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Morphological composition and quality characteristics of carcasses of Ukrainian Black-and-White dairy breed bulls depending on muscle tissue colour

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Abstract. In numerous global standards, muscle tissue colour is used as a key criterion in evaluating the quality of beef carcasses and determining their market value. The relevance of this study lies in establishing the relationship between beef colour and carcass quality characteristics. The objective was to determine slaughter metrics, morphological composition, and quality traits of carcasses from 18- to 24-month-old bulls of the Ukrainian Black-and-White dairy breed based on muscle tissue colour. Following a 24-hour fasting period with free access to water, the slaughter of bulls was conducted at the slaughterhouse in Kalynivka village, Brovary District, Kyiv Region. Muscle tissue colour was assessed using a seven-point scale by the methodology of the Japan Meat Grading Association. Carcasses were divided into two groups: scores of 1 to 5 ($n = 24$) and scores of 6 to 7 ($n = 10$). It was established that animals with higher live weight after fasting exhibited superior muscle tissue colour. A tendency is observed towards a reduction in slaughter yield (carcass) by 0.3 percentage points, the proportion of muscle tissue by 0.3 points, including a decrease in extra (by 0.9) and first rates (by 1.3) cuts, fat tissue (by 0.1), bones (by 0.1 points), marbling (by 3.8%), and the loin eye area (by 17.0%). Conversely, the proportion of muscle tissue at the second rate increases by 2.2 points. With a more intense muscle tissue colour, a significant increase ($P > 0.999$) is observed

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in the percentage of tendons and ligaments (by 0.5 points), carcass conformation (meatiness) (by 43.3%), fat cover (by 25.0%), subcutaneous fat thickness (by 42.9%), and the colour intensity of fat tissue on the carcass (by 17.8%). The practical significance of this study lies in its applicability for meat processing enterprises to classify carcasses of Ukrainian Black-and-White dairy breed animals according to intended use. Consumers are also provided with additional information for making an informed choice of beef based on the relationship between muscle colour and carcass quality traits

Keywords: meat productivity; global standards; beef colour; carcass classification; beef

Introduction

The colour of beef is a critical factor that significantly influences consumer choice, as it is often used as an indicator of freshness and quality. Research by J. Yang *et al.* (2024) demonstrates that consumers typically prefer a bright red meat colour, evenly distributed across the surface, with minimal moisture loss, as it signifies freshness. This colour strongly motivates consumers to purchase beef, whereas any deviation from a bright red appearance tends to elicit a negative response and discourages purchase.

However, meat colour is not always a reliable indicator of its textural properties, particularly shear force (Pacheco *et al.*, 2024). As no definitive correlation between beef colour and tenderness was identified, the authors conclude that visual assessment alone cannot accurately predict the softness or toughness of the product after cooking. This is important for consumers who prioritise specific textural properties of beef and may experience a discrepancy between expected and actual results after purchase.

The colour of muscle tissue is determined by a combination of chromatic and achromatic (colourless) attributes, which together shape its overall appearance. Chromatic attributes depend on the concentration of the pigment myoglobin, which influences the intensity of the red colour. Achromatic attributes, such as light reflectance, contribute to the gloss and brightness of the colour. These contributions can be quantitatively assessed using absorption and scattering coefficients, which characterise the meat surface's light reflection properties. These metrics, or their ratios, are used

(Gagaoua *et al.*, 2024) as combined indicators to evaluate the colour perceived by consumers.

The external appearance of the final product is influenced by factors such as cattle diet, rearing conditions, genotype, sex, and others. Research by M. Hastie *et al.* (2024) indicates that beef from cattle fed a concentrate-based diet exhibited less dark colouring. It was significantly ($P < 0.01$) brighter, making it more appealing to consumers (Correa *et al.*, 2024). This highlights the substantial impact of cattle diet on the visual properties of meat, which in turn affects consumer preferences. Studies by A.M. Romo-Valdez *et al.* (2024) demonstrated that increasing the space allowance per animal from 14 m² to 16 m² improved carcass weight without affecting key quality characteristics of the carcass or beef (such as marbling, pH, and colour).

Research by J. Nusri-Un *et al.* (2024) established that Holstein-Friesian crossbreeds produce higher-quality beef compared to Charolais crossbreeds, despite exhibiting similar meat colour. This finding highlights the relationship between breed-specific traits and meat quality characteristics. It has been demonstrated (Blanco *et al.*, 2020) that beef from heifers is lighter in colour compared to that from bulls and steers. This indicates a correlation between the sex of the animals and meat colour, which could serve as a valuable criterion in breeding programmes. M.M. Krauskopf *et al.* (2024) identified that issues with abnormal meat colour, linked to pH variations, result in as much as 13.9% of beef on the market being categorised as dark, leading to

substantial financial losses. These findings emphasise the importance of monitoring pH and meat colour throughout various stages of production.

Therefore, determining the impact of muscle tissue colour on the morphological composition and quality characteristics of beef carcasses is a pressing issue in Ukraine. This study aimed to assess slaughter performance, morphological composition, and quality traits of carcasses depending on muscle tissue colour in bulls from Ukrainian Black-and-White dairy breed cows (UBWDB).

Materials and Methods

The study was conducted between 2014 and 2016 at the Zhuravushka farm in the Brovary District of Kyiv Region, using 34 carcasses from 18- to 24-month-old bulls of the UBWDB. Data processing, analysis, and synthesis, as relevant to the study's title, were completed in October 2024. All experimental research adhered to established methodological approaches and met the requirements and standards outlined in DSTU ISO/IEC 17025:2005 (2006). The housing of cattle and all related procedures were carried out in compliance with the provisions of the Procedure for Conducting Scientific Experiments on Animals (Law of Ukraine No. 249, 2012) and the European Convention for the Protection of Vertebrate Animals Used for Experimental and Other

Scientific Purposes (1986). The pre-slaughter live weight of the bulls was determined by weighing them following a 24-hour fasting period with free access to water.

The slaughter of the animals was conducted at a slaughterhouse located in Kalynivka village. Within one hour after slaughter and hide removal, the carcasses were weighed using calibrated scales. Certified experts with extensive experience visually classified carcass conformation into the classes E, U, R, O, and P, following the Commission Regulation (EC) No. 1249/2008 (2008). This ensured a high level of classification accuracy and compliance with international standards. In addition to conformation, the assessment considered the external appearance of the carcasses, their symmetry, and the degree of muscle tissue development. Fat cover on the external surface and in the thoracic cavity was classified into five categories based on the same regulatory system. Muscle and fat tissue colour were evaluated using colour scales ranging from 1 to 7, following the Japan Meat Grading Association (2000) standards (Fig. 1). To eliminate the influence of external factors, such as lighting levels or viewing angles, colour assessments were performed under standardised lighting conditions. This approach ensured objective information regarding beef colour, a critical indicator of meat quality.



Figure 1. Muscle tissue colour grading scale

Source: Japan Meat Grading Association (2000)

Based on muscle tissue colour, the 34 carcasses were divided into two groups: Group 1 (scores 1-5, n = 24) and Group 2 (scores 6-7, n = 10). This grouping facilitated a detailed examination of differences in marbling, the physicochemical properties of muscle tissue, and other meat quality indicators depending on colour intensity. Immediately after the

division of carcasses into quarters, marbling of the *m. longissimus dorsi* between the 12th and 13th ribs was assessed according to the Japan Meat Grading Association (2000) standard across 12 classes. This assessment utilised visual grading scales, which enhanced evaluation accuracy and ensured standardisation across different carcasses.

Between the 12th and 13th ribs, the length and depth of the *m. longissimus dorsi* (loin eye) were measured using a ruler. The loin eye area was calculated using the equation (1) according to Order of the Ministry of Agrarian Policy of Ukraine No. 290, 2004):

$$S = L \times D \times 0.8, \quad (1)$$

where S is the loin eye area, cm²; L is the length of the loin eye, cm; and D is the depth of the loin eye, cm. This method serves as a reliable tool for predicting muscle mass and potential meat

quality. All measurements were conducted twice to minimise errors, ensuring precise and reproducible data. Statistical analysis was performed using Microsoft Excel 2016, encompassing the determination of mean values, standard errors, and reliability criteria.

Results and Discussion

The colour of the muscle tissue received a higher score, corresponding to a slightly greater liveweight of bulls after fasting (by 2.4%, Table 1). Improved muscle tissue colour was also associated with a tendency for increased carcass weight (by 1.7%).

Table 1. Slaughter characteristics and morphological composition of bull carcasses based on muscle tissue colour intensity

Characteristic	Muscle tissue colour, points	
	1-5 (n = 24)	6-7 (n = 10)
Live weight after fasting, kg	422 ± 4.7	432 ± 22.1
Carcass weight, kg	193.3 ± 3.46	196.6 ± 10.91
Slaughter yield (carcass), %	45.8 ± 0.12	45.5 ± 0.53
Muscle tissue, %	71.6 ± 0.62	71.3 ± 0.98
Including extra, %	23.0 ± 0.73	22.1 ± 1.23
-//- first rate, %	47.0 ± 0.52	45.7 ± 0.81
-//- second rate, %	30.0 ± 1.03	32.2 ± 1.85
Fat tissue, %	3.7 ± 0.43	3.6 ± 0.24
Tendons and ligaments, %	1.6 ± 0.08	2.1 ± 0.11***
Bones, %	23.1 ± 0.32	23.0 ± 1.13

Note: ***P > 0.999

Source: compiled by the authors

Examining the current state of knowledge regarding the quality of beef carcasses and meat, with a focus on factors influencing its production and processing, M.Á. Cantarero Aparicio *et al.* (2024) observed an improvement in muscle tissue colour with increasing carcass weight. These authors highlight the significant role of carcass weight as a factor that can influence the external characteristics of meat. Conversely, the research conducted by R. Kocyigit *et al.* (2023) presented contradictory findings, indicating that as carcass weight increased, the brightness of muscle tissue colour decreased significantly. The authors attributed this to enhanced fat deposition and a slower decline in glycogen levels in cattle,

which supports lactic acid formation. As a solution, A. Poveda-Arteaga *et al.* (2023) suggested standardising the slaughter weight of animals to minimise substantial differences in meat colour. In this context, the United States Department of Agriculture (USDA) has implemented price deductions for carcasses exceeding 408 kilograms, reinforcing the importance of weight management in ensuring quality (USDA-ERS, 2024).

With the improvement in the evaluation of muscle tissue colour from 1-5 to 6-7 points, there is a significant increase (P > 0.999) of 0.5 points in the amount of tendons and ligaments in the carcass. Ukrainian Black-and-White dairy breed cattle are characterised by late maturity,

According to S. Raza *et al.* (2019), animals of this type exhibit higher calpastatin activity and a greater percentage of connective tissue. Tendons, ligaments, and bones do not affect the nutritional quality of beef; however, muscle and fat tissues have a significant impact, showing a tendency to decrease as muscle colour

improves. Therefore, the results of current research suggest that the colour of beef can serve as an indicator for predicting its morphological composition.

With a more saturated (6-7 points) muscle tissue colour, the conformation (meatiness) of the carcasses improved by 43.3% ($P > 0.999$) (Table 2).

Table 2. Basic physical and chemical parameters of raw materials ($n = 4$)

Muscle tissue colour, points	Characteristics					
	Carcass conformation, points	Fat cover development on the carcass, points	Subcutaneous fat thickness, cm	Marbling of m. <i>longissimus dorsi</i> , points	Fat tissue colour on the carcass, points	Loin eye area m. <i>longissimus dorsi</i> , cm ²
15 ($n = 24$)	3.0 ± 0.19	2.4 ± 0.08	0.7 ± 0.08	5.4 ± 0.72	4.5 ± 0.12	86.1 ± 4.44
76 ($n = 10$)	4.3 ± 0.27***	3.0 ± 0.22***	1.0 ± 0.10***	5.2 ± 1.00	5.3 ± 0.16***	73.6 ± 5.67

Note: *** $P > 0.999$

Source: compiled by the authors

According to G. Indurain *et al.* (2008), the effectiveness of meat colour for differentiating carcass conformation is 62%. With a more intense (6-7 points) muscle tissue colour, fat cover (by 25.0%) and subcutaneous fat thickness (by 42.9%) significantly increased ($P > 0.999$). The direct correlation between visual assessment of muscle tissue colour and fat cover development, its thickness, and carcass meatiness can be explained by the fact that fatter carcasses are obtained with higher conformation scores. According to L. Fiems *et al.* (2000), beef colour showed only limited predictive power ($r < 0.15$) for fat cover development in carcasses. The effectiveness of differentiating this trait is only 37% (Indurain *et al.*, 2008). This somewhat explains the results obtained in the current study and presented in Table 1, regarding the decrease in the content of extra and muscle tissue first rates with improved muscle colour. Better fat cover development and thickness on the carcass with a brighter beef colour reduces the amount of valuable edible parts in it.

With an increase in beef colour intensity, there is a tendency for a 3.8% decrease in its

marbling (intramuscular fat), which during heat treatment gives the meat a specific flavour and lubricates its fibres, improving its consumer perception. Meat colour, along with the amount of visible fat (marbling), are the first characteristics that consumers consider when evaluating its quality (Geay *et al.*, 2001). The lack of a relationship between the studied traits (meat colour and marbling) is the main reason for the negative impact of a better assessment of meat colour on its sensory properties (Kruk & Ugnivenko, 2024). Fresh meat contains deoxymyoglobin and oxymyoglobin. Deoxymyoglobin gives fresh meat its red pigmentation. In the presence of oxygen, it oxidises to oxymyoglobin, which gives the meat a bright pink-red colour. When deoxy- and oxymyoglobin are oxidised to metmyoglobin, the meat acquires a brown colour. The formation of metmyoglobin is promoted by a decrease in pH, which is caused by better fat deposition. The enzyme metmyoglobin reductase reduces the level of the undesirable form of myoglobin and thus stabilises the colour of muscle tissue. Beef, which is characterised by a lower content of intramuscular

fat, is tougher and drier (Clinquart *et al.*, 2023). In carcasses with a low ratio of fat to muscle tissue, which are more prone to the DFD (Dark, Firm, Dry) meat defect, there may be a significant mismatch between meat colour and its quality during processing. With an increase in the score of beef colour, the colour of the fat tissue on the carcass significantly improved ($P > 0.999$) by 17.8%. In studies by H. Kim *et al.* (2023), no significant differences were observed in the quality characteristics of beef between animals in groups with normal fat cover colour and increased yellowness in Korean Hanwoo cattle. These data indicate that the yellowing of fat tissue on the carcass was not significantly correlated with poorer physical characteristics of beef or its chemical composition. Muscle tissue colour did not have a significant impact on the chemical composition, physicochemical, and sensory properties of beef in experiments by A. Moloney *et al.* (2022). The data obtained in the current study show that with an increase in colour intensity from 1-5 to 6-7 points, there is a tendency for a 17.0% decrease in the loin eye area *m. longissimus dorsi*, since there is a tendency for an inverse correlation between muscle tissue colour and the loin eye area (Kruk *et al.*, 2024). This peculiarity of darkening of muscle tissue and yellowing of fat in the experimental animals can be explained by feeding a small proportion of concentrate feed (21.1%) and a significant amount of green, succulent (32.3%) and roughage (30.4%) in the diet.

Therefore, there are problems with assessing beef colour in 18-24-month-old bulls obtained from Ukrainian Black-and-White dairy breed cows, including the deterioration of such characteristics as the proportion of muscle tissue, including extra and first rates, marbling, and the area of the loin eye area *m. longissimus dorsi*. Beef colour is influenced by breed, meat acidity (pH), moisture content, intramuscular fat, and connective tissue content (Pogorzelska *et al.*, 2013). T. Sakowski *et al.* (2022) identified that the lifetime factors affecting muscle tissue colour include the sex and age of the animals, the duration of their feeding,

seasonality, pre-slaughter stress, nutritional status, slaughter process, and meat maturation time after slaughter. Studying the influence of age and sex on the quality characteristics of carcasses and technological indicators of buffalo meat, A. Turan *et al.* (2021) found that the colour of beef in older animals was significantly darker ($P < 0.001$) than in younger ones. The meat of male buffaloes was lighter than that of females. Y. Bao & P. Ertbjerg (2019) explain the darker colour of meat to the larger diameter of muscle fibres, as a result of which the distance between the light bands is longer, which allows more light to pass into the centre of the muscles. A.M. Hanson (2023) considers the main disadvantage of beef from traditional dairy cattle to be a noticeably darker colour, rather than the “cherry-red” appearance of conventional beef, which consumers prefer. However, in studies by F. Giannico *et al.* (2024), neither the grazing system nor the slaughter age affected meat colour. Ageing beef leads to a significant increase in the red hue during storage. 19% of consumers make purchasing decisions about beef based on its colour (Realini *et al.*, 2014). Beef colours DFD (Dark, Firm, Dry) and PSE (Pale, Soft, Exudative) are well-known. In the US beef industry, changes in beef colour result in annual losses of natural resources totalling USD 3.9 billion (Ramanathan *et al.*, 2023). Despite global achievements in regulating the formation of muscle tissue colour in cattle to improve beef quality, this problem has not been sufficiently addressed in Ukraine and deserves further research.

A pressing issue as Ukraine moves towards joining the European Union is the justification for including meat colour as a quality indicator in regulatory documents for classifying beef carcasses. This would enhance beef production, promote consumer health, and reduce the consumption of natural resources and energy.

Parallel assessment of carcass quality based on meat colour is already in place in classification systems such as the Ministry of Agriculture, Food and Rural Affairs (n.d.) in Korea, Japan Meat Grading Association (2000) in Japan, the USDA Beef

Grading Scale (n.d.), and Meat Standards Australia (n.d.) in Australia.

This raises the question of how to produce high-quality beef while considering meat colour as a quality indicator for dairy cattle, which are frequently fattened for slaughter. Future research should also focus on determining the quantitative and qualitative characteristics of beef based on its colour in beef cattle breeds, as this would improve the visual quality of carcasses and meat. Research should also be conducted to identify management factors for raising cattle of common Ukrainian breeds to achieve an optimal beef colour that is appealing to consumers and can be combined with desirable technological, sensory, and chemical properties.

Conclusions

The results obtained from assessing the colour of beef from Ukrainian Black-and-White dairy breed bulls indicate a deterioration in many of its quality characteristics with an increase in colour intensity. With a higher live weight of Ukrainian Black-and-White dairy breed bulls after fasting, there is a tendency for an increase in muscle tissue colour. With an improvement in muscle tissue colour intensity, the percentage of tendons and ligaments significantly increased by 0.5 points ($P > 0.999$), carcass conformation (meatiness) by 43.3%, fat

cover (by 25.0%), fat thickness (by 42.9%), and fat colour (by 17.8%). With an increase in the score of muscle tissue colour, there is a tendency for a decrease in slaughter yield (carcass) (by 0.3 points), percentage of muscle tissue (by 0.3), including extra (by 0.9) and first rates (by 1.3), fat tissue (by 0.1) and bones (by 0.1), beef marbling by 3.8% and the loin eye area by 17.0%, and an increase in second rate meat (by 2.2 points).

To improve the quality of beef from dairy cattle in Ukraine, it is necessary to consider including muscle colour as an indicator in regulatory documents for beef quality assessment. As the results show, colour intensity affects several quality characteristics that determine the product's consumer appeal. Further research should also be conducted on other cattle breeds common in Ukraine to improve beef production technologies with optimal colour indicators. This will allow for a more objective assessment of meat quality and the development of recommendations for producing products with high sensory characteristics that meet consumer preferences.

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Conflict of Interest

None.

References

- [1] Bao, Y., & Ertbjerg, P. (2019). Effects of protein oxidation on the texture and water-holding of meat: A review. *Critical Reviews in Food Science and Nutrition*, 59, 3564-3578. doi: [10.1080/10408398.2018.1498444](https://doi.org/10.1080/10408398.2018.1498444).
- [2] Blanco, M., Ripoll, G., Delavaud, C., & Casasús, I. (2020). Performance, carcass and meat quality of young bulls, steers and heifers slaughtered at a common body weight. *Livestock Science*, 240, article number 104156. doi: [10.1016/j.livsci.2020.104156](https://doi.org/10.1016/j.livsci.2020.104156).
- [3] Cantarero-Aparicio, M.Á., Angón, E., González-Esquivel, C., Peña, F., Caballero-Villalobos, J., Ryan, E.G., & Perea, J.M. (2024). Carcass and meat quality traits in female lidia cattle slaughtered at different ages. *Animals*, 14(6), article number 850. doi: [10.3390/ani14060850](https://doi.org/10.3390/ani14060850).
- [4] Clinquart, A., Ellies-Oury, M.P., Hocquette, J.F., Guillier, L., Santé-Lhoutellier, V., & Prache, S. (2022). Review: On-farm and processing factors affecting bovine carcass and meat quality. *Animal*, 16, article number 100426. doi: [10.1016/j.animal.2021.100426](https://doi.org/10.1016/j.animal.2021.100426).
- [5] Commission Regulation (EC) No 1249/2008. (2008). *Laying down detailed rules on the implementation of the Community scales for the classification of beef, pig and sheep carcasses and the reporting of prices thereof*. Retrieved from <http://surl.li/mbdovq>.

- [6] Correa, D., del Campo, M., Luzardo, S., de Souza, G., Álvarez, C., Font-i-Furnols, M., & Brito, G. (2024). Impact of Aging methods and frozen storage on beef quality attributes from different finishing diets. *Meat and Muscle Biology*, 8(1), article number 17695. doi: [10.22175/mmb.17695](https://doi.org/10.22175/mmb.17695).
- [7] DSTU ISO/IEC 17025:2005. (2006). *General requirements for the competence of testing and calibration laboratories*. Retrieved from http://online.budstandart.com/ua/catalog/doc-page.html?id_doc=50873.
- [8] European Convention for the Protection of Vertebrate Animals used for Experimental and other Scientific Purposes. (1986). Retrieved from <https://rm.coe.int/168007a67b>
- [9] Fiems, L.O., De Campeneere, S., De Smet, S., Van de Voorde, G., Vanacker, J.M., & Boucqué, C.V. (2000). Relationship between fat depots in carcasses of beef bulls and effect on meat colour and tenderness. *Meat Science*, 56(1), 41-47. doi: [10.1016/S0309-1740\(00\)00017-6](https://doi.org/10.1016/S0309-1740(00)00017-6).
- [10] Gagaoua, M., Hughes, J., Terlouw, E.C., Warner, R.D., Purslow, P.P., Lorenzo, J.M., & Picard, B. (2020). Proteomic biomarkers of beef colour. *Trends in Food Science & Technology*, 101, 234-252. doi: [10.1016/j.tifs.2020.05.005](https://doi.org/10.1016/j.tifs.2020.05.005).
- [11] Geay, Y., Bauchart, D., Hocquette, J.F., & Culioli, J. (2001). Effect of nutritional factors on biochemical, structural and metabolic characteristics of muscles in ruminants, consequences on dietetic value and sensorial qualities of meat. *Reproduction Nutrition Development*, 41(1), 1-26. doi: [10.1051/rnd:2001108](https://doi.org/10.1051/rnd:2001108).
- [12] Giannico, F., Karatosidi, D., Carbonara, C., Ragni, M., Tarricone, S., Caputi Jambrenghi, A., Tedone, L., & Colonna, M.A. (2024). Effects of grazing on grassland or wood-pasture, slaughtering age and ageing time on meat production and quality in Podolian young bulls. *Veterinary Quarterly*, 44(1), 1-12. doi: [10.1080/01652176.2024.2381544](https://doi.org/10.1080/01652176.2024.2381544).
- [13] Hanson, M. (2023). *Dairy production. Crossbreeding improves most dairy beef issues*. (n.d.). Retrieved from <https://www.dairyherd.com/news/dairy-production/crossbreeding-improves-most-dairy-beef-issues>.
- [14] Hastie, M., Hepworth, G., Hillman, A., Pfeiffer, C., Cowled, B., & Warner, R. (2024). Bushfire exposure is associated with darker color of beef loin at grading. *Livestock Science*, 287, article number 105527. doi: [10.1016/j.livsci.2024.105527](https://doi.org/10.1016/j.livsci.2024.105527).
- [15] Indurain, G., Goni, V., Horcada, A., Insausti, K., Hernández, B., & Beriain, M.J. (2008). Colour differences among carcasses graded with similar score for conformation and fatness. *Animal*, 2(7), 1093-1100. doi: [10.1017/S1751731108002243](https://doi.org/10.1017/S1751731108002243).
- [16] Japan Meat Grading Association. (2000). *Beef carcass grading standard*. Retrieved from https://twinwoodcattle.com/sites/default/files/publications/2017-06/TWRA120_Japan_Beef_Carcass_Grading_Standard.pdf
- [17] Kim, H., Lee, S., Kumar, S.A., Jung, H., Kim, H., Gil, J., Sun, C., & Jo, C. (2023). Comparison of meat quality from hanwoo cattle having yellow and white carcass fat. *Meat and Muscle Biology*, 7(1), article number 16878. doi: [10.22175/mmb.16878](https://doi.org/10.22175/mmb.16878).
- [18] Kocyigit, R., Yanar, M., Özdemir, V.F., Aydin, R., & Diler, A. (2023). Effects of slaughter weight and muscle types on carcass and meat quality characteristics of Holstein Friesian bulls. *Journal of the Hellenic Veterinary Medical Society*, 74(4), 6669-6676. doi: [10.12681/jhvms.31980](https://doi.org/10.12681/jhvms.31980).
- [19] Krauskopf, M.M., de Araújo, C.D.L., dos Santos-Donado, P.R., Dargelio, M.D.B., Manzi, J.A.S., Venturini, A.C., Balieiro, J.C. de C., Delgado, E.F., & Castillo, C.J.C. (2024). The effect of succinate on color stability of *Bos indicus* bull meat: pH-dependent effects during the 14-day aging period. *Food Research International*, 175, article number 113688. doi: [10.1016/j.foodres.2023.113688](https://doi.org/10.1016/j.foodres.2023.113688).

- [20] Kruk, O., & Ugnivenko, A. (2024). Relationship between the chemical composition, physical, technological, and sensory properties of beef and the colour of muscle tissue. *Animal Science and Food Technology*, 15(1), 42-54. doi: [10.31548/animal.1.2024.42](https://doi.org/10.31548/animal.1.2024.42).
- [21] Kruk, O., Ugnivenko, A., Antoniuik, T., Kolisnyk, O., Slobodyanyuk, N., Nosevych, D., Naumenko, T., & Gruntkovskiy, M. (2024). Evaluation of beef carcass quality using the muscle eye area *M. longissimus dorsi*. *Potravinarstvo Slovak Journal of Food Sciences*, 18, 619-632. doi: [10.5219/1989](https://doi.org/10.5219/1989).
- [22] Law of Ukraine No. 249 “On the Procedure for Carrying out Experiments and Experiments on Animals by Scientific Institutions”. (2012, March). Retrieved from <https://zakon.rada.gov.ua/laws/show/z0416-12#Text>.
- [23] Meat Standards Australia (MSA). (n.d.). Retrieved from <https://www.mla.com.au/marketing-beef-and-lamb/meat-standards-australia/>.
- [24] Ministry of Agriculture, Food and Rural Affairs. (n.d.). Retrieved from <https://www.mafra.go.kr/english/751/subview.do>.
- [25] Moloney, A.P., O’Riordan, E.G., Monahan, F.J., & Richardson, R.I. (2022). The colour and sensory characteristics of longissimus muscle from beef cattle that grazed grass or consumed concentrates prior to slaughter. *Journal of the Science of Food and Agriculture*, 102(1), 113-120. doi: [10.1002/jsfa.11337](https://doi.org/10.1002/jsfa.11337).
- [26] Nusri-Un, J., Kabsuk, J., Binsulong, B., & Sommart, K. (2024). Effects of cattle breeds and dietary energy density on intake, growth, carcass, and meat quality under thai feedlot management system. *Animals*, 14(8), article number 1186. doi: [10.3390/ani14081186](https://doi.org/10.3390/ani14081186).
- [27] Order of the Ministry of Agrarian Policy of Ukraine No. 290 “On Approval of the Instruction on Evaluation of Boars and Sows for the Quality of Offspring in Specialized Testing Stations”. (2004, August). Retrieved from https://zakononline.com.ua/documents/show/250143__250208.
- [28] Pacheco, R.F., Teixeira, J.S., Pinheiro, B.S.D.S., Souza, M.C., Dreher, B.F., Kerkhoff, G. L. W., Donatti, L.M., Teixeira, O. de S., & Vaz, R. Z. (2024). A meta analysis on carcass and meat traits of feedlot steers from different genetic backgrounds in Brazil. *Ciência Animal Brasileira*, 25, article number 78628E. doi: [10.1590/1809-6891v25e-78628E](https://doi.org/10.1590/1809-6891v25e-78628E).
- [29] Pogorzelska, J., Miciński, J., Ostojka, H., Kowalski, I.M., Szarek, J., & Strzyżewska, E. (2013). [Quality traits of meat from young Limousin, Charolais and Hereford bulls](#). *Pakistan Veterinary Journal*, 33(1), 65-68.
- [30] Poveda-Arteaga, A., Krell, J., Gibis, M., Heinz, V., Terjung, N., & Tomasevic, I. (2023). Intrinsic and extrinsic factors affecting the color of fresh beef meat – comprehensive review. *Applied Sciences*, 13(7), article number 4382. doi: [10.3390/app13074382](https://doi.org/10.3390/app13074382).
- [31] Ramanathan, R., Denzer, M., Kiyimba, F., Harr, K., Suman, S.P., Hunt, M., Pfeiffer, M., Mafi, G.G., & Kim, Y.H.B. (2023). Role of postmortem bioenergetics in beef colour chemistry. *Italian Journal of Animal Science*, 22(1), 711-727. doi: [10.1080/1828051X.2023.2240357](https://doi.org/10.1080/1828051X.2023.2240357).
- [32] Raza, S.H.A., Khan, R., Abdelnour, S.A., Abd El-Hack, M.E., Khafaga, A.F., Taha, A., Ohran, H., Mei, C., Schreurs, N.M., & Zan, L. (2019). Advances of molecular markers and their application for body variables and carcass traits in qinchuan cattle. *Genes*, 10(9), article number 717. doi: [10.3390/genes10090717](https://doi.org/10.3390/genes10090717).
- [33] Realini, C.E., Kallas, Z., Pérez-Juan, M., Gómez, I., Olleta, J.L., Beriain, M.J., Albertí, P., & Sañudo, C. (2014). The relative importance of cues underlying Spanish consumers’ beef choice and segmentation, and consumer liking of beef enriched with n-3 and CLA fatty acids. *Food Quality and Preference*, 33, 74-85. doi: [10.1016/j.foodqual.2013.11.007](https://doi.org/10.1016/j.foodqual.2013.11.007).

- [34] Romo-Valdez, A.M., Pérez-Linares, C., Ríos-Rincón, F.G., Figueroa-Saavedra, F., Barreras-Serrano, A., Castro-Pérez, B.I., Sánchez-López, E., & Cazarez, G.V.C. (2024). Influencia del espacio vital en corral sobre las variables productivas, calidad de la canal y carne en novillos Holstein. *Revista Mexicana de Ciencias Pecuarias*, 15(2), 393-403. doi: [10.22319/rmcp.v15i2.6449](https://doi.org/10.22319/rmcp.v15i2.6449).
- [35] Sakowski, T., Grodkowski, G., Gołębiewski, M., Slószarz, J., Kostusiak, P., Solarczyk, P., & Puppel, K. (2022). Genetic and environmental determinants of beef quality – a review. *Frontiers in Veterinary Science*, 9, article number 819605. doi: [10.3389/fvets.2022.819605](https://doi.org/10.3389/fvets.2022.819605).
- [36] Turan, A., Yalcintan, H., Orman, A., & Ekiz, B. (2021). Effects of gender and slaughter age on meat quality of Anatolian water buffaloes. *Tropical Animal Health and Production*, 53, article number 415. doi: [10.1007/s11250-021-02835-8](https://doi.org/10.1007/s11250-021-02835-8).
- [37] USDA Beef Grading Scale. (n.d.). Retrieved from https://www.flannerybeef.com/insights-recipes/usda-beef-grading-scale/?srsltid=AfmBOooxT378A23Bz_h9u-TgD6_71SP7FI0rONiCHUP_vKlcjH2ub_8n.
- [38] USDA-ERS. (2024). *Livestock and meat domestic data*. Retrieved from <https://www.ers.usda.gov/data-products/livestock-meat-domestic-data.aspx/>.
- [39] Yang, J., Chen, X., Duan, X., Li, K., Cheng, H., Sun, G., Luo, X., Hopkins, D.L., Holman, B.W.B., Zhang, Y., & Song, E. (2024). Investigation of oxygen packaging to maintain beef color stability and microbiology safety after periods of long-term superchilled storage. *Meat Science*, 215, article number 109548. doi: [10.1016/j.meatsci.2024.109548](https://doi.org/10.1016/j.meatsci.2024.109548).

Морфологічний склад та якісні ознаки туш бугайців української чорно-рябої молочної породи залежно від кольору м'язової тканини

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Анотація. У багатьох світових стандартах колір м'язової тканини застосовують під час оцінювання якості туш великої рогатої худоби для визначення їх вартості. Актуальність роботи полягає у визначенні зв'язку між забарвленням яловичини та якісними ознаками туш. Метою дослідження було визначити забійні показники, морфологічний склад та якісні ознаки туш 18-24 – місячних бугайців української чорно-рябої молочної породи відповідно до забарвлення м'язової тканини. Після 24-годинного голодування за вільного доступу до води, забій бугайців провели в забійному цеху с. Калинівки Броварського району Київської області. Колір м'язової тканини оцінили за шкалою від 1 до 7 балів згідно з методикою японської асоціації класифікації яловичини Japan Meat Grading Association та туші поділили на дві групи від 1 до 5 балів ($n = 24$) та від 6 до 7 балів ($n = 10$). Установили, що колір м'язової тканини кращий у тварин за більшої живої маси після голодного витримування. За цього проявляється тенденція до зменшення забійного виходу (туші) на 0,3 пункти, відсотка м'язової тканини на 0,3 у тому числі вищого (на 0,9) та першого (на 1,3) сортів, жирової тканини (на 0,1) та кісток (на 0,1 пункти), мармуровості (на 3,8 %) та площі «м'язового вічка» (на 17,0 %), збільшення на 2,2 пункти м'язової тканини другого сорту. За інтенсивнішого кольору м'язової тканини достовірно ($P > 0,999$) збільшуються відсоток сухожилок та зв'язок на 0,5 пункти, конформація (м'ясистість) туш (на 43,3 %), покриття їх жировим покривом (на 25,0) та товщина підшкірного жиру (на 42,9), колір жирової тканини на туші на 17,8 %. Практичне значення роботи полягає в можливості використання отриманих знань на переробних підприємствах, для сортування туш тварин української чорно-рябої молочної породи відповідно до призначення, а споживачам нададуть додаткову інформацію для об'єктивного вибору м'яса за урахування зв'язків між забарвленням м'язів та якісними ознаками туш

Ключові слова: м'ясна продуктивність; світові стандарти; колір яловичини; класифікація туш; яловичина