THE EFFECT OF SELECTION FOR GROWTH RATE ON SENSORY CHARACTERISTICS OF RABBIT MEAT

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Background

Selection for growth rate is currently practiced in commercial sire lines of genetic schemes for rabbit genetic improvement (BASELGA and BLASCO, 1989; LEBAS et al., 1996). Meat rabbit production is based on three-way crosses. Does are crossbred females from lines selected by litter size, whereas terminal sires come from lines selected for growth rate. Selection for growth rate decreases food conversion rate and improves efficiency, but may decrease carcass and meat quality. In rabbits only two experiments have assessed the consequences of selection for growth rate in carcass and meat quality, PILES et al. (2000) and LARZUL et al. (2003). PILES et al. (2000) comparing a control group and a group selected for growth rate, found a worse water holding capacity of the meat in the selected group and a decrease in the fat content of the carcass, but did not find clear differences in fat content of the hind leg between groups. LARZUL et al. (2003) in a divergent selection experiment on 63 days weight found that, as body weight increases, the percentage of skin decreased, carcass yield was slowly affected and perirenal fat increased. However, at present there are not studies about the influence of selection for growth rate on the sensory properties of rabbit meat.

Sensory analyses are usually performed with small samples. Until now, classical statistics has been the usual way of expressing uncertainty with meat quality analysis, whereas Bayesian analysis have been mainly applied by animal breeders to solve complicated genetic problems (see BLASCO, 2001, for a review). An advantage of the Bayesian approach trough MCMC procedures is the possibility of easy construction of all kind of confidence intervals. This allows asking questions that we could not ask within the classical inference approach, or that had complex procedures to be answered. For example, we can find intervals of the type $[k, +\infty)$ having a 95% of the probability area of the marginal posterior distribution. With these intervals we know that the probability of the trait of being lower than k is a 95%. We can also find the probability of finding relevant differences for a trait between two or more treatments. This gives a high flexibility to this type of analyses.

Objectives

Our objective is to study the effect of selection for growth rate on the sensory characteristics of rabbit meat. We use a Bayesian approach.

Materials and methods

Animal material

The animals used in this experiment were originated from a synthetic line selected for growth rate between the 4th and 9th week of life (ESTANY et al., 1992), in the Animal Science Department of Universidad Politécnica de Valencia. Embryos belonging to generation 7th were frozen, thawed and implanted in does in order to produce the control group. The procedure is described by VICENTE et al. (1999). The control group was formed from the offspring of the embryos belonging to the 7th generation, to avoid the effect of cryoconservation. Selected animals belonging to 21st generation were compared with animals of the control group. Control (C) and selected (S) groups were contemporary. Forty animals per group were slaughtered at 9-weeks-old. Animals were slaughtered at the abattoir on the farm, thus they did not suffer stress due to transport. No fasting was practiced. At 24 hours post-mortem the *Longissimus dorsi* muscles were dissected and vacuum packed and frozen at –20ºC until they were required for sensory analysis.

Sensory evaluation

A quantitative descriptive analysis (STONE et al., 1974) was performed by four trained tasters of rabbit meat in 20 sessions. The parameters evaluated were: intensity of rabbit flavour (IRF), aniseed odour (AO), aniseed flavour (AF), liver flavour (LF), tenderness (T), juiciness (J), fibrousness (F). The sensory analysis was carried out on samples of the *Longissimus dorsi* muscle following a complete block design (STEEL and TORRIE, 1980). Samples were vacuum packed and cooked in a water bath at 80ºC for 1 hour. Samples were cut into four pieces and distributed in such way to the panellist to eliminate any location effect within the loin.

Statistical analysis

As panellists had different ranges when scoring sensory traits, variables were transformed dividing by the standard deviation of each panellist, as recommended by (BROCKHOFF et al., 1996). The model used included, group (with two levels, S and C corresponding to selection and control groups respectively), panellist (four panellists), session (20 levels), muscle location (four zones) and sex effects. A Bayesian analysis was performed. Bounded flat priors were used for all unknowns. Data were assumed to be normally distributed. Marginal posterior distributions of all unknowns were estimated by using Gibbs Sampling. After some exploratory analyses we used one chain of 10,000 samples, with a burning period of 2,000, thus marginal posterior distributions were estimated with 8,000 samples each one. Convergence was tested for each chain using the Z criterion of Geweke. Details of the procedure can be found in SORENSEN and GIANOLA (2002).

In sensory analyses, it is difficult to determine what a relevant difference is, thus instead of assessing the differences between the selected and control populations, the ratio of the selection and control effects is analyzed. This is easily made from the results of the Gibbs sampling chains and allows expressing the superiority of the selected over the control population (or conversely the superiority of the control over the selected population) in percentage.

Results and discussion

Features of the estimated marginal posterior distributions of the sensory properties are presented in tables 1 and 2. Monte Carlo standard errors were very small. The Geweke test did not detect lack of convergence in any case. Posterior distributions of sensory properties were symmetrical. This is reflected in the similar values for means and medians, and in the symmetrical high posterior density interval around the mean.

Table 1 shows the features of the marginal posterior distributions of the ratio of the group effects, selection/control (S/C). When S/C >1, we consider that selected and control groups are different if the probability of S/C > 1 is more than 0.95 (*P>1* in table 1 more than 0.95). When S/C <1 we consider that selected and control groups are different if the probability of S/C < 1 is more than 0.95; i.e., when *P>1* in table 1 is less than 0.05. According to the values of *P>1* in table 1, there is a difference between selected and control groups for intensity of rabbit flavour (IRF), aniseed odour (AO), aniseed flavour (AF) and liver flavour (LF). Conversely, no differences were found in tenderness (T), juiciness (J) and fibrousness (F) between groups.

Selected group had a 3% higher value of IRF than control group, with a HPD(95%) from 1.00% to 1.07%. We consider that a relevant difference appears when one group is at least a 10% higher than the other one with a probability higher than 0.95 (Pr: probability of relevance). Although a selection effect appeared for IRF, this effect was not relevant, since the probability that the selected group being at least a 10% higher than the control group was only 0.01.

Conversely, a relevant effect of selection on aniseed odour (AO) and aniseed flavour (AF) appeared (Pr=1), with lower values for selected animals. By calculating the interval (-∞, k] of the marginal posterior distribution containing a 95% of the probability, we can assess the maximum value that the ratio S/C can have with a probability of 0.95. This value was a 0.69 and a 0.63 for AO and AF, respectively, which means that the probability of the selected group being higher than a 69% and a 63% of the control group respectively is only 0.05. These sensory attributes have been previously described in rabbit meat by OLIVER et al. (1997) and HERNANDEZ et al. (2000). The greater intensity of these attributes could provide positive aromatic notes. In these sense, we could consider that selection for growth rate has a negative effect for aroma characteristics, although it is not clear that these differences could be detected by consumers.

An effect of selection for growth rate on liver flavour is also shown in table 1, being a 23% higher the selected group than the control, with a HPD (95%) from 1.03 to 1.44. This attribute is a common descriptor in meat flavour and it has been described previously in beef (FONT et al., 1995). OLIVER et al. (1997) and HERNANDEZ et al. (2000) reported the same descriptor in rabbit meat. These authors considered that an increase of liver flavour could have a negative effect on consumer acceptability. However, the probability that the selected group being at least a 10% higher than the control group was only 0.88, lower than 0.95 that it is minimum value that we have considered relevant.

Table 2 shows the features of the marginal posterior distributions of the ratio of the group effects, males/females (M/F). According to the values of *P>1* in table 2, there is a difference between males and females groups for intensity of rabbit flavour (IRF), with a 4% higher in males than in females. However, this difference was not relevant, since the probability that the selected group being at least a 10% higher than the control group was only 0.01. No differences were found for the rest of the characteristics evaluated.

Table 1. Sensory properties of rabbit meat. Features of the marginal posterior distributions of the ratio of the group effects, selection/control (S/C).

S/C	Mean	Median	HPD(95%)	*P>1*	Pr	k_1	k_2	MCse	Z
IRF	1.03	1.03	1.00, 1.07	0.96	0.01	1.06	1.00	0.0002	-0.11
AO	0.59	0.58	0.47, 0.71	0.00	1.00	0.69	0.49	0.0007	-1.82
AF	0.52	0.51	0.39, 0.65	0.00	1.00	0.63	0.41	0.0007	0.49
LF	1.23	1.22	1.03, 1.44	0.99	0.88	1.41	1.06	0.0011	1.21
T	1.00	0.99	0.96, 1.04	0.49	0.00	1.04	0.97	0.0002	-0.18
J	1.01	1.01	0.95,1.07	0.57	0.01	1.06	0.96	0.0004	-0.32
F	1.02	1.02	0.95, 1.09	0.70	0.01	1.08	0.96	0.0003	1.18

IRF: intensity of rabbit flavour. AO: aniseed odour. AF: aniseed flavour. LF: liver flavour. T: tenderness. J: juiciness. F: fibrousness.
HPD (95%): high posterior density interval at a 95% of probability. *P>1*: Probability of S/C > 1. Pr: Probability of relevance, the probability that one group being at least a 10% higher than the other group. k_1: limit of the interval $(-\infty,k_1]$ containing a probability of 95%. k_2: limit of the interval $[k_2,+\infty)$ containing a probability of 95%. MCse: Monte Carlo Standard error. Z: Z-score of the Geweke test.

Table 2. Sensory properties of rabbit meat. Features of the marginal posterior distributions of the ratio of the group effects, males/females (M/F).

M/F	Mean	Median	HPD(95%)	*P>1*	k_1	k_2	MCse	Z
IRF	1.04	1.04	1.00, 1.07	0.98	1.07	1.01	0.0002	-0.81
AO	1.03	1.02	0.83, 1.22	0.42	1.20	0.87	0.0010	0.14
AF	1.11	1.10	0.87, 1.37	0.80	1.34	0.91	0.0016	-0.56
LF	0.98	0.98	0.81, 1.14	0.40	1.13	0.84	0.0009	1.12
T	0.97	0.97	0.93, 1.01	0.09	1.01	0.94	0.0003	-1.54
J	0.97	0.91	0.91, 1.03	0.16	1.02	0.92	0.0003	-0.21
F	1.04	1.04	0.97, 1.10	0.84	1.09	0.98	0.0003	-0.47

IRF: intensity of rabbit flavour. AO: aniseed odour. AF: aniseed flavour. LF: liver flavour. T: tenderness. J: juiciness. F: fibrousness.
HPD (95%): high posterior density interval at a 95% of probability. *P>1*: Probability of S/C > 1. k_1: limit of the interval $(-\infty,k_1]$ containing a probability of 95%. k_2: limit of the interval $[k_2,+\infty)$ containing a probability of 95%. MCse: Monte Carlo Standard error. Z: Z-score of the Geweke test.

Conclusions

Selection for growth rate has not affected the main characteristics of meat rabbit, like tenderness and juiciness, but it has a negative effect for some flavor characteristics.

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