ACCURATE STUDY ON RABBIT MEAT QUALITY

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Abstract - The meat qualitative characteristics of five rabbit breeds, Californian, New Zealand White, Danish White, German Giant and Belgian, were analysed in present study. The experiments was conducted in the university rabbitry from August 1993 to May 1994. All rabbits were raised under the same conditions. The values pH_1L, pH_1S (the pH values of left musculus longissimus and left semimembranosus after slaughtered in 45 minutes, respectively), pH_2L, pH_2S (the pH values of the samples after chilled in 4°C 24 hr.), are 6.50±0.16, 6.53±0.19, 5.75±0.13 and 5.87±0.17, respectively, and the differences between the breeds are significant ($P < 0.05$ or $P < 0.01$), in pH_1L, pH_1S, and pH_2L. Water holding capacity (%) and cooking percentage (%) are 15.91±3.83 ($P > 0.05$) and 63.67±6.57 ($P > 0.05$). The average storing loss (%) is 1.22±0.62 and the differences between the breeds are significantly demonstrated.

INTRODUCTION

Rabbits are one of the most efficient sources of meat for their polytocous character and comparatively fast growth. They have higher feed conversion ratio and they are not critical for feed quality. Moreover, their meat is always in consumer's good graces for high protein content, low fat and high digestibility. Up to now, however, no consus on the method and standard for evaluating rabbit meat is established and such information is very limited comparing with other species. The present study was designed to seek for the method of measurement, to compare the genetic differences and to provide scientific basis for the selection and breeding of the animals.

MATERIAL AND METHODS

Animals, design and diets

Five breeds, Californian, New Zealand White, Danish White, German Giant and Belgian, were raised in Sichuan Agriculture University rabbitry from August 1993 to May 1994, every breed consisting of 10-12 animals. All healthy tested rabbits with clear pedigree were reared for 100 days. During the first 42 suckling days, the animals were supplemented with the same feed and usual epidemic prevention was held. After weaning, the diet for all rabbits (*ad libitum*) was composed as the following : DE 10.49 MJ/kg, crude protein 17 %, crude fat 5.7 %, crude fiber 9.6 %, Ca 0.58 %, P 0.49 %.

Meat quality parameter

All rabbits were fasted (12 hr.), killed, skinned and eviscerated using conventional methods.

pH -Within a fixed time after slaughter, put the electrode probe of Digital-pH-Meter (Portamesse 651', Firm Knick, Germany) into the meat about 2 cm, then read the number directly.
pH_1L, the pH of the left longissimus muscle between the last rib and the last lumbar vertebra, and pH_1S the pH of the left musculus semimembranosus , were determined in 45 minutes after slaughter. Chill the samples in 4°C for 24 hr. then get pH_2L and pH_2S.

Water holding capacity (WHC) - Within 2 hr. after slaughter, a 2.523 cm diameter core was removed from the right longissimus muscle between the 1st and 4th lumbar vertebra, weighing (W_1), bound up with 18 layers of filter paper and pressed by 35 kg for 5 minutes, then the weight W_2 was obtained. The WHC was expressed with water loss (WL) calculated as follows :

$$WL = (W_1 - W_2) / W_1 \times 100\ \%$$

Cooking percentage (CP) - Within 2 hr. after slaughter, weighed a piece of right musculus semimembranosus (W_1) about 10-25 g, steamed for 30 minutes and cooled under room temperature for 15 minutes, then recorded the weight (W_2). The CP was calculated as follows :

$$CP = W_2 / W_1 \times 100\ \%$$

Storing loss (ST) - Within 2 hr. after slaughter, collected a piece of 2.5 cm long right longissimus muscle between the 4th and the 7th lumbar vertebra (whose weight was W_1), hung it in 4°C refrigerator for 24 hr. and got the weight W_2. The SL was calculated as follows :

$$SL = (W_1 - W_2) / W_1 \times 100\ \%$$

Statistical procedures

Individual records of the tested rabbits were analyzed by conventional least-square methods (HARVEY, 1989) on computer 386.

RESULTS AND ANALYSIS

The least square means of pH, water holding capacity, cooking percentage and storing loss of five breeds are presented in the Table 1.

Table 1 : Rabbit meat qualitative characteristics of five breeds

Breed	pH_1L	pH_2L	pH_1S	pH_2S	WL (%)	CP (%)	SL (%)
Californian	6.61 ± 0.18	5.86 ± 0.19	6.72 ± 0.18	5.96 ± 0.14	19.89 ± 2.33	63.13 ± 3.24	1.03 ± 0.47
New Zealand White	6.65 ± 0.21	5.71 ± 0.09	6.53 ± 0.22	5.84 ± 0.12	18.56 ± 2.57	62.90 ± 1.41	1.41 ± 0.40
Danish White	6.75 ± 0.16	5.76 ± 0.08	6.67 ± 0.18	5.93 ± 0.13	13.28 ± 1.71	65.44 ± 2.58	0.80 ± 0.20
German Giant	6.53 ± 0.11	5.79 ± 0.10	6.39 ± 0.10	5.88 ± 0.10	16.66 ± 0.87	59.74 ± 2.19	0.75 ± 0.29
Belgian	6.67 ± 0.08	5.74 ± 0.05	6.56 ± 0.12	5.95 ± 0.14	17.08 ± 2.65	63.40 ± 1.93	0.84 ± 0.16

pH_2L, pH_1S, pH_2S of Californian and pH_1L of Danish White are the highest while pH_1L, pH_1S of German Giant and pH_2L, pH_2S of New Zealand White are the lowest. The mean value and standard deviation and range of the five breeds about pH_1L, pH_2L, pH_1S, pH_2S are 6.57±0.16 ; 6.31 to 6.80 ; 5.73±0.13 ; 5.63 to 5.86 ; 6.53±0.19 ; 6.37 to 6.78.and 5.87±0.17, 5.79 to 5.96, respectively. Significant differences ($P < 0.05$ or $P < 0.01$) exist in pH_1L, pH_2L and pH_1S between the five breeds. Similar results were obtained by KROGMEIER (1992), but the characteristics of New Zealand White reported by XINGHUA (1994) were lower.

pH is of great importance because high pH would lead to DFD (Dark, Firm, Dry) while low pH would produce PSE (Pale, Soft, Exudative) for pork, both of which will bring enormous pecuniary loss, which also happens on rabbit meat.

When rabbit is killed, blood circulation and oxygen supply cease, which leads to musculus glycogen glycolysis instead of oxidizing with oxygen, producing more lactic acid and muscle pH decreases as a result. At the end of glycolysis, ATP resolves with release of phosphiric acid, which decreases pH further. When meat is stored, microorganism's growth also influences pH greatly.

Therefore, to get an optimum pH requires appratiate amounts of glycogen, ATP and enzyme involved, while they may be different in various breeds, which is to be studied in the future.

Water holding capacity - WL of Californian is the highest and that of Danish White the lowest. The average is 15.91 % with a standard deviation of 3.83 %, varying from 13.28 % to 19.89 %. The lower the WL is, the better the WHC is. No significant differences can be detected between the tested breeds. The results were almost in agreement with expectations based on qualitative characteristics of New Zealand White (XINGHUA, 1994).

WL is another important parameter influenced by species, breed, muscule, sex, age, *feeding and so on* (WUDING, 1993). A great number of ATP reside in living rabbit muscle and inhibit myosin from binding with actin, which results in a great deal of water permeating between them and making cell swell and keep high WHC. But when rabbit is killed, musculus glycogen glycolysis begins, producing only 3 ATP, 36 ATP less than oxidizing with oxygen for 1 glycogen. The pathway of phosphocreatine producing ATP is also held up. So Ca^{2+} is released, which activitiates myosin, then Mg ATP complex decomposes and ATP decreases further. The final result is myosin binding with actin and the water between them is squeezed out.
Since pH decreases explained as above, the polarity of protein molecular changes, crippling the attraction to water, then the water bound by protein is released. Therefore, to a certain extent, we can say that WHC is determined majorly by glycogen glycolysis and pH. But differences only exist in pH not in WHC between the five breeds from the study, maybe there are other reasons.

Cooking percentage - CP of Belgian is the highest and that of German Giant the lowest. The mean is 63.67 % with a standard deviation of 6.57 % and a range of 59.74 %±68.87 %. No significant differences are noted between the breeds. The results are in agreement with previous reports (SCHARUER, 1974 ; NATH, 1993 ; XINGHUA, 1994).
During steaming, the major lost is water and some volatile substance. The farther pH deviates from PI (isoelectric point) of proteins, the more seriously they denature and the more water is released. This suggests that CP may be correlated with the amounts and sorts of musculus protein as well as pH. It is easy to understand high WHC will result in high CP. The amounts and sorts of vitamin and fatty acid are also related to the loss. According to this theory and the results of the study, maybe no significant differences exist in the components of rabbit meat between the five breeds. Whether it is true or not needs further study.

Storing loss (SL) - SL of New Zealand White is the highest and that of German Giant the lowest ($P < 0.05$). The average is 1.22 % with a standard deviation of 0.62 %, which than MENDIRATTA and PANDA's results (1992).
Meats with different pH have different WHC explained as before, which means the amount of water evaporated during chilling is also different. SL is related to the amount and existing forms of water in muscle. The more free water, the higher SL. The amount and activity of enzyme greatly influence the growth of microorganism as well as pH, which directs protein discomposing and affects the lost water in turn.

DISCUSSION

1. The method suggested in this paper is pratical and effective. Of all parameters, pH is the most important and the easiest to get correctly, which is highly correlated with others. High rate of pH fall leads to low WHC, which seriously decreases meat tenderness and CP while raising SL and WL greatly. CP and SL are two important economic criteria.
2. All of the meats tested in the study are normal, with higher pH, better WHC, higher PC and lower SL compared with other species (MENDIRATTA, 1992). Judged by pH, Californian is the best and by storing loss German Giant the best, while no significant differences exist in water holding capacity and cooking percentage among the five breeds. According to the standard deviation of the seven characters, German Giant is the most stable and Californian the most changeable. The interpretation of the results needs further study.
3. There are many factors that influence meat quality seriously, i.e., breed type, year, climate, treatment before slaughter, different muscle, sex, degree of inbreeding, nutrition plane, different method of measurement, health conditions and so on (WUDING, 1993). Different content of enzymes and hormones may also be related to meat quality. In the future, we should pay more attention to these questions to find the mechanism directing meat quality.
4. At present, the main emphasis of rabbit breeding is on increasing growth rate and feed conversion ratio. Based on genetic correlation between meat yield and meat quality, it may be thought that the quality will decrease if no attention is paid (HOVENIER *et al.*, 1994). If we use economic criterion to value meat quality, we would keep the quality at the present level or make a slight improvement, and it will be necessary to include the economic criterion in a selection index at least in the breeding aim in such a way the quality would not worsen.

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