EFFECT OF AGE, SEX AND TRANSPORTATION ON THE COMPOSITION AND SENSORY PROPERTIES OF RABBIT MEAT

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SUMMARY

In order to study the changes in the chemical composition, mechanical and sensory properties of rabbit meat according to age and sex, 60 commercial "hybrid" rabbits (30 males and 30 females) were raised from weaning (age 35 days) to slaughtering. Twenty animals were slaughtered at 77 days, 20 at 84 days and 20 at 91 days of age. Ten animals of each age were immediately slaughtered and 10 were transported for 2 hours and then killed. As slaughter age increased, fat content increased, while L*, a* and b* values both of hindleg and *longissimus dorsi* muscles decreased. The ultimate pH, cooking loss, Warner Bratzler share force and sensory properties of the meat were not affected by age. The polyunsaturated to saturated fatty acid ratio of the perirenal fat increased with age. Sex had no important effect on composition and sensory traits of the meat.
Transportation had a much more significant effect on the chemical composition, with a decrease in fat and water content. The ultimate pH significantly increased in the transported rabbits. On the contrary, cooking losses significantly decreased with transportation. Meat was darker and less colourful in transported rabbits, with lower L*, a*, b* and C* values. Meat tenderness (both instrumental and sensory) was higher in transported rabbit meat.
Keywords: rabbit, transportation, meat composition, sensory properties.

Introduction

Very few studies on the biological, rearing and technological factors affecting the composition and sensory properties of rabbit meat have been performed up until now. In the last few years however a rising interest in the quality properties of rabbit meat has been displayed by operators in the scientific, technical and marketing sectors, both in order to comply with EC directives and to offer consumers a wider range of labelled products (Masoero et al., 1992; Roiron et al., 1992). Transportation from breeding house to slaughter house is one of the leading causes of animal exhaustion (Masoero et al., 1992), especially when the environmental temperature is very high (>30° C). In other animals, such as pigs, transportation stress damage is very serious in both technical and economical terms.

The aim of this study was to evaluate the changes in rabbit meat quality according to different slaughter age, sex and pre-slaughter handling (transportation) and to evaluate the relationship between instrumental and organoleptic measurements of meat quality.

Material and methods

Sixty rabbits, Grimaud Frères "hybrids", 30 males and 30 females, were reared from weaning (age 35 days, live weight 792±86 g) to slaughter (77 to 91 days). The animals were kept in individual wire cages, in half-open air conditions from September (18-20° C average temperature) to November (5-8° C). They were fed *ad libitum* from 35 to 56 days with a maternal commercial diet followed by a fattening commercial diet. Twenty rabbits were then slaughtered at 77 days of age, 20 at 84 days and 20 at 91 days. Ten rabbits of each slaughter age were immediately stunned by electroanesthesia (90 V for 2 sec) and killed by cutting the jugular veins and carotid arteries. The other 10 rabbits were transported for 2 hours in a closed van and then slaughtered using the same technique. The carcasses were prepared and dissected following the method proposed by Blasco et al. (1993). The commercial carcass was refrigerated for 24 hours at 4° C. The ultimate pH (pH_u) of the commercial carcass was determined in duplicate by a pH-meter equipped with a combined Ingold electrode (406 M3) on three muscles of hindleg, *biceps femoris* (BFE), *tensor fasciae latae* and *semimembranosus accessorius*, and

on two points of *longissimus dorsi pars lumbalis* (LDL) (Parigi-Bini et al., 1992). Meat colour was measured in duplicate on BFE and LDL muscles by a colorimeter (Chromameter CR100, Minolta) and the results were expressed as L*a*b* (CIE, 1976). Chroma (C*) was calculated as $C^* = (a^2 + b^2)^{0.5}$. The carcass was divided in two half-carcasses and then dissected. From the right half-carcass, the hindleg muscles and the *longissimus dorsi* muscle were separated for chemical analyses (A.O.A.C., 1984, Parigi-Bini et al., 1992). Perirenal fat in half the rabbits was analysed by gas-chromatography (Parigi-Bini et al., 1992) to determine the proportion of fatty acids (FA). From the left half-carcass, the whole hindleg and a loin portion (from 3rd to 7th lumbar vertebra, bones included) were separated to be analysed for physical, mechanical and organoleptic properties. Cooking loss was assessed by weighing the meat samples before and after cooking under slight vacuum in polythene bags, at 80° C for 2 hours 30 min, followed by a 30 min cooling (Roiron et al., 1992). The cooked samples were used for triplicate Warner-Bratzler shear force measurements on cores (diameter 1.25 cm) obtained by cutting the meat along the fibre grain. The same samples were also evaluated by a taste panel, consisting of 10 persons, trained for both the specific product (rabbit meat) and the sensorial method adopted (Rank Classification; AFNOR, 1989). The panellists tasted the samples in two sessions (6 samples tasted by each panellist per session). In the first session, they were asked to give rank classifications (1 to 6) of the hindleg meat, both for flavour and texture (tenderness and juiciness); in the second session, they were asked to give only a texture evaluation of the loin.

The statistical evaluation of the results was performed by analysis of variance (Harvey, 1987), considering three main effects (slaughter age, sex and transportation) and their interactions. The statistical analysis of the sensory properties was based on Friedman's rank classification test (AFNOR, 1989), by ranking the samples according to age and transportation. The same data were also treated by analysis of variance, in order to consider all the main effects and their interactions.

Results and discussion

Slaughter age slightly influenced meat composition, even though protein content decreased ($P<0.01$) and fat content increased in the *longissimus dorsi* muscle (table 1). The average fat content and the changes in chemical composition were lower than those observed in a previous research on rabbits of equal age (Parigi-Bini et al., 1992). This might be due to the open-air rearing system, that reduced daily growth and fattening. Transportation modified the meat composition, especially that of *longissimus dorsi* ($P<0.01$), with a slight dehydration and lipolysis, while protein concentration increased. These changes however had no influence on the general nutritive properties of rabbit meat, which is usually appreciated for its high protein and low fat contents.

The pH_u and cooking loss were not significantly influenced by age (table 2); on the contrary, the L* value of the meat decreased as age increased ($P<0.001$). The other colour parameters changed in a curvilinear way and on the whole the meat became darker and less colourful with age. The physical and chemical properties of the meat were much more affected by transportation, as the stressed rabbits showed higher pH_u, lower cooking loss and lower L*, a*, b* and C* values ($P<0.01$). These changes are commonly ascribed to higher glycogen depletion in stressed animals, which results in higher pH_u and water holding capacity, which latter reduces meat lightness. The reduction in the chromatic values (a*, b* and C*) is explained by the more intense cellular respiration and consequently by the greater reduction of oxymyoglobin (bright red) into myoglobin (purplish red) that occurs in high pH_u muscular fibres (Renerre, 1982).

The Warner Bratzler share force and the sensory toughness of the meat were affected only by transportation (table 3). In particular, transportation significantly increased meat tenderness ($P<0.01$), according to the results of Masoero et al. (1992). In any case, the rabbit meat share force (2.0-2.4 kg/cm^2) is much lower than that of other species (Lawrie, 1991). As regards the tenderness evaluation, both instrumental and organoleptic measurements gave similar results, in particular on the *longissimus dorsi* muscle, thereby confirming the efficacy of taste panels, provided that the panellists are given sufficient training.

The perirenal fat of the rabbit was distinguished by a high proportion of C16:0 and C18:1 FA (table 4). Moreover it presented a very high proportion of polyunsaturated FA (PUFA) and a high n-3 to n-6 ratio in comparison with other species, according to others (Ouhayoun et al., 1986; Wood, 1990, Cambero et al., 1991; Parigi-Bini et al., 1992). The PUFA to saturated FA (SFA) ratio increased with age ($P<0.001$), primarily because of a reduction in C16:0 and an increase in C18:2. The plasma cholesterol lowering FA to plasma cholesterol elevating FA ratio (PCL-FA/PCE-FA; Reiser and Shorland, 1990) also rose. As regards sex, the females showed a higher C18:0 ($P<0.01$) and a lower monounsaturated FA content, confirming previous results (Parigi-Bini et al., 1992).

Conclusions

Slaughter age reduced meat lightness but increased PUFA/SFA and PCL-FA/PCE-FA ratios and Iodine number. These changes in FA proportion were favourable for the dietetic properties of the meat but negative for its preservation. Sex did not substantially affect the composition and sensory traits of the meat, while some minor changes were observed in FA composition. Transportation had a much more significant effect on meat quality. It decreased fat and water content and significantly increased the pH_u. Cooking losses significantly decreased with transportation. Meat colour was darker and more greyish in the transported rabbits, with lower L*, a* and b* values. Meat tenderness (both instrumental and sensorial) was higher in the transported rabbits. These results suggest that slaughter age and transportation do not lead to important modifications of meat properties or anomalies such as PSE or DFD syndromes. In particular, a short term transportation can improve the organoleptic qualities of rabbit meat, by making it more tender and juicy.

Acknowledgements

The authors wish to thank the "Consorzio Paniere Veneto", Verona, Italy for their technical support of the taste panel. Financial support was provided by E.S.A.V.-Regione Veneto.

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