Meat quality of beef from young bull carcases varying in conformation or fatness according to the EUROP classification system

Piotr Janiszewski, Karol Borzuta, Dariusz Lisiak, Eugenia Grześkowiak and Krzysztof Powałowski

Department of Meat and Fat Technology, Prof. Waclaw Dąbrowski Institute of Agricultural and Food Biotechnology, Poznań, Poland

ABSTRACT

A total of 172 bull carcases were studied in order to determine a relation between m. longissimus dorsi (LD) quality and EUROP grades. The carcases were of four conformation grades and three fatness grades. The quality assessment of the m. LD was performed and based on a pH measurement, colour measured with a Minolta CR-400 and marbling estimation. Based on the available research a thesis might be forwarded that both types of carcase classification: conformation and fatness are not related with the meat quality of studied carcase grades. Only share of redness and yellowness values were lower in meat of P carcase grade as well as the lowest marbling was in meat of U carcase grade. It was also stated that bull’s hot carcase weight was higher as the better conformation class and as the higher fatness class. Similar relation in the rib-eye area of LD muscle of different conformation grades was observed.

ARTICLE HISTORY

Received 22 May 2017
Revised 31 August 2017
Accepted 13 September 2017

KEYWORDS

Bull carcases; EUROP classes; meat quality

Introduction

Nowadays, the methods of estimating beef cattle slaughter performance are based on after slaughter carcase estimation and its typical example functioning in the EU is EUROP system (Commission Regulation EC 2008). Beef carcases are classified and based on the visual estimation of the following traits: carcase conformation expressed in six grades (S, E, U, R, O, P) and fat content expressed in five grades (1st grade for carcases with low fat content, 5th grade for carcases with high fat content). Carcass conformation was estimated on the basis of the development of carcase profile in particular the essential parts (round, back, shoulder). This classification system is very subjective and does not guarantee a uniformity of estimations between different countries or even between classifiers (Borggaard et al. 1996).

The classification of beef carcases according to EUROP grades is related mostly to quantity traits, that is, muscle and fat content. There are also systems of carcase classification based on quantity and quality estimation, for example American, Australian or Japanese systems.

In EU member states, the carcase classification system is based on estimating and describing quantity traits, that is, muscle and fat content in warm carcasses. Whereas classification systems in the USA, Japan and Australia are based on the estimation of carcase quality traits performed on the cross sections of cold carcasses in the place where carcases are cut for quarters and also additionally based on the estimated output of commercial carcase cuts (Polkinghorne et al. 2008; Hocquette et al. 2010; Polkinghorne and Thompson 2010).

According to the presented methods of beef carcase classification, it can be said that system functioning in the European Union is a typical quantity system and does not include any elements of quality assessment. Nonetheless, a different meat and fat tissue ratio in the individual grades of conformation and fatness may be related to some quality traits. This opinion in the literature is rather skimpy and ambiguous. Wajda and Daszkiewicz (2000) confirmed a lack of significant differences between the physiochemical traits, chemical composition and sensory traits of bull meat of different conformation grades. Other authors (Florok and Litwińczuk 2001a, 2001b) proved the relation but only when it comes to physiochemical meat traits. The research showed that beef from the carcases of a higher fat content grade were of higher marbling and...
lower pH and also with better values of sensory traits (Daszkiewicz and Wajda 2000; Daszkiewicz et al. 2003).

The goal of the research was to study the influence of conformation and fatness grades of estimated using the classification EUROPI system, on meat quality. The experiment was conducted on the bull carcases which share in the cattle population in Poland reached about 45% (Janiszewski et al. 2015).

Material and methods

The research was performed in the summer time in slaughterhouse located near Poznan. Number of studied carcases in individual classes was presented in Table 1. All together bulls were Black and White breed and its age was about 24 months. All the animals were slaughtered after 24 hours of rest. The carcases were classified according to the EUROP system by the authorised classifier with accordance to Commission Regulation (EC) No 1249/2008. Beef carcases obtained from the slaughter of young bulls were divided first depending on class of conformation and than on class of fatness and four group of the classes of conformation (U, R, O, P) and three group of the classes of fatness (1,2,3), according to the plan of the experiment (Table 1), were formed. The classes of conformation E and fatness 5 and 4 were not included in the experience, because the share of these classes in the purchasing structure in Poland is very small, approximately 0.1–0.7% (Janiszewski et al. 2015). After cooling with a one-step system at about 4°C, the half carcases were cut between the 7th and 8th rib (so called the pistola cut), so that the assessment of the m. longissimus dorsi cross section was possible to be done. The width and height of the m. longissimus dorsi cross-section was measured with a ruler and its area was calculated as a product of these two measurements multiplied by the 0.8 index (Wichlacz 1999).

The quality assessment included pH24 and lightness and the L*, a*, b* colour components as well as score assessment of the colour using pattern (1 point light colour, 5 points dark colour) and also a score assessment of marbling using the pattern (1 point marbling not visible, 5 points high marbling). Colour and marbling assessment was done by the team of 3 – trained persons. Measurements of the pH were done with the PHM 80 pH-meter with a combined electrode. Meat colour was measured with the Hunterlab system using a Minolta CR 400 spectrophotometer determining L*, a*, b* colour parameters.

Statistical calculation was done with StatSoft, Inc. (2003) STATISTICAL, version 6 (www.statsoft.com) software, using a one-way analysis of variance. Significance of the differences between the average values was determined with the Tukey’s test. The influence of carcase grades on the frequency of Dark, Firm and Dry – meat (DFD) cases was determined and based on chi². As a DFD was recognised the meat with pH24 >6.2 in m. longissimus dorsi (Pisula and Pospiech 2011).

Results and discussion

The results of the measurements and the assessment of the basic quality traits of the m. longissimus dorsi proved that there were no differences between conformation classes in pH24 and colour lightness L* and colour evaluation (Table 2). It was stated only that share of red and yellow colour (a* and b* parameter) were lower (p <.05) in meat of P-grade carcases than in other grades. Longissimus dorsi marbling of R, O and P grades was significantly (p ≥.01) higher as the marbling of the U carcase grade. It can be observed that there were significant differences between

Table 1. Number of bull carcases in studied EUROPI classes.

| Conformation classes | Fatness classes |
|----------------------|----------------|
| U  R  O  P           | 1  2  3         |
| 21  42  92  17        | 53  72  42      |

Table 2. Quality of m. Longissimus dorsi in different EUROPI conformation classes of young bull carcases.

| Conformation classes | U  | R  | O  | P  |
|----------------------|----|----|----|----|
| Quality traits       | x  | SD | x  | SD | x  | SD |
| pH24                 | 5.79 | 0.14 | 5.73 | 0.14 | 5.70 | 0.14 | 5.75 | 0.20 | 0.20 | 0.30 |
| L*                   | 35.16 | 2.0 | 36.43 | 2.0 | 36.99 | 2.0 | 37.79 | 2.0 | 37.79 | 2.0 |
| a*                   | 20.99 | 2.0 | 20.10 | 2.0 | 18.28 | 2.0 | 17.43 | 2.0 | 17.43 | 2.0 |
| b*                   | 5.26 | 2.0 | 5.06 | 2.0 | 5.34 | 2.0 | 5.28 | 2.0 | 5.28 | 2.0 |
| Meat colour evaluation, pts | 2.75 | 0.0 | 3.01 | 0.0 | 3.29 | 0.0 | 3.53 | 0.0 | 3.53 | 0.0 |
| Marbling evaluation, pts | 1.42 | 0.0 | 2.25 | 0.0 | 2.46 | 0.0 | 2.44 | 0.0 | 2.44 | 0.0 |
| Rib-eye area*, cm²   | 41.26 | 5.17 | 35.27 | 5.17 | 30.50 | 5.17 | 32.30 | 5.17 | 32.30 | 5.17 |
| Hot carcase weight, kg | 382.07 | 47.27 | 366.10 | 47.27 | 333.11 | 47.27 | 240.25 | 47.27 | 240.25 | 47.27 |

**Means in rows with different uppercase letters are significant at p ≤ .01.**

**Means in rows with different small letters are significant in rows at p ≤ .05.**

**Area of cross-section of LD muscle between 7 and 8 ribs.**
conformation classes in slaughter value traits. Hot carcase weight was as higher as was better the conformation class. Alike the rib-eye area was higher in U and R grades than in O and P grades. It can be assumed that the classification system of carcass conformation is not related with meat quality in the basic carcass grades i.e. the U, R, O and P. However, there were significant differences between slaughter value traits in studied grades, that is, hot carcase weight and rib-eye area.

No significant differences in all studied quality traits and also rib-eye area between fatness grades 1, 2 and 3 were found. Only a relation between the fat content grades and the warm carcases weight was visible (Table 3) \((p < .01)\). The higher the fatness the higher the carcase weight. No significant differences in interaction ‘conformation \times fatness classes’ of all studied traits was stated.

The results of the meat quality defects presented in Table 4 did confirm any relations between the carcasses of different EUROP grades. The chi\(^2\) test showed a non-significant influence \((p > .05)\) of the carcass conformation grade as well as the carcass fatness grade on the frequency of the DFD meat. In all grades the DFD meat was not registered or was present only in a few per cent of the carcasses (O, P, 1 and 2 classes).

The research of Wajda and Daszkiewicz (2000) performed on the LD muscle of three carcass conformation grades, that is, U, R and O did not show significant differences nor in the physio-chemical traits \((\text{pH, colour lightness, water-holding capacity})\) nor in the sensory traits, between the grades. The investigation of Florek and Litwińczuk (2001a) did indicate worse values of the physio-chemical traits of meat from P-grade carcases. American and Australian studies have indicated differences in the meat quality of different USDA and MSA (Meat Standard Australia) carcass grades (Bratcher et al. 2005; Thompson et al. 2008; O’Quinn et al. 2015).

The studied traits of the slaughter value presented in Table 2 were clearly dependent on the carcass conformation grade. The carcases of the U and R grade were heavier than those of the O and P. The rib-eye area was the biggest in the U grade and the smaller in the O and P grades. No significant differences of the rib-eye area in the U and R grade were found. The research of Wajda and Daszkiewicz (2001) and Nogalski et al. (2014) performed on bulls’ carcases showed that meat of higher fatness carcases was of higher marbling. In the next research Daszkiewicz et al. (2003), the authors confirmed that the meat of heifers with higher subcutaneous fat content had better sensory traits.

The main reason why there were no differences in the level of the most important meat quality features among different carcases estimated with the EUROP

---

### Table 3. Quality of M. Longissimus dorsi in different EUROP fatness classes of young bull carcases

| Fatness classes | 1     | 2     | 3     |
|-----------------|-------|-------|-------|
| Quality traits  | \(\bar{X}\) | SD    | \(\bar{X}\) | SD    | \(\bar{X}\) | SD    | \(P\) |
| \(\text{pH}_24\) | 5.76  | 0.17  | 5.70  | 0.14  | 5.71  | 0.13  | .25  |
| \(L^\ast\)      | 35.47 | 3.86  | 36.72 | 6.68  | 38.08 | 3.75  | .63  |
| \(a^\ast\)      | 17.58 | 3.93  | 18.63 | 2.92  | 20.78 | 3.54  | .13  |
| \(b^\ast\)      | 2.97  | 3.20  | 3.08  | 3.03  | 3.75  | 2.65  | .58  |
| Meat colour evaluation, pts | 3.45  | 1.06  | 3.11  | 0.89  | 3.03  | 0.91  | .44  |
| Marbling evaluation, pts | 1.89  | 0.86  | 2.39  | 0.88  | 2.59  | 1.00  | .16  |
| Rib-eye area\(^a\), cm\(^2\) | 34.34 | 8.34  | 33.43 | 7.32  | 33.16 | 6.87  | .88  |
| Hot carcase weight, kg   | 329.12\(^a\) | 66.24 | 344.15\(^a\) | 59.72 | 382.46 |      | .01  |

\(^a\) Means with different uppercase letters are significant in rows at \(p < .01\).

\(^*\) Area of cross section of LD muscle between 7 and 8 ribs.

### Table 4. Percentage of carcases with DFD meat dependant on conformation and fatness classes.

| Conformation classes | Number of carcases with DFD meat | % of carcases with DFD meat | Fatness classes | Number of carcases with DFD meat | % of carcases with DFD meat |
|----------------------|----------------------------------|-----------------------------|-----------------|----------------------------------|-----------------------------|
| U                    | 20                               | 0                           | 1               | 55                               | 2                           | 3.60 |
| R                    | 43                               | 0                           | 2               | 73                               | 1                           | 1.40 |
| O                    | 93                               | 2.20                        | 3               | 48                               | 0                           | 0    |
| P                    | 18                               | 5.60                        |                 |                                  |                             |      |

\(\text{chi}^2\) emp. = 1.17
\(\text{chi}^2\) 0.05 = 7.81

DFD: Dark, Firm and Dry – meat; \(\text{chi}^2\) emp: the \(\text{chi}^2\) test’s empirical value.
system is the lack of criteria for estimating carcase quality. In order to introduce these criteria, carcases should be classified after cooling down and should be cut on the quarter to reveal the cross-section of the LD muscle. An estimation of carcases using colour, marbling and rib-eye area patterns and additionally pH24 measurement would be a basis sufficient enough to classify the carcases into some quality grades. These quality grades could be supplemental to the EUROP quantity classification system. The assessment done with the rib-eye pattern would be an additional and objective criterion for estimating the conformation of the beef carcase. Thanks to such a modification of the European beef carcases classification system, the system would become more comparable with the American, Australian and Japanese classification ones. The newest French study also proposed a set of indicators, in addition to the EUROP system, to characterise beef carcases in slaughterhouses in a more precise way that considers the interests of the different stakeholders in Europe. Finally, five indicators were proposed: hindquarter weight, meat colour, retail-cut yield, rib-eye area and marbling score (Monteils et al. 2017).

Conclusions

The research done on the population of 172 young bulls carcases classified according to the EUROP classification system showed a weak relation between the quality traits of the longissimus dorsi muscle and conformation and fatness grades. In order to develop the EUROP classification system, the information on meat quality could be added. To do that we need to modify the system by implementing a quality assessment criteria and that requires a switch from an estimation of warm carcases to an estimation of cold carcases.

Disclosure statement

No potential conflict of interest was reported by the authors.

References

Borggaard C, Madsen NT, Thodberg HH. 1996. In-line image analysis in the slaughter industry, illustrated by beef carcase classification. Meat Sci. 43(Suppl):151–163.
Bratcher CL, Johnson DD, Litell RC, Gwartney BL. 2005. The effects of quality grade, aging, and location within muscle on Warner-Bratzler shear force in beef muscles of locomotion. Meat Sci. 70:279–284.
Commission Regulation (EC) 2008. Commission Regulation (EC) No 1249/2008 of 10 December 2008 laying down detailed rules on the implementation of the Community scales for the classification of beef, pig and sheep carcases and the reporting of prices thereof.
Daszkiewicz T, Wajda S, Bąk T, Matuszevicus P. 2003. Jakość mięsa jałowców mieszańców ras czarno-białej x Limousin w zależności od klasy otłuszczenia w systemie EUROP. Zesz Nauk Przegl Hodowl. 68:275–282.
Daszkiewicz T, Wajda S. 2000. Quality of meat from carcases of bulls from crossing Limousine bulls with Black and White cows classed to the different classes of fatness in EUROP system (in Polish). Roczn Inst Przemy Mięsn i Tł. XXXVIII:43–49.
Florek M, Litwińczuk Z. 2001a. Interdependences between evaluation of half-carcase conformation and fatness in EUROP system and physicochemical quality of young bull meat. Pol J Food Nutr Sci. 10/51:201–204.
Florek M, Litwińczuk Z. 2001b. Comparison of physicochemical quality of young bull meat classification into three commercial classes EUROP. Pol J Food Nutr Sci. 10/51:205–208.
Hocquette JF, Legrand I, Jurie C, Pethick DW, Micol D. 2010. Perception in France of the Australian system for the prediction of beef quality (Meat Standards Australia) with perspectives for the European beef sector. Anim Prod Sci. 51:30–36.
Janiszewski P, Borzuta K, Lisiał D, Powałowski K, Samardakiewicz Ł. 2015. Effect of carcass conformation and fatness on beef pH and characterization of the purchase structure of domestic beef cattle. Scient Ann Pol Soc Anim Prod. 11:56–67.
Monteils V, Sibra C, Ellies-Oury MP, Botreau R, De La Torre A, Laurent C. 2017. A set of indicators to better characterize beef carcases at the slaughterhouse level in addition to the EUROP system. Liv Sci. 202:44–51.
Nogalski Z, Wielgosz-Groth Z, Purwin C, Nogalska A, Sobczuk-Szul M, Winarski R, Pogorzelska P. 2014. The effect of slaughter weight and fattening intensity on changes in carcass fatness in young Holstein-Friesian bulls. Ital J Anim Sci. 13:66–72.
O’Quinn TG, Brooks JC, Miller MF. 2015. Consumer assessment of beef tenderloin steaks from various USDA quality grades at 3 degrees of doneness. J Food Sci. 80:444–449.
Pisula A, Pospiech E. 2011. Mięso podstawy nauki i technologii. Warszawa, 520 str: Wydawnictwo SGGW.
Polkinghorne RJ, Thompson JM, Watson R, Gee A, Porter M. 2008. Evolution of the Meat Standards Australia (MSA) beef grading system. Australian J Exp Agricult. 48:1351–1359.
Polkinghorne RJ, Thompson JM. 2010. Meat standards and grading: a world view. Meat Sci. 86:227–235.
Thompson JM, Polkinghorne R, Hwang IH, Gee AM, Cho SH, Park BY, Lee JM. 2008. Beef quality grades as determined by Korean and Australian consumers. Australian J Exp Agricult. 48:1380–1386.
Wajda S, Daszkiewicz T. 2000. Quality of meat from carcases of Black and White bulls and crossbred bulls from crossing Limousine with Black and White cows assigned to different musculature classes in the EUROP system after different time of ageing (in Polish). Roczn Inst Przemy Mięsn i Tł. XXXVIII:33–42.
Wajda S, Daszkiewicz T. 2001. Slaughter value and meat quality of bulls carcasses assigned to different classes of fatness in the EUROP system (in Polish). Roczn Inst Przem Mięśni i Tł. XXXVIII:23–29.

Wichlacz H. 1999. A study on the usefulness of traditional and electronic methods for tissue components assessment in half-carcasses of slaughter cattle. Habilitations Theses (in Polish). Ann Anim Sci Monograph. 11:1–75.