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# PREDICTION OF THE FATTENING PERFORMANCE OF YOUNG SLAUGHTER CATTLE BASED ON SELECTED LIVE ANIMAL MEASUREMENTS

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**Abstract.** The objective of the study was to determine the possibility for early prediction of the fattening ability of young crossbred beef bulls using multiple regression equations developed on the basis of selected live animal measurements. The experimental material comprised 96 young crossbred beef bulls being the offspring of Polish Holstein-Friesian (HF) cows and beef bulls (Limousin, Hereford and Charolaise). At the age of 6 months, at the introduction of the animals into semi-intensive fattening system lasting for 12 months, live animal measurements were performed. Using a stepwise regression method, prediction equations were derived: average daily gain (ADG), dry matter conversion, crude protein conversion, net energy conversion per 1 kg body weight gain. The highest predictive values are provided by the equation estimating ADG. The application thereof in practice allows the acceptably accurate estimation, at the age of 6 months, of the rate of body weight gains of young bulls fattened semi-intensively until the 540th day of age, and the selection of calves for fattening on this basis.

**Key words:** estimation, fattening performance, daily gains

## INTRODUCTION

Beef consumption in Poland has been showing a downward trend for many years. This is mainly due to high prices of beef and its products, also in relation to

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other kinds of meat, and unpredictable quality of the offered products. According to the GUS (Central Statistical Office) data [‘Supplies to the Domestic Market...’ 2014], in 2013, the balance sheet consumption of beef was at a level of 1.5 kg per capita, as compared with 1.6 kg in 2012. The year 2014 may be crucial as (according to the Institute of Agricultural and Food Economics – National Research Institute estimates) the beef consumption could have returned to a level of 1.6 kg per capita. Given the improvement in the income situation of the population, the upward trend may continue, and the beef consumption level in 2015 may increase to 1.7 kg per capita. At the same time, the retail prices of beef being lower than the last year, as well as the predicted improvement in the income situation of the population in 2015 and the improved quality of meat for consumption, may contribute to an increase in the domestic demand [‘Forecast of market prices...’ 2015]. Despite the knowledge that the highest quality beef is produced from beef breeds, in Poland they account for less than 1% of the total cattle population [Nogalski et al. 2013], and the cattle slaughtered in Poland varies in terms of the breed, sex, or the feeding level.

One can hardly expect a significant increase in the beef cattle population in the next few years; therefore, an interest of the scientific circles in the production of live cattle, involving further improvement in the technology of fattening of dairy breed cattle (primarily young bulls), and the promotion of commercial crossbreeding of dairy cows and beef breed bulls as a solution aimed at both an improvement to the fattening efficiency and increase in the production, seems reasonable [Grodzki and Przysucha 2013]. Satisfactory production results may only be obtained with the selection of an appropriate technology involving the selection of appropriate breeds to be crossed, the identification of the optimum feeding level, and the determination of the age being most preferred for the slaughter of animals. The proper determination of the final body weight, and the adjustment of feeding intensity to the potential of the fattened animals, may be obtained through the selection of calves in terms of the type of conformation [Nogalski et al. 2000]. The type of conformation is one of the factors affecting both the course of fattening and the carcass slaughter value [Jones et al. 1984]. The strong relationship between the body size and the slaughter traits was reported by, inter alia: Tatum et al. [1982], Papstein et al. [1992], Nogalski et al. [2000], and Adamczyk et al. [2004], who concluded, at the same time, that an assessment of the conformation also partially describes the economic value of an animal, including the production traits.

For the live assessment of the animals’ type of conformation, including the formation of muscles and the amount of fat tissue, zoometric and ultrasound measurements were applied. Zoometric measurements of the body allow conclusions to be drawn as regards the maturity of animals, and the proportionality of their conformation [Bene et al. 2007]. Strong correlations between the results of live ultrasound measurements and the actual slaughter value were confirmed by Blanco Roa et al. [2003], Tait et al. [2005], Parish et al. [2008], Indurain et al. [2009], and Peña et al. [2014]. The heritability level of body dimensions is relatively high; therefore, when comparing them in animals of the same breed, sex, and age, selection procedures may be effectively performed [Brem 1998]. Intravital muscle scoring is another easy, cheap and quick method for estimating the meat production value of an animal. The degree of development of particular muscle groups is associated, to a large extent, with the slaughter yield and slaughter value of the carcass [McKiernan 2007, Choroszy et al. 2010].

The production traits are also correlated with certain blood parameters, and their level may be considered in forecasting the use value, the health status, and the regularity of body metabolism [Terosky et al. 1997, Steinhardt and Thilescher 2000]. An example may be the relationship, as confirmed in studies by Tokuda and Yano [2001], or Higashiyama et al. [2003], or Yamada et al. [2003], between the content of intramuscular fat and the blood plasma leptin levels. However, in contrast to dairy cattle, there are few reports on the concentration of metabolites in the serum of fattening cattle [Lazzaroni et al. 1998, Lobley 1998, Hocguette et al. 1999]. Results of zoometric and ultrasound measurements of the thickness of *Longissimus dorsi* muscle (MLD) are used in the assessment of the breeding value of beef breed bulls, which provides information on their genetic value considering the impact of both the environment and origin, and is a basis for the selection [‘Evaluation of breeding value…’ 2013]. When combined with other analyses, they might also be used in regression equations for predicting the meat performance traits.

Ultrasound measurements in forecasting the beef carcass slaughter value were used by, inter alia, Tait et al. [2005], and Aass et al. [2009]. Ultrasonography in combination with the pre-slaughter body weight were used, for the same purpose, by Blanco Roa et al. [2003], and Silva et al. [2012]. Choroszy et al. [2007], and Pogorzelska-Przybyłek et al. [2014] additionally considered zoometric measurements. However, all the above-mentioned studies concern animals over 1 year of age. It seems, however, that the most important thing is to develop methods for the earliest possible identification of the animals’ predispositions towards a specific raising technology ensuring optimum body weight gains and the conversion of feed nutrients. Acquiring this knowledge will allow breeders to take better investment decisions, and will also contribute to an increase in the profitability of beef production in Poland. The objective of the study was to determine the possibility for early prediction of the fattening ability of young crossbred beef bulls using multiple regression equations developed on the basis of selected live animal measurements.

## MATERIAL AND METHODS

### Animals

The experimental material comprised 96 young crossbred beef bulls being the offspring of Polish Holstein–Friesian breed cows (HO) and beef breed bulls. In the crossbreeding, sperm of 6 Hereford breed bulls (HH), 14 Limousine breed bulls (LM), and 8 Charolaise breed bulls (CH) was used. Calves (32 head of beef crossbreds: HO × HH, HO × LM, and HO × CH) designed for fattening were purchased in north-eastern Poland. During the rearing period until the age of 6 months, the animals were kept in groups in a calf raising pen with straw bedding, and fed milk replacer from automatic calf feeders. Beginning at 2 weeks of age, the calves were fed concentrate and hay, and from 4 weeks of age, they were provided grass silage. The feeding was finished when the calves have reached 130 kg of body weight. During the solid feeding period, the animals were kept in the same premises, and fed the same grass silage ad libitum and concentrate at an amount of 2.5 kg per head on a daily basis. All animals were dehorned by heat cauterisation.

At the age of 6 months, the animals were introduced into a fattening system in an experimental free stall barn, and during the transition period were fed grass silage supplemented with concentrate at a level of 25 g $\cdot$ kg$^{-1}$ metabolic weight ($W^{0.75}$). For the semi-intensive fattening by the 540th day of age, grass silage, triticale grain, rapeseed meal, and premixture were used. The percentage of the mixture in rations was calculated based on the energy density of the ration (GED) as recommended under the INRA evaluation and feeding system, and their formulations were optimised according to the criterion of the content of protein digested in intestine PDIN and PDIE [INRA 1993]. In order for the fatteners to reach the body weight of 350 kg, they were provided mixture I (with a higher crude protein content), and above this weight, mixture II (with a lower crude protein content) (Table 1). The applied level of concentrate was 25 g of the mixture dry matter per 1 kg of metabolic weight. The animals were provided the daily concentrate ration in 4 portions. The feed conversion was expressed by the dry matter (kg), net energy (UFV), and crude protein (g) conversion per 1 kg body weight gain.

After the fattening was completed, the animals were weighed in order to determine the average daily weight gains (ADG), and then transported to a meat processing plant and placed for 20–24 hours at a lairage, in individual pens equipped with drinking troughs. After one day with no feed provided, the bulls were slaughtered in accordance with the technology being applicable in the meat industry.

Live animal measurements were performed upon the introduction of the animals into the fattening system, at the age of 6 months. Zoometric and ultrasound

Table 1. Chemical composition and nutritional value of concentrate, g · kg$^{-1}$ DM [Wyżlic 2015]

Tabela 1. Skład chemiczny i wartość pokarmowa paszy treściwej, g · kg$^{-1}$ SM [Wyżlic 2015]

| Specification<br>Wyszczególnienie | Triticale grain<br>Ziarno pszenżyta | Rapeseed meal<br>Śruta poekstrakcyjna rzepakowa | Mixture I<br>Mieszanka treściwa I | Mixture II<br>Mieszanka treściwa II | SEM |
|---|---|---|---|---|---|
| Dry matter – Sucha masa | 880.7 | 896.5 | 880.8 | 883.0 | 0.90 |
| Organic matter – Substancja organiczna | 981.4 | 931.1 | 927.7 | 925.5 | 1.50 |
| Crude protein – Białko ogólne | 123.4 | 372.3 | 182.3 | 166.1 | 1.90 |
| Crude fat – Tłuszcz surowy | 10.7 | 64.8 | 22.3 | 24.9 | 1.40 |
| Crude fibre – Włókno surowe | 32.5 | 129.6 | 54.4 | 50.8 | 0.90 |
| UFV – JPŻ | 1.24 | 1.12 | 1.16 | 1.17 | 0.01 |
| PDIN – BTJN | 83.3 | 241.2 | 119.1 | 109.6 | 3.82 |
| PDIE – BTJE | 107.8 | 150.8 | 114.2 | 111.7 | 1.76 |

SEM – standard error of the mean; UFV – meat fodder units; PDIN – protein digested in the small intestine when rumen fermentable N is limiting; PDIE – protein digested in the small intestine when rumen fermentable energy is limiting.

SEM – błąd standardowy średniej; JPŻ – jednostka paszowa produkcji żywca; BTJN – białko trawione w jelicie cienkim z uwzględnieniem podaży N; BTJE – białko trawione w jelicie cienkim z uwzględnieniem podaży energii.

measurements were taken, the musculature was scored visually on a 10-point scale (1 – lean animal, 10 – remarkably muscled animal), and blood samples were collected. The following zoometric measurements were performed: height at sacrum, chest width, chest depth, chest girth behind the shoulder blades, pelvic width (at the iliac processes of the pelvis), rump width, pelvic length, trunk length, oblique trunk length, spiral thigh circumference, and cannon bone girth. The musculature was scored visually on a 10-point scale from 1 (lean animal) to 10 (remarkably muscled animal). Ultrasound measurements were performed of the following: (1) thickness of gluteobiceps muscle, and thickness of subcutaneous rump fat (above the gluteobiceps muscle); (2) thickness of the *Longissimus dorsi* muscle (MLD), and thickness of subcutaneous back fat (at the level of the 12th–13th thoracic vertebrae, above the MLD), cross-sectional area of MLD. Ultrasound measurements were performed by one person using the Mysono 201 scanner (Medison Co., USA), operating in the 2–5 MHz frequency range, and equipped with a 170 mm linear probe (PB-MYL2-5/170 CD). The skin was shaved, and ultrasound gel was used during measurements to ensure optimal contact between the transducer head and the skin. Blood was sampled twice, at the age of 25 and 26 weeks, from the external jugular vein. Following centrifugation, the blood serum was frozen at a temperature of –70°C pending analyses. Selected blood parameters were determined using the BS-120 biochemistry analyser (Mindray, USA): glucose (GLU), urea (UREA), cholesterol (CHOL), triglycerides (TG), lactate dehydrogenase (LDH) and creatinine (CREA) levels, as well as the activity of aspartate aminotransferase (AST), alanine aminotransferase (ALT) and alkaline phosphatase (ALP). Serum levels of the following hormones were determined: insulin (INS), free thyroxine (FT4), free triiodothyronine (FT3), and leptin (LEP). Leptin concentrations were determined using a Leptin Enzyme – Linked Immunosorbent Assay kit (ELISA) by the company USCN, with a BioTek ELISA reader (USA). Thyroid hormones and insulin levels were determined by an electrochemiluminescence method (ECLIA) using a Cobas 6000 analyser by the company Roche Diagnostics (Switzerland).

## Statistical analysis methodology

The model was developed using stepwise regression methods [Statistics Toolbox MATLAB R 2014a, MathWorks, USA]. A set of 96 cases was split into two subsets: training subset (based on which the model was developed) with the size of 72, and validation subset with the size of 24. The analysis was divided into two steps. In the first step, for all the variables data for the sets were randomly sampled 1000 times without replacement. In order to develop a general model, it was assumed that the variable will be introduced to the model if it is added to the model at least 350 times in 1000 repeated analyses. In the second step, also 1000 times randomized sets was carried out stepwise regression and determined coefficients of assessing the accuracy of the model. The values shown are averages of 1000 repetitions.

The stepwise regression model was described by the following general equation (1):

$$y = b_0 + \sum_{i=1}^{n} b_i \cdot x_i + \varepsilon \tag{1}$$

where:

- $b_0$ – absolute term,
- $b_i$ – coefficient for a dependent variable,
- $n$ – number of dependent variables included in the model,
- $x_i$ – $i$-th independent variable,
- $y$ – dependent variable,
- $\varepsilon$ – standard error of the estimate.

The validation was performed based on the assessment of linear fit of the measurement data for the dependent variable from the validation set and the model values obtained through the substitution of the assembly of independent variables from the validation set into the regressive model determined on the basis of the training set.

The prediction model was validated by the determination of MBIAS (mean deviation error), RMSE (root mean square error), MEF (the modelling efficiency), and the corrected determination coefficient (p$R^2$). MBIAS, RMSE and MEF were calculated using the method described by Tedeschi [2006]:

$$\mathrm{MBIAS} = \frac{\sum_{i=1}^{n}(Mes_i - Mod_i)}{n} \quad (2)$$

$$\mathrm{RMSE} = \sqrt{\frac{\sum_{i=1}^{n}(Mes_i - Mod_i)^2}{n}} \quad (3)$$

$$\mathrm{MEF} = 1 - \frac{\sum_{i=1}^{n}(Mes_i - Mod_i)^2}{\sum_{i=1}^{n}(Mes_i - \overline{Mes})^2} \quad (4)$$

where: $Mes$ is the measurement, $\overline{Mes}$ is the mean of measurements, and $Mod$ is the predicted value.

For the perfect fit, the statistics for MEF (Eq. 4) should approach the value of one (the upper limit of MEF). The lower limit of MEF is infinitely negative (theoretically). If the MEF value is below zero, it means that the predicted values are inferior to the mean of observed values, equal to zero – the model can be replaced by the observed mean. If the MEF value is above zero, the predicted values are superior to the observed mean.

All variables were standardized, because it allows to compare two or more data sets with different units. The standardized data has mean 0 and standard deviation 1, and retains the shape properties of the original data set (Eq. 5).

$$V_{x \in X} x = \frac{(x - \overline{X})}{S} \quad (5)$$

where $S$ – standard deviation.

## RESULTS AND DISCUSSION

Six-month-old animals used in the experiment reached an average body weight of 193.9 kg, and their musculature score was 5.9 points. The results of measurements of the animals' body frame, characterising their growth performance i.e. the height at sacrum, and the width at the shoulder joints and hip joints (pelvic width), were 106.4, 31.91 and 29.49 cm, respectively (Table 2). An average result of the ultrasound measurement of the thickness of subcutaneous fat tissue at the level of the 12–13 thoracic vertebrae and at the rump was 3.74 mm and 4.76 mm, respectively, and was significantly higher than the result of the measurement performed in a study by Peña et al. [2014] in beef breed cattle being older by over 2 months (Charolaise, 2.1 mm and 2.8 mm, respectively; Limousine, 2.5 mm and 3.2 mm, respectively). The rather significant fatness of the presented calf population is also confirmed by the comparison with the study on crossbred beef steers aged 8–12 months; the average of the measurements of the subcutaneous fat tissue at the back and at the rump was 0.95 mm [Conroy et al. 2009]. The ultrasoundally measured cross-sectional area of the *Longissimus dorsi* muscle had an average value of 40.16 $cm^2$. During the fattening, the average daily gain in young bulls was 0.874 kg.

According to Szefner-Mirzołemska [2009], there is a strong relationship between the basic blood parameters and the age of the cattle. There are few reports on the concentration of blood parameters in calves; the existing ones concern calves of less than 6 months of age, primarily of dairy breeds [Mohri et al. 2007, Piccione et al. 2010, Herosimczyk et al. 2012]. As regards the mean values from two measurements describing the biochemical profile of blood of the animals under study, the most variable were the following: insulin content, alkaline phosphatase activity, and the triglyceride and leptin levels. The insulin level in the blood of cattle is strongly correlated with the rate of body weight gains [Hayden et al. 1993, Hersom et al. 2004]. Leptin acts as an intermediary in the transfer of information between the fat tissue and the central nervous system being responsible for the appetite and the control of body weight [Oprządek and Dymnicki 2009], and its concentration in the blood plasma is associated with the amount of fat tissue, while the changes to the body weight reflect changes to the volume thereof. Following a comparison with the reference values of blood parameters for calves, as provided by Baumgartner [2005], in the experimental material, the following were found: increased activity of aspartate aminotransferase (AST), an elevated level of cholesterol (CHOL), as well as a decreased level of creatinine (CREA) and, slightly, of urea (UREA) (Table 2). The levels of triglycerides and cholesterol are an indirect reflection of the nature of energy management of the body, and the fat conversions [Hawkins et al. 1995], while the total cholesterol level may be one of the indicators facilitating the selection of cattle aimed at the rate of growth and body weight prior to the slaughter [Brucka-Jastrzębska et al. 2007]. The values of biochemical indicators for calves and adults are different. According to Klinkon and Ježek [2012], there are few available data on physiological values of the biochemical blood parameters in calves, and the results of various studies are different. As regards the standards for cattle according to Winnicka [2008], the values obtained in own studies fall within the recommended ranges.

Table 2. Descriptive statistics of variables in training (N = 72) and validation (N = 24) subsets

Tabela 2. Charakterystyka zmiennych w zbiorze treningowym (N = 72) i walidacyjnym (N = 24)

| Variables – Zmienne | Acronym Skrót | Training set Zbiór treningowy | | Validation set Zbiór walidacyjny | |
|---|---|---|---|---|---|
| | | x̄ | SD | x̄ | SD |
| Independent variables – Zmienne niezależne | | | | | |
| Body weight, kg – Masa ciała, kg | BW | 194.0 | 22.21 | 193.7 | 25.11 |
| Intravital muscle score, pts – Przyżyciowa ocena umięśnienia, pkt | IMS | 5.89 | 1.34 | 5.94 | 1.36 |
| Height at sacrum, cm – Wysokość w krzyżu, cm | HS | 106.4 | 3.55 | 106.4 | 3.68 |
| Forechest width, cm – Szerokość przodu, cm | WCH | 31.95 | 3.43 | 31.78 | 3.54 |
| Chest depth, cm – Głębokość klatki piersiowej, cm | DCH | 48.87 | 2.99 | 48.68 | 3.19 |
| Pelvic width, cm – Szerokość miednicy, cm | WP | 29.55 | 2.61 | 29.31 | 2.75 |
| Rump width, cm – Szerokość zadu, cm | WR | 33.18 | 1.88 | 33.13 | 1.95 |
| Pelvic length, cm – Długość miednicy, cm | LP | 35.54 | 2.04 | 35.51 | 2.16 |
| Trunk length, cm – Długość tułowia, cm | LT | 67.93 | 5.25 | 67.92 | 5.12 |
| Oblique trunk length, cm – Skośna długość tułowia, cm | OTL | 112.5 | 6.14 | 112.3 | 5.87 |
| Chest girth, cm – Obwód klatki piersiowej, cm | CHG | 128.5 | 6.88 | 128.4 | 6.86 |
| Spiral thigh circumference, cm – Spiralny obwód uda, cm | STC | 139.5 | 6.93 | 139.4 | 7.25 |
| Cannon bone circumference, cm – Obwód nadpęcia, cm | CBC | 15.22 | 0.86 | 15.18 | 0.87 |
| Thickness of *M. longissimus dorsi,* mm<br>Grubość *M. longissimus dorsi,* mm | uBMt | 44.28 | 6.53 | 44.67 | 6.79 |
| Thickness of subcutaneous back fat, mm<br>Grubość podskórnej tk. tłuszczowej na grzbiecie, mm | uBFt | 3.74 | 1.12 | 3.75 | 1.17 |
| Cross-sectional area of *M. longissimus dorsi*, cm²<br>Powierzchnia przekroju poprzecznego *M. longissimus dorsi*, cm² | uREA | 40.14 | 7.23 | 40.20 | 7.17 |
| Thickness of *M. gluteo-biceps,* mm<br>Grubość *M. gluteo-biceps,* mm | uRMt | 49.70 | 7.58 | 49.28 | 7.49 |
| Thickness of subcutaneous rump fat, mm<br>Grubość podskórnej tkanki tłuszczowej na zadzie, mm | uRFt | 4.73 | 1.60 | 4.85 | 1.67 |
| Triiodothyronine, pg · $ml^{-1}$ – Trójjodotyronina, pg · $ml^{-1}$ | FT3 | 4.42 | 0.47 | 4.44 | 0.52 |
| Thiroxine, ng · $dl^{-1}$ – Tyroksyna, ng · $dl^{-1}$ | FT4 | 1.27 | 0.16 | 1.28 | 0.16 |
| Insulin, uIU · $ml^{-1}$ – Insulina, uIU · $ml^{-1}$ | INS | 2.84 | 1.38 | 2.84 | 1.40 |
| Leptin, ng · $ml^{-1}$ – Leptyna, ng · $ml^{-1}$ | LEP | 3.83 | 1.00 | 3.85 | 0.99 |
| Alanine aminotransferase, U · $L^{-1}$<br>Aminotransferaza alaninowa, U · $L^{-1}$ | ALT | 19.95 | 4.73 | 19.89 | 4.62 |
| Aspartate aminotranferase, U · $L^{-1}$<br>Aminotransferaza asparaginianowa, U · $L^{-1}$ | AST | 57.62 | 11.65 | 58.09 | 11.66 |
| Cholesterol, mg/dL – Cholesterol, mg/dL | CHOL | 122.2 | 22.76 | 122.1 | 22.57 |
| Alkaline phosphatase, U · $L^{-1}$Fosfataza zasadowa, U · $L^{-1}$ | ALP | 131.2 | 43.47 | 132.1 | 44.23 |
| Glucose, mg · $dL^{-1}$ – Glukoza, mg · $dL^{-1}$ | GLU | 78.60 | 12.63 | 78.98 | 12.55 |
| Urea, mg · $dL^{-1}$ – Mocznik, mg · $dl^{-1}$ | UREA | 20.25 | 4.37 | 20.39 | 4.37 |
| Triglycerides, mg · $dL^{-1}$ – Triglicerydy, mg · $dL^{-1}$ | TG | 20.68 | 5.53 | 20.84 | 5.85 |
| Creatinine, mg · $dL^{-1}$ – Kreatynina, mg · $dL^{-1}$ | CREA | 1.19 | 0.28 | 1.20 | 0.27 |
| Lactacte dehydrogenase, U · $L^{-1}$<br>Dehydrogenaza mleczanowa, U · $L^{-1}$ | LDH | 1220.5 | 190.8 | 1226.9 | 189.6 |
| Dependent variables – Zmienne zależne | | | | | |
| Average daily gain, kg – Dobowe przyrosty masy ciała, kg | ADG | 0.875 | 0.14 | 0.871 | 0.15 |
| Dry matter conversion per 1 kg body weight gain<br>Zużycie SM dawki/kg przyrostu | DMC | 7.39 | 0.90 | 7.38 | 0.88 |
| Crude protein conversion per 1 kg body weight gain<br>Zużycie białka ogólnego/kg przyrostu | CPC | 1139.2 | 156.08 | 1137.1 | 145.56 |
| Net energy conversion per 1 kg body weight gain<br>Zużycie energii netto (JPŻ)/kg przyrostu | NEC | 6.79 | 1.03 | 6.73 | 0.99 |

As a result of statistical analyses, for the live animal estimation of the fattening performance of the fattened beef crossbreds, many multiple regression equations were derived. This study presents four of them, being characterised by the most favourable measures of fit. Table 3 presents coefficients in models (b), their standardised values (b*) indicating the strength of the effect of a given independent variable on the estimated value of the dependent variable, and the value of statistics p. The equation estimating the ADG included 5 independent characteristics, all of which were statistically significant. The model explains 0.565 and 0.573 of the variability of the studied characteristic, for both the non-standardised and standardised measurement values, respectively (Table 4). It may be concluded from the presented values of the b* coefficients that it is the WCH and BW that have the greatest effect on the ADG, with the values of 0.518 and 0.354, respectively (Table 3). Similarly, in a study by Nogalski et al. [2000], young bulls from the group of tall (due to the withers height) and wide animals (due to the chest width) were characterised by the highest growth potential, reached an average daily weight gain of 1.028, and their weight at the age of 6 months was 176 kg. It appears that the animals' body weight obtained as a result of the proper rearing provides a basis for obtaining daily gains at a satisfactory level. Both the LEP and uRM have a weaker effect on the equation estimating the ADG; it is contrary in relation to the previously mentioned coefficients. In contrast, Dymnicki and Oprządek [2000] found significant relationships between the concentrations of triiodothyronine and ALP in the blood plasma and the daily gains (r = 0.23, and r = 0.24, respectively). Another study confirms the strong linear relationship between the LEP concentration and the content of fat tissue in calves [Erhardt et al. 2000]. As regards the Japanese Black breed (Wagu), an increase in the leptin level in the plasma from 11th to 14th month of age, and from 11th to 18th month of age was positively correlated with the thickness of subcutaneous fat at the slaughter age of 27 months [Kawakita et al. 2001]. Similarly, high correlations were noted between the leptin concentration and the thickness of subcutaneous fat and its total content in the carcass for the Charolais breed (0.76 and 0.68, respectively) [Bellman et al. 2004].

The equation estimating the DMC includes three independent variables. The effects of each of them are comparable; however, the effect of WCH is contrary to that of the OTL and IMS. The greatest effect on the DMC is exhibited by the visual, i.e. subjective, musculature scoring. The existence of a highly significant correlation between the live animal scoring of musculature, performed prior to the slaughter, and the classes of formation and fatness of carcasses specified post-slaughter (r = 0.66–0.74) (depending on the scoring person, and the number of sites scored) is reported by Drennan et al. [2008] and, in a later study, by Conroy et al. [2009]. The usefulness of this scoring in predicting the slaughter value is

Table 3. The coefficients in the stepwise regression model with their measure of fit – dependent variables: ADG, DMC, CPC, NEC

Tabela 3. Współczynniki w modelu regresji krokowej wraz z ich miarą dopasowania – zmienne zależne: ADG, DMC, CPC, NEC

| Independent variables Zmienne niezależne | Dependent variables Zmienne zależne | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | ADG | | | | | DMC | | | | | CPC | | | | | NEC | | | | |
| | b* | SD b* | b | SD b | p | b* | SD b* | b | SD b | p | b* | SD b* | b | SD b | p | b* | SD b* | b | SD b | p |
| $b_0$ | –0.002 | | –0.013 | | | –0.001 | | 2.926 | | | 0.001 | | 483.44 | | | –0.244 | | 0.000 | | |
| BW | 0.354 | 0.092 | 0.002 | 0.000 | 0.001 | | | | | | | | | | | | | | | |
| IMS | | | | | | 0.409 | 0.106 | 0.274 | 0.071 | 0.001 | | | | | | | | | | |
| WCH | 0.518 | 0.092 | 0.018 | 0.003 | 0.000 | –0.412 | 0.107 | –0.107 | 0.028 | 0.001 | | | | | | | | | | |
| OTL | | | | | | 0.375 | 0.102 | 0.056 | 0.015 | 0.002 | 0.327 | 0.112 | 8.310 | 2.838 | 0.011 | 0.288 | 0.123 | 0.048 | 0.020 | 0.038 |
| TL | | | | | | | | | | | | | | | | –0.221 | 0.135 | –0.043 | 0.026 | 0.163 |
| CBC | | | | | | | | | | | | | | | | 0.361 | 0.138 | 0.425 | 0.163 | 0.020 |
| uRM | –0.137 | 0.073 | –0.002 | 0.001 | 0.103 | | | | | | | | | | | | | | | |
| FT3 | | | | | | | | | | | –0.192 | 0.112 | –63.809 | 36.156 | 0.123 | –0.225 | 0.119 | –0.065 | 0.035 | 0.096 |
| INS | 0.141 | 0.072 | 0.013 | 0.006 | 0.118 | | | | | | | | | | | | | | | |
| LEP | –0.135 | 0.072 | –0.016 | 0.009 | 0.113 | | | | | | | | | | | | | | | |

b* – normalized value of the coefficient b; SD b* – standard deviation of the coefficient b*.

b* – wartość znormalizowana współczynnika b; SD b* – odchylenie standardowe współczynnika b*.

confirmed by the previously conducted own study [Pogorzelska-Przybyłek et al. 2014]. The effect of the OTL measurement on the CPC is approx. 2 times greater than that of FT3; in addition, the effects of these variables are inverse. CBC has the greatest effect on the NEC, while the effect of OTL (with the same sign) is weaker; on the other hand, both FT3 and TL exhibit a comparable strength of the effect, with both these discriminants acting contrary to the two former ones. In contrast to the presented own studies, Dymnicki and Oprządek [2000] report that the conversion of crude protein and net energy per a kilogram of body weight gain correlates positively with the FT3 concentration in the blood plasma ($r = 0.20$, and $r = 0.19$, respectively), and a reduction in the energy intake results in a decrease in the contents of FT3, FT4 and INS in the blood [Yelich et al. 1995].

Table 4. The results of the equations validation (N = 24)

Tabela 4. Wyniki walidacji równań (N = 24)

| Equation Równanie | Measurement values* Wartości pomiarowe* | MBIAS | RMSE | MEF | $pR^2$ | Intercept | p_intercept | Slope | p_slope |
|---|---|---|---|---|---|---|---|---|---|
| ADG | n-std | 0.000 | 0.040 | 0.532 | 0.565 | 0.052 | 0.441 | 0.942 | 0.000 |
| | std | 0.002 | 0.322 | 0.544 | 0.573 | 0.009 | 0.479 | 0.951 | 0.001 |
| DMC | n-std | –0.001 | 0.377 | 0.228 | 0.293 | 4.972 | 0.001 | 0.327 | 0.037 |
| | std | 0.001 | 0.420 | 0.231 | 0.295 | –0.006 | 0.428 | 0.325 | 0.036 |
| CPC | n-std | –0.333 | 70.161 | 0.043 | 0.104 | 952.784 | 0.000 | 0.125 | 0.168 |
| | std | –0.001 | 0.461 | 0.053 | 0.112 | –0.001 | 0.396 | 0.127 | 0.158 |
| NEC | n-std | 0.001 | 0.476 | 0.042 | 0.103 | 5.605 | 0.000 | 0.157 | 0.160 |
| | std | 0.000 | 0.470 | 0.040 | 0.101 | 0.004 | 0.429 | 0.157 | 0.158 |

*n-std – non-standardised, std – standardised; MBIAS – mean deviation error; RMSE – root mean square error; MEF – the modelling efficiency; $pR^2$ – corrected determination coefficient; Intercept – place where the model line intersects the Y axis; p_intercept – value of statistic p for the Intercept; Slope – slope of the model line; p_slope – value of statistic p for the Slope.

*n-std – nieznormalizowane, std – znormalizowane; MBIAS – średni błąd odchylenia; RMSE – średni błąd kwadratowy; MEF – statystyka efektywności dopasowania modelu; $pR^2$ – poprawiony współczynnik determinacji; Intercept – miejsce w którym linia modelowa przecina oś Y; p_intercept – wartość statystyki p dla wyrazu Intercept; Slope – nachylenie linii modelowej; p_slope – wartość statystyki p dla nachylenia linii modelowej.

The precision and accuracy of the obtained equations were tested on 24 young bulls from the validation set. For each model, the following were determined: the corrected value of the determination coefficient $R^2$ ($pR^2$) allowing the comparison of the model fit with the experimental data with a different number of independent variables; mean deviation error (MBIAS); root mean square error (RMSE); and the modelling efficiency (MEF) (Table 3). The presented results are mean values from 1000 repetitions. In addition, the values for both the slope and the absolute term of the straight line describing the fit and the measures of the significance of these values. The measures of fit of the linear model to the experimental data are provided for both the non-standardised and standardised measurement values. The standardisation was based on the mean value and standard deviation using the z-score procedure (Statistic Toolbox, Matlab). The best fit is exhibited by ADG, $pR^2 > 0.55$ and MEF > 0.53. An inferior fit is exhibited by the DMC, values of the $pR^2$ and MEF coefficients < 0.3. On the other hand, the linear model is not suitable for the CPC and NEC. An analysis of the values of the following coefficients: MBIAS, RMSE, p intercept, and p slope, allows a conclusion to be drawn that the ADG model is both accurate and precise, since the term Intercept is not included in the model (p = 0.441) which is inclined at an angle of almost 45° to the axis (slope = 0.942), and the measures of scattering of the measurement points for MBIAS and RMSE are small.

## CONCLUSIONS

The variables concerning zoometric measurements (width at the shoulder joints, oblique trunk length), and blood parameters (FT3), being repeated in the prediction models, confirm their usefulness in the construction of the proposed regression equations. The independent variables considered in the study did not allow the authors to obtain models to predict, with sufficient precision, the feed nutrients conversion on the body weight gain of young bulls. Misalignment of animal material (includes 3 genotypes) could affect the outcome of prediction. As regards the derived models, the highest prediction coefficients are presented by the equation estimating the daily gains in animals (ADG). The application of this model in practice allows the acceptably accurate estimation, at the age of 6 months, of the rate of body weight gains of young bulls fattened semi-intensively until the 540th day of age, and the selection of calves for fattening on this basis.

## REFERENCES

Aass, L., Fristedt, C.G., Gresham, J.D. (2009). Ultrasound prediction of intramuscular fat content in lean cattle. Livest. Sci., 125, 177–186.

Adamczyk, K., Szarek, J., Skrzyński, G., Strzetelski, J. (2004). Effect of body conformation of crossbred bulls on their slaughter value. Ann. Anim. Sci., 4(2) 253–261.

Baumgartner, W. (2005). Klinische Propädeutic der inneren Krankheiten und Nantkrankheiten der Haus und Heintiere. Parey, Berlin.

Bellmann, O., Wegner, J., Teuscher, F., Schneider, F., Ender, K. (2004). Muscle characteristics and corresponding hormone concentrations in different types of cattle. Livest. Prod. Sci., 85, 45–57.

Bene, S., Nagy, B., Nagy, L., Kiss, B., Polgár, J.P., Szabó, F. (2007). Comparison of body measurements of beef cows of different breeds. Arch. Tierz., Dummerstorf, 50(4), 363–373.

Blanco Roa, N.E., Huba, J., Polák, P., Hetényi, L., Peškovičová, D., Bahelka, I. (2003). Comparison of differences in muscle depth and possibilities to predict some parameters of carcass value in bulls by an ultrasonographic method. Czech J. Anim. Sci., 48(8), 338–343.

Brem, G. (1998). Exterieurbeurteilung landwirtschaftlicher Nutztiere. Agricultural Publisher, Budapest.

Brucka-Jastrzębska, E., Kawczuga, D., Orowicz, W. (2007). Profil lipidowy krwi bydła rasy simentaler w zależności od wieku zwierząt [Simmental cattle's lipid profile and age dependence]. Med. Weter., 63(7), 836–838 [in Polish].

Choroszy, Z., Choroszy, B., Grodzki, G., Stachyra, M., Szewczyk, A. (2010). Metoda oceny pokroju bydła mięsnego w Polsce [A new method for evaluation of beef cattle conformation in Poland]. Rocz. Nauk. Zootech., 37(1), 3–12 [in Polish].

Choroszy, Z., Grodzki, G., Szewczyk, A., Litwińczuk, Z., Różycki, M., Choroszy, B. (2007). Projekt metody oceny wartości użytkowej buhajów ras mięsnych [Design of methods for assessing the performance of beef bulls]. Prz. Hod., 12, 2–4 [in Polish].

Conroy, S.B., Drennan, M.J., Kenny, D.A., McGee, M. (2009). The relationship of live animal muscular and skeletal scores, ultrasound measurements and carcass classification scores with carcass composition and value in steers. Animal, 3(11), 1613–1624.

Drennan, M.J., McGee, M., Keane, M.G. (2008). The value of muscular and skeletal scores in the live animal and carcass classification scores as indicators of carcass composition in cattle. Animal, 2(5), 752–760.

Dymnicki, E., Oprządek, J. (2000). Możliwości wcześniejszej selekcji bydła w kierunku cech użytkowości mięsnej [Possibilities of early cattle selection for beef performance traits]. Ann. Wars. Agric. Univ., Anim. Sci., 35 (Supl.), 41–47 [in Polish, summary in English].

Ehrhardt, R.A., Slepetis, R.M., Siegal-Willott, J., van Amburgh, M.E., Bell, A.W., Boisclair, Y.R. (2000). Development of a specific radioimmunoassay to measure physiological changes of circulating leptin in cattle and sheep. J. Endocrinol., 166, 519–528.

Forecast market prices of basic agricultural and food products. 2015. Analysis and Programming Office, Agricultural Market Agency. http://www.pigmiur.pl/plik,1041,prognoza-17-04-2015-pdf. (data access: June 2015).

Grodzki, H., Przysuch, T. (2013). Uwarunkowania produkcji wołowiny w Polsce. XXI Szkoła Zimowa Hodowców Bydła „Obecne problemy produkcji mleka i wołowiny w Polsce i na świecie" [Determinants of beef production in Poland. XXI Winter School of Cattle Breeders]. Current problems of milk and beef production in Poland and in the World. Zakopane 11–15 March 2013, 37–53 [in Polish].

Hawkins, D.E., Niswender, K.D., Oss, G.M., Moeller, C.L., Odde, K.G., Sawyer, H.R., Niswender, G.D. (1995). An increase in serum lipids increases luteal lipid content and alters the disappearance rate of progesterone in cows. J. Anim. Sci., 73, 541–545.

Hayden, I.M., Williams, J.E., Collier, J.J. (1993). Plasma growth hormone, insulin-like growth factor, insulin and thyroid hormone association with body protein and fat accretion in steers under going compensatory gain after dietary energy restriction. J. Anim. Sci., 71, 3327–3338.

Herosimczyk, A., Lepczyński, A., Ożgo, M., Skrzypczak, W.F. (2012). Effect of age and food intake on the selected blood plasma/serum proteins in calves during the early postnatal period. Med. Weter., 68(5), 265–268.

Hersom, M.J., Wettmann, R.P., Krehbiel, C.R., Horn, G.W., Keisler, D.H. (2004). Effect of live weight gain of steers during winter grazing: III. Blood metabolites and hormones during feedlot finishing. J. Anim. Sci., 82, 2059–2068.

Higashiyama, Y., Abe, H., Hayashi, M., Hodate, K. (2003). The comparison of plasma level and mRNA expression of leptin from Japanese black steers and Holstein steers. Livest. Prod. Sci., 81, 247–255.

Hocquette, J.F., Bass, P., Bauchart, D., Vermorel, M., Geay, Y. (1999). Fat partitioning and biochemical characteristics of fatty tissues in relation to plasma metabolites and hormones in normal and double-muscled young growing bulls. Comp. Biochem. Physiol., 122 (part A), 127–138.

Indurain, G., Carr, T.R., Goni, M.V., Insausti, K., Beriain, M.J. (2009). The relationship of carcass measurements to carcass composition and intramuscular fat in Spanish beef. Meat Sci., 82, 155–161.

INRA 1993. Normy żywienia bydła, owiec i kóz- wartość pokarmowa pasz dla przeżuwaczy [Nutrition Standards Cattle, Sheep and Goats - nutritional value of feed for ruminants]. Development by INRA. IZ, Kraków [in Polish].

Jones, S.D.M., Burgess, T.D., Wilton, J.W., Watson, C.H. (1984). Feedlot Rerformance, Carcass Composition and Efficiency of Muscle Gain in Bulls and Steers of Different Mature Size Slaughtered AT Similar Levels of Fatnes. Can. J. Anim. Sci., 64, 621––630.

Kawakita, Y., Abe, H., Hodate, K., Iguchi, A., Kobayashi, M., Mori, T., Kasai, K., Tanai, Y., Kanbe, Y., Mashiyama, H., Asada, T., Miyashige, T. (2001). The relation between plasma leptin concentrations and carcass lipid contents in Japanese Black steers. Livest. Prod. Sci., 73, 25–34,

Klinkon, M., Ježek, J. (2012). A bird's-eye view of veterinary medicine. Edited by Carlos C. Perez-Marin, Published by InTech Janeza Trdine 9, 51000 Rijeka, Croatia.

Lazzaroni, C., Toscano Pagano, G., Biagini, D., Ardelli, A. (1998). Plasma metabolitem trend in double muscled cattle. In: Proceeding of the Symposium on Growth in ruminants: basic aspects, theory and practice for the future. J.W. Blum, T. Elssaser and P. Guilloteau, University of Berne. Berne, Switzerland, P13, 299.

Lobely, G.E. (1998). Nutritional and hormonal control of muscle and peripheral tissue metabolism in farm species. Livest. Prod. Sci., 56, 91–114.

McKiernan, B. (2007). Muscle scoring beef cattle. NSW Department of Primary Industries, New South Wales, Australia, http:www.dpi.nsw.gov.au/__data/assets/pdf_file/0-006/103938/muscle-scoring-beef-cattle.pdf. (data access: October 2014).

Mohri, M., Sharifi, K., Eidi, S. (2007). Hematology and serum biochemistry of Holstein dairy calves: Age related changes and comparison with blood composition in adults. Res. Vet. Sci., 83, 30–39.

Nogalski, Z., Kijak, Z., Pogorzelska, J. (2000). Wpływ typu budowy na tempo wzrostu i wartość rzeźną buhajków mieszańców mięsnych [Effect of the type of body conformation on the rate of groeth and slaughter value of beef crossbred young bulls]. Zesz. Nauk. Prz. Hod., 51, 285–294 [in Polish].

Nogalski, Z., Wroński, M., Wielgosz-Groth, Z., Purwin, C., Sobczuk-Szul, M., Mochol, M., Pogorzelska, P. (2013). The effect of carcass conformation class (EUROP system) on the slaughter quality of young crossbred beef bulls and Holstein-Friesians. Ann. Anim. Sci., 13(1), 121–131.

Evaluation of breeding value of beef bulls 2013/2 (Methods). http://buhajemiesne.izoo.krakow.pl/hodowlana20132.php?strona=2. [In Polish] (data access: October 2014).
Oprządek J., Dymnicki E., 2009. Markery genetyczne cech opasowych i rzeźnych bydła. „Genomika bydła i świni" pod red. L. Zwierzchowskiego i M. Świtońskiego [Genetic markers characteristics of fattening and slaughter cattle]. "Genomics cattle and pigs". Eds. L., Zwierzchowski, M., Świtoński. Publisher University of Life Sciences in Poznań [in Polish].
Papstein, H.J., Ender, K., Pepstein, I. (1992). Wachstumsuntersuchungen an grossrahmigbreiten Bullen des Schwartzbunten Rindes. Arch. Tierz., 35, 551–560.
Parish, J.A., Rhinehart, J.D., Vann, R.C. (2008). Ultrasound Scanning Beef Cattle for Body Composition. Mississippi State: Mississippi State University, Extension Service, Publication: 2509.
Peña, F., Molina, A., Juárez, M., Requena, F., Avilés, C., Domenech, V., Horcada, A. (2014). Use of serial ultrasound measures in the study of growth- and breed-related changes of ultrasonic measurements and relationship with carcass measurements in lean cattle breeds. Meat Sci., 96, 247–255.
Piccione, G., Casella, S., Pennisi, P., Giannetto, C., Costa, A., Caola, G. (2010). Monitoring of physiological and blood parameters during perinatal and neonatal period in calves. Arquivo Arq. Bras. Med.Vet. Zoo., 62(1), 1–12.
Pogorzelska-Przybyłek, P., Nogalski, Z., Wielgosz-Groth, Z., Winarski, R., Sobczuk-Szul, M., Łapińska, P., Purwin, C. (2014). Prediction of the carcass value of young holstein-friesian bulls based on live body measurements. Ann. Anim. Sci., 14(2) 429–439.
Silva, S. da L. e., Tarouco, J.U., Ferraz, J.B.S., Gome R. da C., Leme, P.R., Navajas, E.A. (2012). Prediction of retail beef yield, trim fat and proportion of high-valued cuts in Nellore cattle using ultrasound live measurements. Rev. Bras. Zootech., 41(9), 2025––2031.
Statistics Toolbox MATLAB R2014a, (2014). MathWorks, USA.
Steinhardt, M., Thielscher, H.H. (2000). Tiergerechte Haltung und physiologische Funktionen von Tieren. Tierärztliche Umschau, 55(4), 189–198
Dostawy na rynek krajowy oraz spożycie niektórych artykułów konsumpcyjnych na 1 mieszkańca w 2013 r. [Supplies to the domestic market and the consumption of certain consumer goods on 1 inhabitant in 2013]. CENTRAL STATISTICAL OFFICE Trade and Services Division. Material for the press conference on 29 August 2014. http://stat.gov.pl/obszary-tematyczne/ceny-handel/handel/dostawy-na-rynek-krajowy-oraz-spozycie-niektorych-artykulow-konsumpcyjnych-na-1-mieszkanca-w-2013-r-,9-,4.html (data access: December 2014) [in Polish].
Szefner-Mirzołemska, A. (2009). Ocena wybranych parametrów hematologicznych bydła rasy holsztyńsko-fryzyjskiej [The estimation of chosen hematological parameters of the cattle of the Holstein-Frisian breed]. Zesz. Nauk. Uniw. Szczec., 581, Acta Biologica, 16, 119–128 [in Polish].
Tait, R.G. Jr., Wilson, D.E., Rouse, G.H. (2005). Prediction of retail product and trimmable fat yields from the four primal cuts in beef cattle using ultrasound or carcass data. J. Anim. Sci., 83, 1353–1360.
Tatum, J.D., Smith, G.C., Murphey, C.E., Carpenter, Z.L., Schake, L.M. (1982). Feeder cattle frame size, muscle thickness, and subsequent beef carcass characteristics. Meat. Sci., 6, 275–284.

Tedeshi L.O., 2006. Assessment of the adequacy of mathematical models. Agric. Syst., 9, 225–247.
Terosky, T.L., Wilson, L.L., Stull, C.L., Stricklin, W.R. (1997). Effects of individual housing design on special fed Holstein veal calf growth performance, hematology and carcass characteristics. J. Anim. Sci., 75(7), 1697–1703.
Tokuda, T., Yano, H. (2001). Blood leptin concentrations in Japanese Black cattle. Anim. Sci., 72, 309–313.
Winnicka, A. (2008). Wartości referencyjne podstawowych badań laboratoryjnych w weterynarii. Wydanie IV poprawione i uzupełnione [The reference values of basic laboratory tests in veterinary medicine]. Fourth edition revised and supplemented, SGGW, Warszawa [in Polish].
Wyżlic, I. (2015). Efektywność opasu mieszańców różnych ras bydła w zależności od intensywności żywienia i wieku [Efficiency of fattening of crossbred beef of different breeds depending on feeding intensity and age]. PhD thesis, UWM Olsztyn [in Polish].
Yamada, T., Kawakami, S.I., Nakanishi, N.T. (2003). The relationship between leptin concentrations and the distribution of body fat in crossbred steers. Anim. Sci. J., 74, 95–100.
Yelich J.V., Wettemann, R.P., Dolewal, H.G., Lusby, K.S., Bishop, D.K., Spicer, L.J. (1995). Effects of growth rate on carcass composition and lipid partitioning at puberty and growth hormone, insulin-like growth factor 1, insulin and metabolites before puberty in beef heifers. J. Anim. Sci. 73, 2390–2405.

# SZACOWANIE ZDOLNOŚCI OPASOWEJ MŁODEGO BYDŁA RZEŹNEGO NA PODSTAWIE WYBRANYCH POMIARÓW PRZYŻYCIOWYCH

**Streszczenie.** Celem pracy było określenie możliwości wczesnego przewidywania przydatności opasowej buhajków mieszańców mięsnych przy wykorzystaniu opracowanych, na podstawie wybranych pomiarów przyżyciowych, równań regresji wielokrotnej. Materiał badawczy stanowiło 96 buhajków mieszańców mięsnych, będących wynikiem krzyżowania krów rasy polskiej holsztyńsko-fryzyjskiej i buhajów ras mięsnych (hereford, limousine, charolaise). W wieku 6 miesięcy, w momencie włączenia zwierząt w opas półintensywny trwający 12 miesięcy, dokonywano pomiarów zoometrycznych, usg, wizualnie oceniano umięśnienie i pobierano próby krwi do analiz wskaźników biochemicznych. Po zakończeniu opasu określano tempo przyrostów dobowych masy ciała (ADG). Metodą regresji krokowej wyprowadzono 4 równania szacujące: ADG oraz zużycie suchej masy (DMC), energii netto (NEC) i białka ogólnego (CPC) na 1 kg przyrostu masy ciała. Uwzględnione w badaniach zmienne niezależne nie pozwoliły uzyskać modeli, które przewidywałyby z zadawalającą precyzją zużycie składników pasz na przyrost masy ciała buhajków. Najwyższe wskaźniki predykcji przedstawia równanie szacujące ADG (MBIAS = 0,000–0,002; RMSE = 0,040–0,322; p intercept = 0,441–479; p slope = 0,000–0,001). Jego zastosowanie w praktyce pozwala, z zadowalającą dokładnością, oszacować w wieku 6 miesięcy tempo przyrostów masy ciała buhajków opasanych półintensywnie do 540 dnia życia i na tej podstawie dokonać wyboru cieląt do opasu.

**Słowa kluczowe:** szacowanie, zdolność opasowa, dzienne przyrosty

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