Sensory and rheological evaluation of meat from rabbits reared at different floor type and stocking density

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Abstract

Thirty-six weaned rabbits were used to test the effect of floor type (wire net vs straw bed) and stocking density (8 vs 12 vs 16 rabbits/m^2) on meat quality, according to a balanced 2x3 experimental design. Rabbits were slaughtered at 11 weeks of age and both parts of M. *Longissimus dorsi* were dissected and used for sensory evaluation (tenderness, "rabbit flavour", off-flavours), cooking losses, Warner-Bratzler Shear Force (WBSF) and Texture Profile Analysis (TPA) parameters. Sensory evaluation was performed by eighteen trained panelists according to a ranking test of intensity level of each descriptor. Each sample was evaluated by 3 panelists (108 observations). The panelists were asked to judge positively or negatively the "rabbit flavour" and to define each off-flavour perceived on a descriptors scale. Experimental factors didn't affect the analysed variables. WBSF was significantly correlated ($P<0.01$) with TPA-hardness ($R= 0.66$), moderately correlated ($P<0.05$) with tenderness ($R= -0.37$) and "rabbit flavour" ($R= -0.34$). Tenderness was correlated with TPA-hardness and TPA-gumminess with $R= -0.38$ and $P<0.05$. The high rabbit's flavour intensity was considered positive by the 72% of panelists. Off-flavours were detected on 46% of observations, judging freezer burned the 16%, livery the 13% and rancid the 11% of them. The off-flavour evaluation was independent to the "rabbit flavour" judgment, underlying the discrimination power of the selected off-flavours descriptors.

Introduction

Rabbit meat consumption is mainly developed in Mediterranean countries of the EU. Rabbit meat is considered by the traditional consumer to have positive sensory properties such as tenderness, low fat and delicately flavoured, although a main cause of refusal is its typical wild taste (Dalle Zotte, 2002). Rabbit meat sensory properties are thus crucial for the consumer's choice.

To satisfy the expectations of animal welfare researchers are studying the effects of less intensive rearing conditions on rabbit's behaviour, as well as on rabbit's productive performance, carcass (Princz et al., 2008) and meat traits (Dalle Zotte et al., 2008). However, the effects of such a modification on the rabbit meat sensory properties must be monitored to avoid disappointment on rabbit meat consumers.

Materials and methods

Thirty-six weaned rabbits were used to test the effect of floor type (wire net vs straw bed) and stocking density (8 vs 12 vs 16 rabbits/m^2) on meat quality, according to a balanced 2x3 experimental design. Rabbits were slaughtered at 11 weeks of age and both sides of M. *Longissimus dorsi* were dissected. One side was used for sensory evaluation (tenderness, "rabbit flavour", off-flavours), whereas the other side was used for cooking losses (1h in a water-bath at 80°C), Warner-Bratzler Shear Force (WBSF) and Texture Profile Analysis (TPA).

For WBSF measurement 4 to 6 1.27 cm diameter cores were sheared perpendicular to the muscle fibres orientation using an Instron 5543 with a Warner–Bratzler shear device and crosshead speed set at 200 mm/min (AMSA, 1995). TPA variables were quantified and expressed according to Bourne (1978).

Sensory evaluation was performed by eighteen trained panelists (7 females/11 males; with averaged age of 27 and 29 yrs, respectively) according to a ranking test of intensity level (1= lesser; 6=greater) of each descriptor (tenderness, "rabbit flavour", off-flavours). Each panelist evaluated 6 samples corresponding to the 3x2 combinations of experimental factors. Each sample was evaluated by 3 panelists (108 observations). The panelists were asked to judge positively or negatively the "rabbit flavour" and to define each off-flavour

perceived on a descriptors scale (acid, livery, metallic, freezer burned, rancid). For this purpose, samples were cooked in a conventional oven preheated at 170 °C, until internal temperature of 70 °C was reached; then, each sample was cut into 3 sub-samples and served to 3 panelists. All selected panelists habitually consumed rabbit meat with the consumption frequency reported in Table 1.

Table 1. Panel frequency of rabbit meat consumption

Consumption/year	No. of panelists
1	3
2	3
5	5
10	1
12	2
>12	4
Total panelists	18

Analysis of variance was performed using PROC GLM of the Statistical Analysis System (SAS Institute Inc., 2000) on WBSF, cooking losses and TPA variables. Floor type and stocking density were tested as the main effects in the model. In addition, Pearson's correlation coefficients were calculated using PROC CORR. Main effects were tested by performing a Friedman's Test on sensory data of mean ranks.

Results and discussion

Cage floor type and stocking density didn't affect the rheological and sensory attributes of M. *L. dorsi* (Table 2). In the same work (Jekkel *et al*., 2008) the rabbits reared at the highest stocking density (16 rabbits/m²) presented higher perirenal fat than rabbits reared at lower (8 or 12 rabbits/m²) stocking densities ($P<0.05$), but loin proportion and slaughter yield were unaffected. The presence of straw on floors significantly increased the hind part proportion and reduced the perirenal fat amount ($P<0.01$). Even so, all these differences didn't modify the rabbit meat quality.

Table 2. Rheological and sensory attributes of M. *L. dorsi* of rabbits differently housed

	Floor Type (F)		Stocking density (D)			*P*-value			SE
	Straw	Wire	8	12	16	F	D	FxD	
Samples, n	18	18	12	12	12				
Cooking loss, %	27.9	27.4	27.9	27.0	28.0	ns	ns	ns	2.03
WBSF, kg	3.12	3.41	2.94	3.60	3.25	ns	ns	ns	1.05
Texture Profile Analysis:									
Hardness, N	39.8	46	41.2	46.8	40.7	ns	ns	ns	16.3
Cohesiveness	0.35	0.32	0.32ab	0.40b	0.28a	ns	*	ns	0.1
Springiness	1.04	0.99	0.96a	1.13b	0.96a	ns	ns	ns	0.19
Gumminess, N	14.5	16.5	14.0	19.5	13.0	ns	ns	ns	0.58
Chewiness, N	15.9	17.4	14.1a	22.4b	13.4a	ns	ns	ns	10.7
Adhesiveness, J	-0.005	-0.006	-0.006	-0.005	-0.005	ns	ns	ns	0.003
Sensory Attributes:									
Tenderness	3.74	3.26	3.42	3.11	3.97	ns	ns	ns	1.41
"Rabbit Flavour"	3.46	3.54	3.39	3.44	3.67	ns	ns	ns	1.23
Off-Flavours	3.31	3.69	3.31	3.72	3.47	ns	ns	ns	1.16

a, b: Within a row, least squares means without a common superscript letter differ, $P<0.05$

Correlation analysis between rheological and sensory variables is shown in Table 3. WBSF was significantly correlated ($P<0.01$) with TPA-hardness ($R= 0.66$), but moderately correlated ($P<0.05$) with sensory tenderness ($R= -0.37$) and "rabbit flavour" ($R= -0.34$). Sensory tenderness was correlated with TPA-hardness and TPA-gumminess with $R= -0.38$ and $P<0.05$).

Table 3. Pearson's correlation coefficients between cooking losses, WBSF, TPA and sensory scores for loin meat

	WBSF	TPA						Sensory scores		
		HAR	COH	SPR	GUM	CHE	ADH	TEN	RAFL	OFFL
Cooking losses (CL)	0.34*	0.41*	ns	ns	ns	ns	-0.35*	ns	ns	ns
WBSF	1.00	0.66***	0.39*	ns	0.59***	0.46**	-0.50**	-0.37*	-0.34*	ns
Hardness (HAR)		1.00	0.44**	ns	0.92***	0.75***	-0.71***	-0.38*	ns	ns
Cohesiveness (COH)			1.00	0.71***	0.71***	0.82***	ns	ns	ns	ns
Springiness (SPR)				1.00	0.41*	0.71***	ns	ns	ns	ns
Gumminess (GUM)					1.00	0.93***	-0.54***	-0.38*	ns	ns
Chewiness (CHE)						1.00	ns	-0.36*	ns	ns
Adhesiveness (ADH)							1.00	ns	ns	ns
Tenderness (TEN)								1.00	ns	ns
"Rabbit flavour" (RAFL)									1.00	ns
Off-flavours (OFFL)										1.00

* *P*< 0.05; ** P< 0.01; *** P< 0.001

The high "rabbit flavour" intensity was considered positive by the 72% of the panelists. Off-flavours were detected on 46% of observations, judging freezer burned the 16%, livery the 13% and rancid the 11% of them (Table 4). The off-flavour evaluation was independent to the "rabbit flavour" judgment, underlying the discrimination power of the selected off-flavours descriptors. Off-flavour detection wasn't related to floor type and stocking density, even though 4 meat samples belonging to rabbits reared at the lowest stocking density were classified off-flavour by all the 3 panelists that evaluated the same samples.

Table 4. Off-flavour frequency according to the "rabbit flavour" perception

	"Rabbit flavour"		total
off-flavour:	negative	Positive	
Acid	0%	1%	1%
Livery	13%	13%	13%
Metallic	7%	5%	6%
freezer burned	17%	15%	16%
Rancid	13%	10%	11%
None	50%	55%	54%

P Chi-square: 0.792

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