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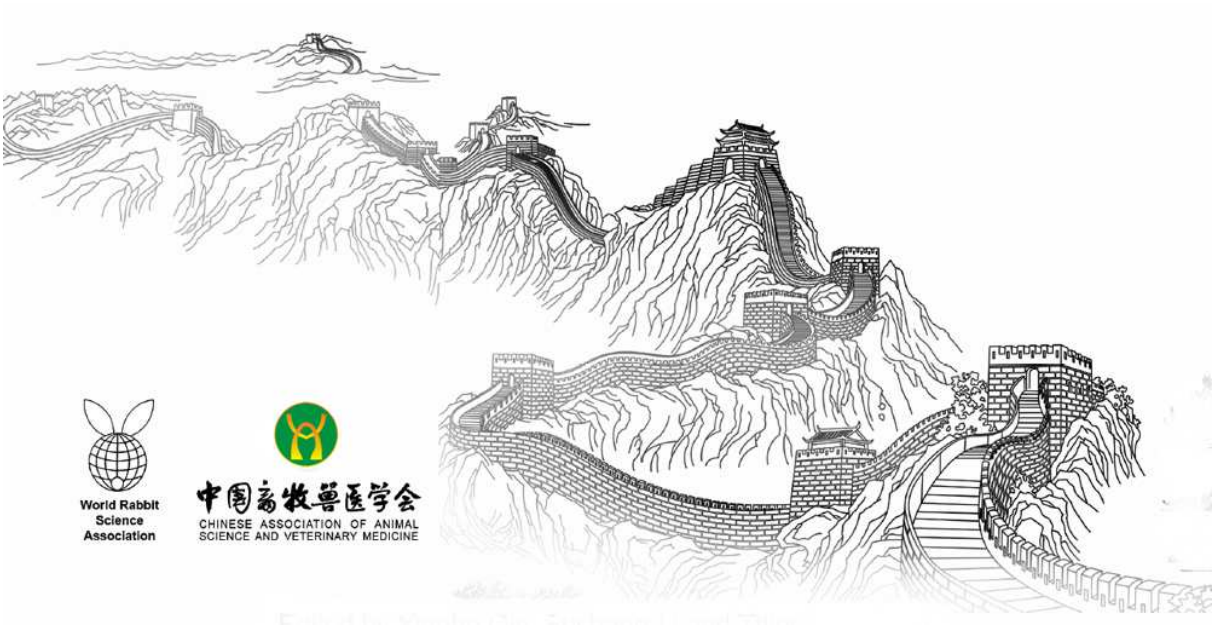

EFFECT OF SELECTION FOR INTRAMUSCULAR FAT ON INSTRUMENTAL TEXTURE AND SENSORY TRAITS IN RABBITS

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ABSTRACT

The aim of this work was to study the effect of selection for intramuscular fat (IMF) on instrumental texture parameters and sensory attributes of the *Longissimus dorsi* (LD) muscle in rabbits. A total of 116 rabbits from a divergent selection experiment for IMF were slaughtered at 9 or 13 wk. For each animal, left LD was analyzed by near infrared reflectance spectroscopy (NIRS) to measure IMF whereas right LD was used for the instrumental texture or sensory analysis. The instrumental texture parameters maximum shear force (SF), shear firmness (F) and total work performed to cut the sample (W) were measured by a Warner-Bratzler shear blade. Sensory attributes measured were rabbit odor, liver odor, rabbit flavor, liver flavor, aniseed flavor, hardness, juiciness and fibrousness. The high line showed 58% higher intramuscular fat than the low line. Selection had effect only in firmness instrumental texture parameter (low line showed 9.9% higher firmness than high line) but had no effect in the other traits. Rabbits at 13 wk showed higher IMF, odor, flavor, instrumental and sensory hardness, and lower juiciness than rabbits at 9 wk.

Key words: intramuscular fat, rabbit, instrumental texture, sensory analysis

INTRODUCTION

Intramuscular fat (IMF) is one of the main parameters affecting meat quality. Intramuscular fat has been positively correlated with sensory tenderness, juiciness and negatively correlated with Warner-Bratzler shear force. In rabbits, information about the effect of IMF on instrumental texture and sensory properties is scarce (Gašperlin et al., 2006; Polak et al., 2006).

Only three experiments of selection for IMF have been published, in pigs (Schwab et al., 2009), chicken (Zhao et al., 2007) and cattle (Sapp et al., 2002). Currently, a divergent selection experiment on IMF in rabbits is in progress. The aim of this work was to study the effect of selection for IMF on texture parameters and sensory attributes of the *Longissimus dorsi* (LD) muscle in rabbits.

MATERIALS AND METHODS

Animals This study was performed with rabbits from the sixth generation of a divergent selection experiment for IMF in *Longissimus dorsi*. Selection was based on the phenotypic value of IMF measured by NIRS in 2 full sibs of the candidate (a male and a female) at 9 wk, as described in Zomeño et al., (2013). A total of 116 rabbits from the lines selected for high IMF (H) and low IMF (L) were slaughtered at 9 wk or 13 wk of age. After slaughter, carcasses were chilled for 24h at 4ºC. From each animal, both LD muscles were excised. Right LD muscles were vacuum packed and stored at -20ºC until instrumental texture or sensory analyses were performed. Left LD muscles were ground, freeze-dried and scanned with NIRS to measure IMF applying the calibration equations previously developed by Zomeño et al. (2011).

Texture and sensory analyses

Sixty rabbits (15 from each selection line and age group) were used for the instrumental texture analysis whereas 56 rabbits (14 from each selection line and age group) were used for the sensory analysis. Right

LD muscles were thawed at 4ºC during 24 h in their vacuum-packed plastic bag and cooked at 80ºC for 1h by immersion in a water bath with automatic temperature control.

For the instrumental texture analysis, samples were obtained by cutting three rectangles of 2x1 cm of cross section, parallelly to the muscle fiber direction. They were cut by a Warner-Bratzler shear blade and the maximum shear force, the shear firmness and the total work performed to cut the sample were recorded. The cooking loss was calculated as the ratio (x100) of the difference in weight between the cooked and raw muscle relative to the weight of the raw muscle.

For the sensory analysis, a quantitative descriptive analysis (Stone et al., 1974) was performed by 8 assessors trained in the evaluation of rabbit meat. Attributes included in the evaluation form were: rabbit and liver odor, rabbit, liver and aniseed flavor, hardness, juiciness and fibrousness. Each assessor evaluated 4 samples per session (one per group of age and line) during 7 sessions following a complete block design. Immediately after cooking, loins were unpacked and cut into four pieces, wrapped in aluminum foil and served hot to assessors. The order of sample presentation was randomized over assessors in order to balance the effects of order presentation.

Statistical Analysis

Intramuscular fat and instrumental texture parameters were analyzed fitting a model including the line (H and L line), age (9 and 13 wk), and sex as fixed effects and common litter as a random effect. Sensory data were standardized by subtracting the mean and dividing by the standard deviation of each assessor. Then, they were analyzed using a model with age, line, sex, muscle location (with four levels) and session (with six levels) as fixed effects and common litter as a random effect. Bayesian inference was used. Normal priors for the random effects and flat priors for the remaining effects were used.

RESULTS AND DISCUSSION

Table 1 presents the descriptive statistics of traits at 9 and 13 weeks.

Table 1. Descriptive statistics of traits at 9 and 13 wk.

	9 wk		13 wk	
Trait	Mean	CV[1]x100	Mean	CV[1]x100
Intramuscular fat (g/100g)	1.04	23.5	1.35	29.2
Warner Bratzler parameters				
Shear Force (kg/cm^2)	3.07	18.4	3.47	17.1
Firmness (kg/s*cm^2)	1.57	18.1	1.58	14.2
Total work (kg*s/cm^2)	4.20	21.8	5.55	23.9
Cooking loss (%)	29.4	11.3	27.0	8.98
Sensory attributes				
Rabbit odor	4.33	22.6	4.71	20.2
Liver odor	1.55	66.0	1.79	52.3
Rabbit flavor	3.96	25.3	4.32	21.7
Liver flavor	2.21	48.8	2.12	41.8
Aniseed flavor	0.55	170	1.06	112
Hardness	4.26	21.6	4.77	20.6
Juiciness	4.00	22.3	3.20	28.5
Fibrousness	4.23	20.6	4.79	21.2

[1]CV: coefficient of variation.

The means and coefficients of variation are within the range of values previously reported by other authors in rabbit (Bataglini et al., 1994; Polak et al., 2006; Hernández et al., 2000 and Gondret et al.,

1998). Aniseed flavor showed the lower score, with a high coefficient of variation partially due to the low value of the mean.

Table 2 presents the ratios between H and L line and 13 and 9 wk of age for intramuscular fat, instrumental texture parameters, cooking loss and sensory attributes.

Table 2. Features of the marginal posterior distributions of the ratios between lines (high line (H) / low line (L)) and between ages (13wk/9wk) for measured traits.

	H line/L line				13 wk/9 wk			
Trait	Median[1]	$HPD_{95\%}$[2]		P[3]	Median[1]	$HPD_{95\%}$[2]		P[3]
Intramuscular fat (g/100g)	1.58	1.47	1.70	1.00	1.30	1.23	1.37	1.00
Warner Bratzler parameters								
Shear Force (kg/cm^2)	0.95	0.80	1.10	0.76	1.13	1.03	1.22	1.00
Firmness ($kg/s*cm^2$)	0.91	0.81	1.00	0.97	1.00	0.92	1.09	0.51
Total work ($kg*s/cm^2$)	0.97	0.77	1.18	0.62	1.32	1.18	1.48	1.00
Cooking loss (%)	1.00	0.92	1.09	0.51	0.93	0.88	0.98	1.00
Sensory attributes								
Rabbit odor	1.02	0.96	1.08	0.71	1.09	1.03	1.15	1.00
Liver odor	0.99	0.82	1.15	0.54	1.16	0.98	1.35	0.96
Rabbit flavor	1.02	0.94	1.09	0.67	1.09	1.02	1.15	1.00
Liver flavor	1.01	0.87	1.16	0.55	0.96	0.84	1.08	0.76
Aniseed flavor	1.21	0.82	1.65	0.85	2.21	1.43	3.46	1.00
Hardness	0.99	0.94	1.05	0.59	1.11	1.06	1.18	1.00
Juiciness	1.00	0.94	1.07	0.55	0.80	0.75	0.85	1.00
Fibrousness	1.01	0.95	1.06	0.59	1.12	1.06	1.19	1.00

[1]Median: median or the ratio between 13 wk and 9 wk of age; [2]$HPD_{95\%}$: high posterior density interval at a 95% of probability; [3]P: probability of the ratio being >1 when the ratio is higher than 1 or <1 when the ratio is lower than 1.

The high line showed 58% higher intramuscular fat than the low line (P=1.00). Firmness instrumental texture parameter was 9.9% higher in the L line than in the H line (P=0.97), whereas shear force, total work and cooking loss were similar in both lines. In the sensory attributes, lines were only different in the aniseed flavor; it was 21% higher in the H than in the L line (P=0.85) although this is not a relevant attribute because all the scores were near 0.

Currently, there is no other experiment of selection for IMF in rabbits. In other species, Zhao et al., (2007) observed lower shear force in a line of chickens selected for high IMF, in agreement with our results. Schwab et al. (2009) observed higher pork flavor in pigs selected for high IMF whereas hardness, juiciness and cooking loss were not affected. In rabbits, several studies (Gašperlin et al., 2006; Polak et al., 2006) compared instrumental texture and sensory attributes in rabbit lines with different IMF. The leanest line showed higher cutting value across the fibers (Polak et al., 2006) but did not shown differences in most sensory attributes with respect to the line with highest IMF (Gašperlin et al., 2006; Polak et al., 2006).

Instrumental texture parameters and sensory attributes showed differences between ages (Table 2). Animals with 13 wk of age showed higher shear force, total work and lower cooking loss than animals with 9 wk of age (P =1.00), whereas firmness was similar at both ages. Rabbits of 13 wk of age showed higher sensory hardness, fibrousness, rabbit odor and flavor, liver odor, and lower juiciness than rabbits of 9 wk of age (P ≥0.96). Aniseed flavor was higher in 13 wk rabbits than in 9 wk rabbits although scores were low in both cases.
Jehl and Juin (1999) observed more tenderness and juiciness and less meat odor in hind legs of younger animals when comparing rabbits with 10, 12 and 14 wk of age, in agreement with our results. Other authors did not find differences in instrumental texture or sensory attributes (Bataglini et al., 1994; Gašperlin et al., 2006; Polak et al., 2006); however, in these studies rabbits only differed in 2 wk of age.

Conversely, Gondret et al. (1998) observed higher tenderness, less fibrousness and similar juiciness and flavor in LD from rabbits with 18 wk of age than in LD from rabbits with 11 wk of age. In other species, several studies showed higher toughness, fibrousness, odor and flavor, and less juiciness in meat from older animals, as Čandek-Potokar et al., (1999) in pigs and Madruga et al., (2000) in goat, which is in line with our results.

CONCLUSIONS

Line selected for high IMF showed 58% higher intramuscular fat than line selected for low IMF. Selection had effect only in firmness instrumental texture parameter, that was higher in the low line, but no effect was observed in shear force, total work, sensory properties and cooking loss. Rabbits at 13 wk showed higher IMF, instrumental and sensory hardness, odor and flavor and lower juiciness than rabbits at 9 wk.

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