2 min, respectively. It is interesting to note that the majority of the journey were conducted during the night (22:00-6:00) because slaughtering shifts were concentrated (85%) from 5:00 to 11:00 (Figure 1).

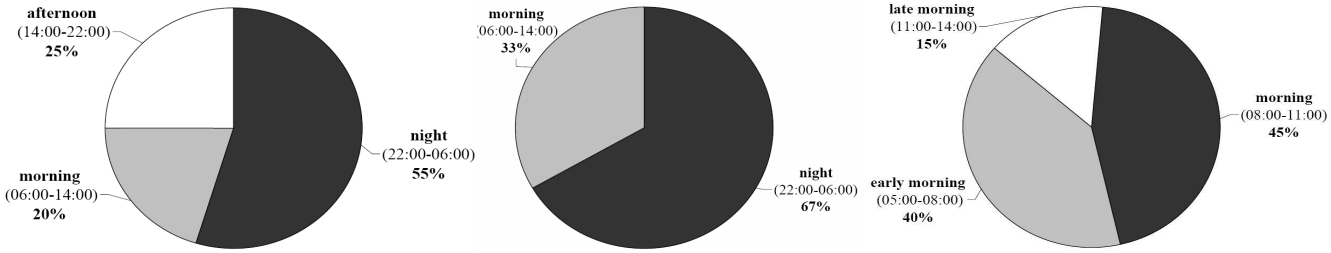

Figure 1: Distribution of the periods of the day of rabbit flock departure from the farm (a), arrival at abattoir (b) and starting of slaughtering (c)

The previous data reflect the flock harvesting organization of the considered production chain which is managed by quality control personnel working at abattoir and allows to reduce as much as possible the journey and lairage durations. In a survey conducted in Spain, Buil *et al.* (2004) found that the average transport time was 154 min (range: 20 to 600) corresponding to 137.5 km (range: 25 to 500) and lairage time was 110 min (range: 0 to 420). The overall mortality rate was 0.082% ranging from 0.000 to 1.288%. These data showed that the incidence of DOA rabbits was slightly higher than those recorded in swine (0.01%) and bovine (0.05%) (Nanni Costa, 2007), while it was much lower in respect of mortality rates reported in poultry (0.35, 0.38, and 1.22% in broilers, turkeys, and spent hens, respectively) (Petracci *et al.*, 2006). As for carcass evaluation, incidence of downgraded and condemned carcasses were 0.40 and 0.46%, respectively, while bruised carcass level was 2.22%.

Table 1: Descriptive statistics (flock number = 831)

	Mean	SD	Minimum	Maximum
Farm				
Live weight at farm (kg)	2.57	0.17	2.12	3.00
Transportation				
N. rabbits/flock	2,268	1,527	201	8651
Stocking density (kg/m^2)	71.7	5.8	56.7	86.2
Distance farm-abattoir (km)	221.9	124.5	13.0	494.0
Journey duration (min)	273.4	151.6	13.0	835.0
Abattoir				
Live weight at arrival (kg)	2.48	0.16	2.06	2.91
Live weight loss (%)	3.39	1.25	0.26	7.56
Lairage duration (min)	204.2	113.0	2.0	574.0
Mortality rate (%)	0.082	0.122	0.000	1.288
Carcass characteristics				
Chilled carcass weight (kg)	1.48	0.10	1.14	1.74
Carcass yield (%)	57.4	1.3	53.1	63.4
Bruised carcasses (%)	2.22	1.27	0.00	9.45
Downgraded carcasses (%)	0.40	0.87	0.00	0.70
Condemned carcasses (%)	0.46	0.66	0.00	8.27

The results for mortality, live weight loss and carcass defects according with season, journey and lairage duration are presented in Table 2. Mortality rate was significantly affected by journey and lairage duration. An increase of DOA rabbits incidence was observed with the advance in both transport (0.053 vs. 0.080 vs. 0.113%; $P<0.01$) and lairage (0.065 vs. 0.075 vs. 0.105%; $P<0.01$) times.

Table 2: Influence of season, journey and lairage duration on mortality rate, live weight loss, carcass yield and carcass defects

Effect	Classes	Flock distribution (%)	Mortality rate (%)	Live weight loss (%)	Carcass yield (%)	Bruised carcasses (%)	Downgraded carcasses (%)	Condemned carcasses (%)
Season	Winter	23.1	0.084	3.12 a	57.3 a	2.03 a	0.21 a	0.42 ab
	Spring	25.3	0.080	3.38 b	57.2 a	1.99 a	0.44 b	0.48 bc
	Summer	27.9	0.094	3.55 b	58.0 b	2.88 b	0.31 ab	0.56 c
	Autumn	23.7	0.068	3.48 b	57.2 a	1.85 a	0.68 c	0.34 a
Journey	Short (<220 min)	32.7	0.053 a	2.43 a	58.0 c	2.22 b	0.35	0.40
	Medium (220-320 min)	34.2	0.080 b	3.47 b	57.3 b	2.02 a	0.45	0.44
	Long (>320)	33.1	0.113 c	4.26 c	57.0 a	2.41 c	0.42	0.53
Lairage	Short (<150 min)	33.5	0.065 a	-	57.8 c	2.23	0.41	0.47
	Medium (150-240 min)	32.5	0.075 b	-	57.4 b	2.31	0.43	0.45
	Long (>240 min)	33.9	0.105 c	-	57.2 a	2.11	0.38	0.45
	Pooled sem		0.004	0.04	0.05	0.04	0.03	0.02
Probability	Season		ns	**	**	**	**	*
	Journey		**	**	**	**	ns	ns
	Lairage		**	-	**	ns	ns	ns
	Season × Journey		ns	ns	ns	ns	ns	ns
	Season × Lairage		ns	-	ns	ns	ns	ns
	Journey × Lairage		ns	-	*	ns	ns	ns

**=P<0.01; *=P<0.05; ns=not significant
means with different letters on the same column within the same effect differ significantly (P<0.05)

These results agree with Jolley (1990) who pointed out that the risk of death during *ante-mortem* period increases enormously as time between crating and slaughtering increases. However, no significant effect was exerted by the season. This can be partially explained by that transport and lairage of rabbits were mainly conducted during the night and early morning to moderate the effect of high temperatures registered during the summer. Live weight loss was significantly affected by both season and journey duration. The flocks slaughtered during winter exhibited the lowest live weight loss values (3.12%) in respect with other seasons. Moreover the increase in journey duration (<220 vs. 220-320 vs. >320 min) determined a higher live weight loss (2.43 vs. 3.47 vs. 4.26%, respectively; P<0.01). These results are consistent with previous studies which confirm that a longer duration of transportation negatively affected weight loss (Luzi *et al.*, 1994; Trocino *et al.*, 2003; Lambertini *et al.*, 2006). Carcass yield was significantly influenced by all considered effects. Flocks slaughtered during summer exhibited the higher carcass yield (58.0%) in respect with the other periods of the year. This evidence confirms the findings of Chiericato *et al*. (1993) who observed lower market weight at slaughter age, but higher carcass yield in rabbits slaughtered during hot seasons because of the lower proportion of skin, empty gut and offal. Moreover a decrease of carcass yield was observed with the advance in both transport (58.0 vs. 57.3 vs. 57.0%; P<0.01) and lairage (57.8 vs. 57.4 vs. 57.2%; P<0.01) durations. These results agree with those found by Trocino *et al.* (2003) and Lambertini *et al.* (2006) and indicate that the loss during *ante-mortem* time impairs carcass yield as a consequence of moisture and nutrient losses in body tissues of the animals. The significant interaction "Journey×Lairage" (P<0.05) evidenced that lairage exerted a relevant effect mainly when rabbits are transported for short time. As for carcass quality defects, season influenced all considered variables. Bruised carcass exhibited the higher incidence (2.88%) during the summer if compared with other seasons, while downgraded carcasses prevalence was higher (0.68%) during the autumn. Condemned carcasses had the lower rate (0.34%) during the autumn. Lairage duration did not exert significant effects, while longer journeys determined a higher incidence (2.41%) of bruised carcasses.

CONCLUSIONS

In conclusion, this study has shown that the preslaughter conditions of the rabbits in a commercial integrated chain production are rather satisfying as a consequence of the effective coordination of transport and lairage based on slaughtering daily programme. The main critical points are represented by long transport and lairage which can impair mortality rate, slaughtering yields and carcass quality,

while a minor role is played by the season. This can be explained by that transport was mainly conducted during the night and early morning to moderate the effect of high temperatures of the summer.

ACKNOWLEDGEMENTS

The authors are grateful to technical support of Martini Alimentare s.r.l. This research was funded by MIUR - PRIN 2005.

REFERENCES

Buil T., Maria G.A., Villarroel M., Liste G., Lopez M. 2004. Critical points in the transport of commercial rabbits to slaughter in Spain that could compromise animals' welfare. *World Rabbit Sci., 12, 269-279.*

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

Chiericato G.M., Rizzi C., Rostellato V. 1993. Effect of genotype and environmental temperature on the performance of young meat rabbit. *World Rabbit Sci., 1, 119-125.*

De La Fuente J., Salazar M., Ibanez M., Gonzales De Chiavarri E. 2004. Effects of antemortem treatment and transport on slaughter characteristics of fryer rabbits. *Anim. Sci., 78, 285-292.*

EFSA 2004. The welfare of animals during transport. *The EFSA Journal, 44, 1-36.*

EU 2007. The Health and Consumer Protection Directorate General of European Commission. Animal welfare during transport. *Home page address: http://ec.europa.eu/food/animal/welfare/transport/index_en.htm (accessed December 15, 2007).*

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.*

Le Neindre P., Terlouw C., Boivin X., Boissy A., Lensink J. 2001. Behavioral research and its application to livestock transport and policy: A European perspective. *J. Anim. Sci., E159-165.*

Liste G., Marıa G.A., Buil T., Garcia-Belenguer S., Chacon G., Olleta J.L., Sanudo C., Villarroel M. 2006. Journey length and high temperatures: effects on rabbit welfare and meat quality. *Dtsch. Tierarztl. Wochenschr., 113, 59-64.*

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.*

Nanni Costa L. 2007. Importanza e conseguenze degli stress acuti: il caso del trasporto e della macellazione. *In: Bertoni G. (Ed.) Il benessere degli animali da reddito: quale e come valutarlo. Fond. Iniz. Zoop. Zoot., Brescia, Italy, 105-116.*

Petracci M., Bianchi M., Cavani C., Gaspari P., Lavazza A. 2006. Preslaughter mortality in broiler chickens, turkeys, and spent hens under commercial slaughtering. *Poultry Sci., 85, 1660-1664.*

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

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.*