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# EFFECT OF AGE AT SLAUGHTER ON QUALITY OF CARCASS AND MEAT IN COWS

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## ABSTRACT

In the study, quality of carcass (SEUROP), meat (musc.long.dorsi - MLD) and occurrence of the qualitative deviation in meat dark cutting beef (DCB) were compared with slaughter cows at the age to 4 years (3.03) and at the age over 4 years (6.59). Better meat contents in carcass (1.40) and larger MLD area (68.10 $m^2$) was noted in older cows (B). In fattiness of carcass there were no statistically significant differences between groups (A-1.88, B-1.93). Chemical analysis of MLD showed that older cows had less water (73.88 and 75.72 g.100 $g^{-1}$, resp.) but more proteins (20.57 and 19.98 g.100 $g^{-1}$, resp.) and intramuscular fat (4.50 and 3.30 g.100 $g^{-1}$, resp.) in the muscular substance. There were no statistically significant differences among age groups of cows in physico-technological parameters and sensorial evaluation of grilled meat. However, the trends suggest that there is darker meat and higher values of shear force in grilled meat of older cows. Occurrence of DCB deviation was balanced in both groups and it was about 6.50 %.

Key words: cows, age, carcass quality, meat quality, DCB

## INTRODUCTION

Each meat from different species of farm animals is marked by typical properties. The consumer is aware of them and he perceives them and according to his needs and possibilities (health, social, etc) he buys meat for further culinary utilization.

Cattle offers meat for processing and direct consumption from a number of slaughter animals (calves, young bulls, bulls, cows, oxen and heifers) in contrast to other categories of farm animal species. Each category is marked by specific needs in production phase of meat production and known are also differences in quality of carcass and meat.

In the last few years a rise in the proportion of cows in total number of slaughtered cattle has been noticed in Slovakia because of several reasons. At present it represents some 50 -55 %. On the basis of calculations Koucký and Kudrna (2006) stated that the Czech Republic represents the proportion of cow meat more than one third of beef consumption per inhabitant and year out of the total annual beef consumption. In contrast to the past cow meet is now-a-days offered to consumers also at different stages of trade network. The positive aspect for the consumers is that the slaughter category, from which the beef originates, is known at sale. Consumer's price of cow meet is 15 – 20 % lower compared to meat of bulls although the quality of cow meat produced at present remains doubtful. It is often discussed at different specialist platforms whether the cow meat should not only be processed, there are even opinions that selling in shops should be completely prohibited (Steinhauser, 2001) or that meat of cows for selling at shops should be limited by the age of 3 years, which means the selected first-calf-cows (Franc and Herrmann, 1994; Jedlička, 1988). In some states cow meat is not accepted for selling.

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A number of authors studied the quality of skeletal muscles in cows at different ages at slaughter form various views (Hoffman, 2006; Moon et al., 2006; Stika et al., 2007; Xiong et al., 2007; Galli et al., 2008). The aim of this study was to compare the meat quality from randomly selected slaughter cows divided into two groups at different ages at slaughter.

## MATERIAL AND METHODS

Fifty eight randomly selected cows, slaughtered at different slaughter-houses in Slovakia, were used in the study. The set of cows was divided into two categories according to age: cows under 4 years of age (group A) and cows over 4 years (group B). There were 26 animals in group A and 32 in group B during the experiment. Carcasses were weighed and classified after slaughter by a classifier according to the SEUROP system and classed within a class of quality and fattiness. Following values were used for numeral expression and for evaluation of meat contents: class E - 5, U – 4, R – 3, O – 2 and P – 1.

Real meat quality was evaluated in samples of MLD, which were taken from the region of $9^{th} – 10^{th}$ ribs 24 hours post mortem. Samples were stored in a refrigerator at a temperature of 1 - 3°C until next analyses. Marbling degree was assessed by 10 point scale (USDA, 1997) on MLD cut after 48 hours of storage. Degree 1 represented very intensive marbling and degree 10 marbling without traces of intramuscular fat. MLD area was measured by planimeter (Daro Reiss Precision, Germany).

Chemical analysis of the sample was done using the apparatus Infratec 1265 Meat Analyser (Tecator, Sweden). We also measured pH value ($pH_{48}$) by portable, battery-operated pH meter, type 3071 (Jenway, England). At the same time, pH value of meat was used as a criterion for evaluation of DCB qualitative deviation occurrence; for DCB meat with $pH_{48}$ over 6.2 was taken. Meat colour was measured by the apparatus Mini Scan x E Plus (Hunter lab., USA), water holding capacity by modified Grau-Hamm's method (Palanská and Hašek, 1976) and electric conductivity in muscular substance by the apparatus PMV 51 (Biotech, Slovak Republic). Grilling tests were done with 2.5 cm thick slices of meat in contact grill, model PM-1015 (RM Gastro, Czech Republic) at the temperature of 180° C for 4 minutes on seventh day after slaughter. Shear force of grilled meat was measured subsequently by the apparatus Texture Analyser TA.XT2i (Stable Microsystems, England) equipped with a Warner-Bratzler knife. Sensorial quality of meat was assessed by three panels according to a 5 point scale.

PC programme Excel 2000 was used to evaluate the results statistically (basic parameters, t-test).

## RESULTS AND DISCUSSION

### Carcass quality

Average age of slaughtered cows in group A was 3.03 years and in group B 6.59 years, the difference being statistically significant ($P<0.01$).

At present, the preferred classification system in Europe is the SEUROP system, which is used to evaluate the quality of carcass and to assess the degree of meat contents and fattiness. This system was also used to obtain results of carcass quality in both the age groups as demonstrated in table 1. The results showed that older cows in group B had better meat contents (1.40) than younger cows (1.15), these differences were statistically significant. In general, we can negatively assess the meat contents in carcasses of slaughtered cows, as most of them were classified in the worst classes of meat O and P. Mojto et al. (2007) analysed slaughter cattle killed in Slovakia in 2006 and they found that up to 74 % carcasses of cows were classified in the worst classes of meat O and P. Moon et al. (2006) did not find statistically significant differences among groups of slaughter cows while evaluating the quality of carcass (the so called "yield grade"); the cows were divided into three age groups (young, medium old and old) .

**Table 1: Some parameters of carcass quality**

| Parameter | Cows to 4 years of age (A) (n = 26) | | | | Cows over 4 years of age (B) (n = 32) | | | | S (t-test) |
|---|---|---|---|---|---|---|---|---|---|
| | $\bar{x}$ | $s_{\bar{x}}$ | min. | max. | $\bar{x}$ | $s_{\bar{x}}$ | min. | max. | |
| Age at slaughter | 3,03 | 0,15 | 2,00 | 4,00 | 6,59 | 0,35 | 5,00 | 14,00 | A : B++ |
| Class of conformation | 1,15 | 0,72 | 1,00 | 2,00 | 1,40 | 0,08 | 1,00 | 2,00 | A : B+ |
| Class of fat cover | 1,88 | 0,13 | 1,00 | 3,00 | 1,93 | 0,14 | 1,00 | 4,00 | |
| Weight of carcass kg | 218,65 | 10,09 | 129,00 | 334,00 | 269,03 | 10,10 | 154,00 | 411,00 | A : B++ |
| Area of m.long.dorsi $cm^2$ | 60,80 | 2,17 | 43,00 | 80,00 | 68,10 | 2,59 | 41,00 | 96,00 | A : B+ |
| Occurence of DCB % | 6,44 | 0,06 | | | 6,78 | 0,19 | | | |

+P ≤0,05; ++ P ≤0,01

Age differences were not manifested with fattiness. Differences among groups were minimal and on average near 2nd class of fattiness, which means moderate degree of fattiness in carcass.

MLD area is important from the commercial point of view. It is one of the four decisive parameters while evaluating carcass quality at purchase according to the "yield grade" system. In the present study, MLD area was significantly larger (68.10 $cm^2$) in older cows (B) than the younger animals in group A (60.80 $cm^2$). Similar to meat contents MLD area in slaughtered cows can be described as insufficient. Moon et al. (2006) already found MLD area of 65.18 $cm^2$ in old cows and 73.59 $cm^2$ in young cows.

Manipulation with animals before slaughter results in occurrence of qualitative DCB deviation for different reasons (physical activity, emotional stress, etc.). This phenomenon of high final pH value of meat and dark colour occurs in cows also, however, substantially less frequently as e.g. in the category of young bulls. We found no differences in the occurrence of DCB deviation between the studied age categories. Detected values were 6.44 % in group A and 6.78 % in group B.

**Meat quality (MLD)**

Meat quality of slaughter cows, in a strict sense, is expressed as a number of qualitative parameters. Detailed results are shown in tables 2 – 4, in accordance with the common classification into chemical, physico-technological and sensorial parameters.

Chemical composition of meat (table 2) showed differences between group B and A; cows in group B had less total water (73.88 and 75.22 g.100 $g^{-1}$, respectively) and more proteins (20.57 and 19.98 g.100 $g^{-1}$, resp.) and intramuscular fat (4.50 and 3.30 g. 100 $g^{-1}$, resp.).Total energy value of meat was also higher with older cows. All these differences between group A and B were statistically significant. Hoffman (2006) reported 73.49 and 75.90 g.100 $g^{-1}$ water, 23.83 and 20.67 g.100 $g^{-1}$ proteins, and 1.74 and 1.50 g.100 $g^{-1}$ intramuscular fat in 10 – 13 years old cows of Simmental breed in MLD of the right and left carcass halves, respectively. Our results are interesting in comparison, mainly because of low values of fat. Galli et al. (2008) divided the studied set of Hereford cows into 4 age groups: 3, 4 – 5, 6 – 8 and 12 years. Content of total water varied from 73.49 to 75.26 g.100 $g^{-1}$. The oldest 12 years old cows had the least content of proteins in meat (21.23 g.100 $g^{-1}$) and also the least amount of intramuscular fat (1.97 g.100 $g^{-1}$).

Physico-technological parameters of MLD are presented in table 3. We found statistically significant differences between groups only in electric conductivity in meat, with higher value 4.19 m S in group B, out of the most important parameters. We can speak about trends only as far as other parameters are concerned (colour of meat, loose water, shear force), with somewhat worse results in group B. Interesting are the results in marbling of meat; the knowledge that there is more marbled meat in older cows was not confirmed, although differences were found after chemical assessment of intramuscular fat (table 1). However, Galli et al. (2008) found no significant differences in $pH_{24}$ value, colour of meat (L*) and shear force in their study. However, they stated that with age of cows the intensity of fat colour increases towards yellow. Moon et al. (2006) reported higher weight losses with cooking of meat and significantly higher values of shear force (N), i.e. tougher meat in old cows. Xiong et al. (2007) also found higher values of shear force in older cows. Stika et al. (2007) are of the opinion that as cow grows older the meat quality decreases.

Consumer assessment is an important test of quality. The panel assessment of four important sensorial parameters of meat (tenderness, smell, juiciness, taste) showed no statistically significant differences in any of the parameters among the groups (table 4). It means that the panels did not find significant differences in quality of grilled meat between younger and older cows. Moon et al. (2006) from a comparative experiment reported that in all sensorial evaluated parameters the meat from old cows got less points from panels. It was manifested

**Table 2: Basic chemical analysis of musc.long.dorsi**

| Parameter | | Cows to 4 years of age (A) (n = 26) | | | | Cows over 4 years of age (B) (n = 32) | | | | S (t-test) |
|---|---|---|---|---|---|---|---|---|---|---|
| | | $\bar{x}$ | $s_{\bar{x}}$ | min. | max. | $\bar{x}$ | $s_{\bar{x}}$ | min. | max. | |
| Content of water | g . 100 $g^{-1}$ | 75,72 | 0,34 | 72,01 | 78,92 | 73,88 | 0,38 | 69,11 | 77,63 | A : B++ |
| Content of proteins | g . 100 $g^{-1}$ | 19,98 | 0,18 | 18,36 | 21,62 | 20,57 | 0,15 | 18,64 | 22,12 | A : B+ |
| Content of fat | g . 100 $g^{-1}$ | 3,30 | 0,27 | 1,20 | 5,55 | 4,50 | 0,42 | 1,07 | 9,28 | A : B+ |
| Energetic value | KJ. 100 $g^{-1}$ | 459,13 | 11,15 | 372,21 | 550,20 | 514,49 | 15,06 | 377,71 | 693,38 | A : B++ |

+P ≤0,05; ++ P ≤0,01

**Table 3: Physical-technological quality of musc.long.dorsi**

| Parameter | Cows to 4 years of age (A) (n = 26) | | | | Cows over 4 years of age (B) (n = 32) | | | | S (t-test) |
|---|---|---|---|---|---|---|---|---|---|
| | $\bar{x}$ | $s_{\bar{x}}$ | min. | max. | $\bar{x}$ | $s_{\bar{x}}$ | min. | max. | |
| Color of meat (L-value) | 29,20 | 0,72 | 22,51 | 38,61 | 28,92 | 0,53 | 20,67 | 34,46 | |
| $pH_{48}$ | 5,91 | 0,06 | 5,22 | 6,57 | 5,85 | 0,36 | 5,47 | 7,13 | |
| Loose water g.100 $g^{-1}$ | 29,85 | 0,82 | 23,01 | 39,84 | 31,55 | 0,88 | 19,81 | 40,44 | |
| Marbling of meat (degrees) | 7,61 | 0,30 | 3,00 | 10,00 | 7,15 | 0,26 | 4,00 | 9,00 | |
| Shear force in grill meat kg | 9,68 | 0,68 | 3,81 | 16,79 | 10,59 | 0,70 | 3,06 | 20,02 | |
| Electric conductivity in meat m S | 2,95 | 0,18 | 1,50 | 5,20 | 4,19 | 0,34 | 1,70 | 9,40 | A : B++ |

++ P ≤0,01

**Table 4: Sensorial evaluation of grilled meat (points)**

| Parameter | Cows to 4 years of age **(A)** (n = 26) | | | | Cows over 4 years of age **(B)** (n = 32) | | | | S (t-test) |
|---|---|---|---|---|---|---|---|---|---|
| | $\bar{x}$ | $s_{\bar{x}}$ | min. | max. | $\bar{x}$ | $s_{\bar{x}}$ | min. | max. | |
| Tenderness | 3,39 | 0,16 | 2,00 | 5,00 | 3,36 | 0,14 | 1,00 | 5,00 | |
| Smell | 3,66 | 0,10 | 2,60 | 5,00 | 3,70 | 0,10 | 2,60 | 5,00 | |
| Juiciness | 3,49 | 0,11 | 2,30 | 4,60 | 3,62 | 0,12 | 2,30 | 4,60 | |
| Taste | 3,58 | 0,12 | 2,30 | 5,00 | 3,61 | 0,12 | 1,00 | 5,00 | |

mainly when total acceptability was expressed – meat of old cows got an average of 3.69 points vs. 4.48 and 4.42 points with young and medium old cows, respectively.

## CONCLUSION

Results showed the differences in quality of carcass among age groups of slaughter cows. It may be correlated with different slaughter weights. Chemical composition of meat is interesting mainly because of higher content of intramuscular fat in older cows, which was not confirmed by many investigators in their comparative experiments.

No significant differences were found in physico-technological parameters and sensorial parameters of meat among the age categories of cows. Obtained results can be implications of only 3 years' differences between the assessed groups. On the basis of existing scientific knowledge worse results can be expected in meat quality at higher age of cows at slaughter.

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