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INFLUENCE OF THE FEATURES OF WEIGHT GAIN, AGE AND DIRECTION OF BREED PRODUCTIVITY ON THE QUALITY PARAMETERS OF BEEF

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Introduction. Formulation of the problem

To meet consumers' needs in high quality beef, with good sensory, cooking, and technological properties and high nutritional value, it is necessary to study in depth its dependence on the animals' genotype

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Abstract. Comparative assessment of beef has been carried out in relation to the animals' age and breed differences. It has been determined that meat breeds and dairy breeds raised in the Kyiv and Cherkasy regions have certain points of difference in the quality of their beef. It has been established that the parameters of weight gain and slaughter age have an effect on the chemical composition of the beef of bulls aged 20–22 months of the Ukrainian black-and-white dairy and meat breeds. The beef of young stock of Ukrainian dairy and meat breeds differs significantly in its chemical composition. Meat bulls are inferior to dairy ones of the same age in the content of dry matter (by 28.8 and 31.8%), minerals (by 5.9 times), and fat (by 10.2 and 12.6 times) in their meat. The protein content is the same in both groups. An older age of slaughter of young dairy and meat stock has no significant effect on the content of dry matter, minerals, and fat. Only the meat of dairy animals aged 20 months has a higher protein content. Up to the age of 22 months, animals of the Ukrainian black-and-white dairy breed tend to increase their fat content with a slight reduction in protein. The weight of animals before slaughter does not affect the chemical composition of beef. With an increase in the actual live weight before slaughter, the dry matter content only tends to increase. There is no significant difference in the protein, fat, and mineral content. With faster growth of animals of both breeds, only the protein content of their beef tends to increase, whereas the content of minerals tends to decrease. The meat of bulls of the Ukrainian meat breed tends to increase in fat by 0.3 points as their growth increases. Comparison of the chemical compositions of the *m.Longissimus dorsi* of Ukrainian black-and-white dairy and beef cattle shows that the beef of the meat breed most closely meets the market requirements. If this breed is well fed, the result is the rapid growth of muscle tissue and late formation of adipose tissue. These animals have a specific biological feature, which is absent in the dairy breed: up to the age of 20–22 months, they gain weight mainly due to accumulation of muscle tissue, with moderate growth of adipose tissue.

Keywords: beef, Ukrainian black-and-white dairy breed, Ukrainian meat breed, *m. Longissimus dorsi*, chemical composition.

and specific features of their weight gain and age of slaughter.

The quality of beef is a complex concept characterised by many features. The main ones are its technological properties and chemical composition. According to these indicators, beef is the most valuable

type of meat, which has the optimal ratio of fat and protein [1]. The nutritional value of meat is significantly determined by the presence of intramuscular fat. Only after its accumulation, it is possible to get muscle tissue with enough fat in it. Optimal distribution of fat in muscle tissue imparts valuable technological properties to it (marbling, tenderness, and juiciness) and improves the sensory ones (taste, aroma). Besides the accumulation and distribution of fat, another factor determining the tenderness of meat is the amount of connective tissue and the diameter of muscle fibres. A topical task is to evaluate the quantitative and qualitative characteristics of beef from young stock of domestic dairy and meat breeds by its chemical composition in relation to their growth and slaughter age, and to use these data in industrial beef production. This is supposed to help intentionally direct the growth and development of muscle tissue and control quantitative and qualitative processes of ontogenesis.

Therefore, it is necessary to highlight the problem of regulating the slaughter age and weight gain parameters, and of using different breeds to obtain meat, which varies significantly in its chemical composition and technological properties.

Analysis of recent research and publications

Parameters of beef quality are significantly influenced by the age of slaughter of animals [2]. Beef of older animals is lower in moisture and much higher in dry matter [3-5].

Beef from bulls has a higher protein content and less fat than that from oxen [6-8]. Beef from heifers of meat breeds differs in its characteristics and complex of saturated fatty acids from meat of adult cows and bulls [9]. heifers and cows of meat breeds have larger fat deposits than oxen and bulls do. The intermuscular fat content varies depending on the area of the longissimus lumborum muscle [10]. Its growth is accompanied by a simultaneous increase in the marbling of beef.

Meat of the Aberdeen Angus breed has the highest dry matter and intramuscular fat content, so the quality characteristics of food products from them are the best [11]. The flavour of beef is determined by the fat content rather than by moisture or protein [11].

Meat from the *m. Longissimus thoracis* of oxen has a higher content of intramuscular fat, is less tough, but gentler and more pleasant than meat of bulls whose intramuscular fat contains a higher concentration of polyunsaturated fatty acids [7]. Animals older than 20 months have higher meat quality than those slaughtered at the age of 20 months. Bulls' slaughter age significantly ($p < 0.05$) affects the parameters of the intramuscular fat content and organoleptic characteristics of meat [8].

In the course of studying the chemical composition of meat samples and the *m. Longissimus dorsi*, fat appears to be the most variable

component [5]. The content of protein and minerals in meat is relatively stable.

Recently, the demand for lean and biologically complete beef has been increasing both in our country and abroad. To obtain the required amount of such meat, great importance should be given to the Ukrainian black-and-white dairy breed, as its proportion in the total number of Ukrainian cattle is the largest [1]. The biological parameters of bulls of this breed allow using its meat production potential effectively while fattening the animals intensely to the live weight 500–550 kg [12]. Extending the fattening limits of these cattle to 570–600 kg of live weight at the age of 23 months is an important reserve to increase the meat potential of the country: it allows significantly increasing beef production without loss of quality and with the same numbers of animals [12]. Cattle of the Ukrainian meat breed, too, should play an important role in solving the problem of beef shortage [1]. The paper [13] gives data on the productivity and chemical composition of beef from different breeds and genotypes compared with the Holstein Friesian breed. However, there are not enough data on comparative analysis of the chemical composition of beef from Ukrainian black-and-white dairy and meat breeds.

The purpose and objectives of the study. The purpose of the study was to substantiate the optimal time of slaughter of bulls of the Ukrainian black-and-white dairy and meat breeds for meat production.

For this purpose, the following **objectives** have been achieved:

- studying how the slaughter age, live weight, and growth rate effect on the technological properties of beef from bulls of the Ukrainian black-and-white dairy breed;
- analysing the chemical composition of beef from bulls of different breeds at different growth rates, slaughtered at different age, and having different actual live weight at the moment of slaughter.

Research materials and methods

The object of study was bulls of the Ukrainian black-and-white dairy breed (UBWD) and the Ukrainian meat breed (UM). The UBWD animals from their birth up to 4 months of age were kept in groups of 25 animals at the farm *Zhuravushka* in Brovary District of the Kyiv Region. During the milking period, they were given 547.2kg of whole milk and 182.4kg of skimmed milk. Rearing and fattening the animals was carried out on fattening grounds. The experimental animals were fed according to the rations adopted on farms. From birth to the age of 20 months, the bulls consumed 31,486 MJ, and up to 22 months of age, 36,119 MJ. The diet included, respectively, 18.8 and 18.4% of concentrated feeds. The slaughter was carried out in a slaughterhouse (village of Kalynivka). The UM animals were studied at the farm *Volya* (Cherkasy Region). From birth to weaning, the calves were kept

with their mothers. From the age of 1 month, they were additionally fed with concentrated feed and hay. At the age of 8 months, they were tested for their own productivity, which lasted until they reached the age of 22 months. During the periods from 8 to 20 and from 8 to 22 months, each bull consumed 24,697 and 26,243 MJ respectively. In different periods, the feeds consumed varied in quantity: roughage from 13.3 to 23.5%, succulent from 15.9 to 25.6%, green from 8.8 to 21.6%, concentrated from 42.1 to 49.1%. Concentrated and green feeds were the most nutritious (49.1% and 21.6% respectively). The bulls were slaughtered at the Zolotonosha Poultry Plant and the Cherkasy Meat Plant. The animals were grouped for slaughter according to the method of balanced analogous groups [14]. The difference in the age of the animals was up to 5%.

The live weight of the bulls was determined based on weighing them individually. The animals were weighed in 2-3 hours after their birth, and then on the 20th-22nd day of each month, 1-2 hours before the morning feeding. Based on these data, the live weight was extrapolated to the animals' birthdays.

The average daily increase in the live weight of the bulls was determined by formula 1:

$$D_a = \frac{W_t - W_0}{t} \quad (1)$$

where: D_a – an average daily increase in an animal's live weight, g,

W_t – live weight of the animal at the end of the period, kg;

W_0 – live weight of the animal at the beginning of the period, kg.

t – number of days in the period.

The chemical and technological characteristics of the beef were studied in the laboratory of the Department of Meat, Fish, and Seafood Technology at the National University of Life and Environmental Sciences of Ukraine. The beef samples analysed were taken from the *m. Longissimus dorsi* in the area of the 11th-12th rib in 24 hours after slaughter. The dissected muscle was cleared of fascia and fat, weighed, and minced. An average sample was taken from the minced meat, and the following parameters were determined: moisture content – in accordance with ISO 1442:2005, protein – GOST 25011-81, fat – DSTU ISO 1443:2005, minerals – DSTU ISO 936:2008. The moisture retention capacity of the meat was studied in three parallel determinations. The 0.3 g test sample was pressed with a 1kg load, the moisture released under the pressure was sorbed with filter paper, and the amount of the moisture isolated was determined by the area of the wet spot on the filter paper, according to the method described in the work [15]. The moisture capacity of the meat was calculated by formula 2:

$$\chi = \frac{\alpha - 8,4 \times b}{m} \times 100 \quad (2)$$

where χ – content of bound moisture, % of the weighed portion of meat;

α – total moisture content in the sample, cm²;

b – area of the wet spot, cm²;

m – weight of the portion of meat, mg.

The pH of the beef was determined in accordance with DSTU ISO 2917-2001, using a laboratory ionometer (Y-160M). The maximum shear stress, according to GOST 50814-95, was measured using the penetrometer Ulab 3-31 M. The calorie content of the beef was determined by formula 3:

$$C = [M - (F + A)] \times 41 + F \times 93 \quad (3)$$

where C – calorific value of natural meat, kcal/kg;

M – dry matter, %;

F – fat, %;

A – ash, %;

41 – calorific value of 10 g of protein or REM, kcal (1% of kg);

93 – calorific value of 10 g of fat, kcal (1% of kg).

The average value (M) of the chemical components of the muscle *m. Longissimus dorsi* and the error of this value ($\pm m$) was calculated according to the methods described in [16].

Results of the research and their discussion

The technological properties of beef from the UBWD bulls of different ages are given in Table 1. In the period from the bulls' age of 20 months to the slaughter age when they are 22 months old, the calorific value of this beef remains the same, but the coefficients of correlation between marbling and calorific value increased with the age of slaughter: $r=0.1$ at 20 months, $r=0.4$ at 22 months. The muscle fibres become denser as a result of their growth, and the collagen fibres lose the ability of hydrometric destruction during heating. That is why the meat of adult animals after heat treatment is tougher than that of young animals.

Table 1 – Technological properties of beef from UBWD bulls of different age, $M \pm m$

Parameter	Age of slaughter, month	
	20 (n=6)	22 (n=7)
Calorific value of meat, kcal	179.1±9.33	172.2±13.10
Moisture holding capacity, %	61.3±4.01	52.8±4.47
Active acidity, pH	6.0±0.21	5.8±0.57
Critical shear stress, Pa	22.7±2.14	17.2±2.09

The rate and extent of changes in the pH are important for the quality of meat being sold. With an increase in the bulls' slaughter age, the active acidity tends to decrease. It is believed [17] that dispersed food systems in the form of raw materials have a different structure, chemical composition, and physical properties, which together determine the quality of the finished product. Quite objectively, the quality of the product can be characterised by its physical state, which depends on the chemical composition and is determined by the internal structure.

Critical shear stress is a parameter that characterises the structural and mechanical properties of raw materials [17]. With the increasing slaughter age of animals, it tends to decrease by 32.0%.

The decrease in bound water, too, confirms the good preservation of beef obtained from bulls aged 22 months. This is evidenced by the pH of the water-meat extract (less than 5 in all experimental groups at all ages), in which glycogen, within 48 hours after slaughter of the bulls under study, through intermediate reactions turned into lactic acid. As a result, the pH changes from slightly alkaline to weakly acidic. The shift of the reaction towards acidity is also of practical importance: it inhibits the development of pathogenic microflora, which makes it possible to store meat for a longer time.

No less important a characteristic of beef is its juiciness, which also determines its taste. It is determined by two factors: the moisture-binding capacity, or moisture content, and the presence of intramuscular fat. High moisture retention capacity makes the meat of 20-month-old bulls drier in the cut, it loses less water during heat treatment, and that is why the product made from it will be juicier. Meat's high moisture retention capacity is determined by the content of proteins in muscle fibres, which, due to their chemical structure and the presence of free active groups, can hold a large amount of water. The amount of bound water in the meat characterises its juiciness and tenderness. Choosing the optimal heat treatment conditions for beef determines its high culinary and technological characteristics. Lower pH values cause a decrease in the moisture holding capacity of the meat.

With an increase in animals' actual live weight before slaughter, the calorie content of beef changes unevenly (Table 2). The moisture retention capacity, pH, and shear stress of beef with the increasing actual live weight of bulls before slaughter tend to decrease.

The yield of meat directly depends on the weight of the carcass. The heavier the carcass and the better its morphological and chemical composition, the more beef is obtained from it, and the higher the meat quality is. The yield of flesh per 1 kg of carcass bones and per 1 day of life of bulls decreases with their age. The best fleshing index has been recorded for all bulls under study at the age of 18 months, when the growth energy reaches its maximum. The studies [18] have shown that lowering of the pH decreases the moisture holding capacity of meat, and in the course of heat treatment, the moisture loss increases.

The calorie content, moisture holding capacity, and pH of beef decrease with a higher growth rate of the bulls from birth to slaughter (Table 3), as there is an increase in the moisture content and a slight increase in the protein content in the beef. Depending on the average daily weight gain, the protein content is from 19.29 (up to 500g) up to 20.48% (551 to 600g), and the mineral content ranges from 1.99 to 2.22%. Penetration tends to increase by 7%.

Table 2 – Technological properties of beef from UBWD bulls of different live weight, M±m

Parameter	Actual live weight, kg		
	350-400 (n=4)	401-450 (n=6)	451-500 (n=3)
Calorific value, kcal	189.0±3.55	160.8±10.29	186.3±26.60
Moisture holding capacity, %	61.7±5.25	56.4±4.26	50.8±8.89
Active acidity, pH	6.3±0.23	5.7±0.07	5.8±0.08
Critical shear stress, Pa	24.2±1.89	17.3±2.55	18.6±3.26

Table 3 – Technological properties of beef of UBWD bulls at different growth rates, M±m

Parameter	Average daily weight gain, g	
	up to 550 (n=3)	551–600 (n=4)
Calorific value, kcal	181.2±10.65	165.4±12.56
Moisture holding capacity, %	62.6±4.83	57.5±6.15
Active acidity, pH	6.3±0.32	5.8±0.14
Critical shear stress, Pa	18.7±2.47	20.0±4.24

With increasing weight gain from birth to slaughter, the content of adipose tissue (subcutaneous fat) tends to increase for animals of the Ukrainian black-and-white dairy breed. Changes in the growth rate of UBWD bulls do not affect significantly the variability of the indices that characterise the ratio of different tissues in the carcass (meat to bone ratio, muscle tissue index, fleshing index). When the rate of UBWD bulls' growth from birth to slaughter increases over 700 g, it encourages farmers to reduce the slaughter age of animals by 31–51 days and 120–166 days respectively. This does not significantly affect on the deterioration of the morphological composition of carcasses.

Thus, it has been found that changes in the parameters of weight growth and slaughter age of the animals lead to changes in the technological properties of the beef from the UBWD bulls under study.

With rationed feeding and normal development of cattle, the chemical composition of the body's growth and the protein to fat ratio in beef depended on the age of the animals.

Beef from young livestock of Ukrainian dairy and meat breeds differs significantly in its chemical composition (Table 4). The meat of bulls of the Ukrainian meat breed aged 20 and 22 months contains less dry matter (by 28.8 and 31.8%) than that of bulls of the Ukrainian black-and-white dairy breed.

The fat content of UBWD animals is 10.2 and 12.6 times higher due to the formation of so-called marbled meat in the meat breeds, and of subcutaneous fat in the UBWD. The process of fat formation in the Ukrainian meat breed begins at later stages of ontogenesis. There was no significant difference in protein content between the groups.

The ability of cattle to increase the proportion of muscle tissue in the body during growth depends mainly on the breed. In the muscle tissue of UBWD cattle carcasses, the fat content is higher ($P > 0.95$) than in the meat from UM animals. This is explained by the fact that while animals grow, fat is first deposited on

the internal organs and between the muscles, then under the skin and inside muscles. This process takes place earlier in dairy than in meat cattle. The difference

in the fat content is due to the different ratio of fatty acids in it.

Table 4 – Chemical composition of beef from bulls of different breeds and slaughter ages, M±m

Parameter	20 months		22 months	
	UBWD (n=6)	UM (n=3)	UBWD (n=4)	UM (n=3)
Dry matter, %	29.5±1.32	22.9±0.40*	28.2±2.18	21.4±0.27
Protein, %	21.3±0.56	21.3±0.34	19.8±1.07	19.8±0.48
Fat, %	6.1±0.98	0.6±0.13*	6.3±0.93	0.5±0.26*
Fat to protein ratio	1:0.29	1:0.03	1:0.32	1:0.03
Ash, %	2.2±0.07	1.1±0.02	2.2±0.09	1.1±0.05

Note: *P>0.95

Live weight gain due to increased adipose tissue is not effective, as it consumes more feed energy than the increase in muscle tissue does [18]. The younger the slaughter age of UBWD animals, the more protein is contained in the meat, the lower the fat content is, and the better the meat quality parameters are. An increase in the slaughter age of cattle leads, mainly, to an increase in fat, which results in a lower protein content and deterioration of meat quality. In this respect, the cattle of the Ukrainian meat breed have an obvious advantage. They are physically large and can steadily gain much weight over a long period of time due to the growth of muscle tissue, and not fat. The heaviest carcasses are obtained from bulls of the Ukrainian meat breed, but the composition of their meat is lower in fat, compared to the dairy cattle.

Taking into account the requirements for the quality of beef and economic aspects of its production, the optimal age of slaughter is determined. It depends on many factors. The main one is the breed. Young animals of the Ukrainian black-and-white dairy breed should be sold for meat at the age of 20 months, and those of the meat breed at 22 months. After this age, rearing and fattening of animals can increase the proportion of the edible part, but steadily increase the fat content in the meat. In the UM breed, fat is deposited much later and reaches its maximum at a more mature age. Because of this, animals of this breed can be raised to a live weight of more than 650 kilograms, when the slaughter weight and fat content in the meat will correspond to the optimal ratio.

Increasing the slaughter age of young dairy and meat cattle from 20 to 22 months brings no significant

change in the dry matter content. Similar results are described in the studies [4,19]. In the breeds under study, the mineral and fat content in the carcasses does not significantly depend on the age of the animals. The tendency to gain fat till the age of 22 months with a slight reduction in the protein content is only observed in the Ukrainian black-and-white dairy breed. The materials obtained by studies of bulls of dairy and meat breeds at this age do not confirm the well-known biological tendency that with age, the ratio of the basic nutrients in meat changes: the dry matter, especially fat, gradually increases, the protein to fat ratio improves, the beef becomes more mature. A significant difference in the chemical composition of beef is only observed between animals at the age of 3 [20] and 6 [4] months, and after the age of 12 months. According to the data presented in these studies, the maximum moisture content in the meat is observed in newborn calves, then it gradually decreases. The fat content is much lower before the age of 3 months, than after 12 months. The tendency to a higher protein content in animals' meat is only observed at the age of 20 months.

The live weight of animals of Ukrainian black-and-white dairy and meat breeds before slaughter does not significantly affect the chemical composition of the *m. Longissimus dorsi*. The dry matter content tends to increase with an increase in the actual live weight of bulls of the studied breeds before slaughter (Table 5). As to the content of protein, fat, and minerals in the meat of bulls of different live weight, no significant difference has been found, which indicates the chemical maturity of the beef.

Table 5 – Chemical composition of bulls' beef of different actual live weight at the moment of slaughter, %, M±m

Parameter	UBWD		UM	
	350-400kg (n=4)	451-500kg (n=3)	570-620kg (n=3)	625-640kg (n=3)
Dry matter, %, including:	31.0±1.01	31.1±4.48	22.0±0.25	22.4±0.82
Protein, %	21.5±0.54	21.4±1.93	20.5±0.14	20.7±0.90
Fat, %	7.0±0.54	6.8±1.65	0.4±0.15	0.7±0.19
Protein to fat ratio	1:0.33	1:0.32	1:0.02	1:0.03
Minerals, %	2.5±0.06	2.9±0.07	1.2±0.04	1.1±0.03

Note: n – number of animals.

A similar characteristic of the chemical composition of beef after an increase in the slaughter

weight (from 422 to 550 kg) is described in [21]. People's greatest demand is for relatively lean meat

with the fat content 10–15%. Beef should have the protein to fat ratio 1:0.4–1.2. The meat of bulls of the Ukrainian meat breed is of the best quality. The protein to fat ratio in the carcasses of these animals is 1 to 0.02–0.03. Increasing the amount of fat reduces the nutritional value of meat. As for the bulls of the Ukrainian black-and-white dairy breed, their meat quality is lower. The ratio of protein and fat in them is relatively low, but still much higher than in animals of Ukrainian meat breed. Therefore, to obtain high-quality beef, bulls of the Ukrainian black-and-white dairy breed should be fattened to the live weight 451–00 kg, and those of the Ukrainian meat breed to more than 620kg, keeping to a low protein to fat ratio.

In obtaining beef of a high nutritional value, the most important factor is the growth of muscle and adipose tissue. Their ratio determines the composition of carcasses and the value of meat. To increase the proportion of muscle in the carcass, it is necessary to use the Ukrainian meat breed more extensively, since adult animals of this breed have a large live weight, large size, and are characterised by late formation of adipose tissue. This allows slaughtering of animals with a larger live weight. In Ukrainian meat animals, with an increase in the live weight, the intensity of protein accumulation in meat does not decrease, and fat begins to increase sharply. This results in animals with a large live weight, which allows obtaining heavy carcasses with an optimal ratio of fully functional substances after slaughter. When the live weight reaches more than 620 kg, only up to 0.7% of fat accumulates in the carcasses, and further fattening of animals is advisable. Carcasses are not too fatty, and additional weight gain does not require too much food, which is because there is no significant increase in adipose tissue.

The quantity and quality of beef depends on the growth rate of animals from birth to slaughter (Table 6). In turn, they depend on the animals' individual characteristics and temperament [22]. With an increase in average daily gains in young animals, the quality of meat improves due to more intensive accumulation of protein in muscle tissue with moderate fat deposition. As the growth rate increases, young animals, first of all, build up muscle tissue, which is the most nutritionally valuable. In the body of beef cattle, protein is deposited most intensively, with a slight accumulation of fat. Only meeting these conditions allows obtaining carcasses with the highest content of muscle tissue, the main source of complete protein, accompanied by some fat, in the amount just enough to improve the taste of the meat. Carcasses of bulls of the Ukrainian black-and-white dairy breed contain more fat, so they have fatter meat and lower quality. As the growth rate of animals of both breeds increases, only the protein content of beef tends to increase, while the mineral content tends to decrease.

In the chemical composition of beef of dairy and meat bulls, individual elements differ significantly at different growth rates before slaughter. In the *m. Longissimus dorsi* of bulls of the Ukrainian meat breed, when the growth rate increases, there is a tendency of an increase in the dry matter content and reduction in water and minerals. As the growth rate of young dairy animals increases, there is a tendency of an increase in the protein content and reduction in the fat and minerals content. Only in the meat of dairy animals, there is an increase in the protein to fat ratio. In *m. Longissimus dorsi* of meat animals, on the other hand, the ratio of protein to fat tends to decrease as the growth rate increases.

Table 6 – Chemical composition of beef of bulls at different growth rates, g, M±m

Parameter	UBWD		UM	
	up to 550 (n=6)	551–600 (n=3)	up to 1030 (n=4)	over 1031 (n=3)
Dry matter, %, including:	29.0±1.62	27.6±0.42	22.0±0.25	22.4±0.82
Protein, %	19.3±1.11	20.5±1.51	20.5±0.14	20.7±0.90
Fat, %	7.5±0.46	5.1±0.88	0.4±0.15	0.7±0.19
Protein to fat ratio	1:0.39	1:0.25	1:0.02	1:0.03
Minerals, %	2.2±0.31	2.0±0.60	1.2±0.04	1.1±0.03

Note: n – number of animals.

Young cattle of dairy breeds, in contrast to young ones of meat breeds, have a lower growth rate and give a carcass in which the accumulation of intramuscular fat is faster and higher. Different breeds of cattle are not this precocious. They are divided into relatively precocious, moderately precocious and large (super precocious). Early-maturing cattle can store up a significant amount of fat even with low-calorific feed, while fat in large animals' bodies is not intensively deposited until the growth of muscle tissue stops. Meat with a higher moisture content is produced in the carcasses of the large Ukrainian meat breed rather than in other breeds. The Ukrainian black-and-white breed

of dairy direction of production should be classified as moderately precocious. Animals of the Ukrainian meat breed are large. Large cattle for a long time retain the ability to build up intensively the muscle tissue with but slight accumulation of fat. Slaughtered at the age of 20–22 months, these animals yield leaner beef. When selecting the required type of livestock, these features should be taken into account, because they allow determining the right time when to sell it for slaughter. The intensity and duration of growing should be different for different breeds.

Conclusion

1. It has been studied how different rates of weight gain and different slaughter age determine the change in the technological properties of beef from bulls. The moisture-retaining capacity, active acidity, calorific value, and mechanostructural properties of meat of bulls of the Ukrainian black-and-white dairy breed tend to decrease when the slaughter age increases. Higher rates of animals' growth lead to a decrease in the calorific value of beef.

2. By the individual elements of the chemical composition, the beef from the Ukrainian black-and-white dairy breed differs significantly from that of the meat breed. Meat of bulls of dairy breeds is superior by its dry matter content compared to beef from meat breeds. When the slaughter age of young dairy and meat cattle is increased from 20 to 22 months, the dry matter content does not change significantly. Only dairy animals at the age of 20 months have a higher

protein content. With an increase of the growth rates of cattle, the chemical composition of the *m. Longissimus dorsi* (namely its minerals and fat) does not depend on the age of the animals. By the age of 22 months, the fat content tends to increase with a slight reduction in the protein content for animals of the Ukrainian black-and-white dairy breed. It has been found that the weight of animals of the studied breeds before slaughter does not affect the chemical composition of beef. With an increase in actual live weight before slaughter, the dry matter content tends to increase. In protein, fat, and mineral content, there is no significant difference either. Only the protein content of beef tends to increase as the growth rate of animals of both breeds increases.

3. Thus, based on the studies conducted, it has been scientifically substantiated that the optimal time to slaughter bulls is 20–22 months.

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ВПЛИВ ОСОБЛИВОСТЕЙ ВАГОВОГО РОСТУ, ВІКУ ТА НАПРЯМКУ ПРОДУКТИВНОСТІ ПОРОДИ НА ПОКАЗНИКИ ЯКОСТІ ЯЛОВИЧИНИ

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Анотація. Проведено порівняльну оцінку яловичини у міжпородному і віковому аспекті тварин. Визначено конкретну різницю якісних показників яловичини м'ясних і молочних порід, вирощених у Київській та Черкаській областях. Встановлено вплив різних параметрів вагового росту та віку забою на хімічний склад яловичини 20–22-місячних бугайців українських чорно-рябої молочної і м'ясної порід. За хімічним складом яловичина молодняку українських молочної і м'ясної порід має суттєву різницю. Бугайці м'ясної породи поступаються ровесникам молочної за вмістом у м'ясі сухої (на 28,8 і 31,8%) та мінеральних речовини (у 5,9 рази) і жиру (у 10,2 та 12,6 рази). За вмістом білка різниці між групами не існує. За підвищення віку забою молодняку молочного і м'ясного напрямку продуктивності вміст сухої речовини, мінеральних речовин і жиру суттєво не змінюється. Спостерігається вищий вміст білка в м'ясі лише молочних тварин у віці 20-ти місяців. До 22-місячного віку в тварин української чорно-рябої молочної породи є тенденція до наростання вмісту жиру за незначного скорочення протеїну. Маса тварин перед забоєм не впливає на хімічний склад яловичини. Уміст сухої речовини за збільшення фактичної живої маси перед забоєм має лише тенденцію до збільшення. За вмістом білка, жиру і мінеральних речовин істотної різниці не існує. За швидшого росту тварин обох порід тенденцію до збільшення має лише вміст білка у яловичині, а мінеральних речовин – до зниження. М'ясо бугайців української м'ясної породи за підвищення їх приростів має тенденцію до збільшення жиру на 0,3 пункти. Порівняння хімічного складу *m. Longissimus dorsi* українських чорно-рябої молочної та м'ясної худоби показує, що найбільше вимогам ринку відповідає яловичина української м'ясної породи, яка на задовільну годівлю реагує швидким ростом м'язової тканини і пізнім утворенням жирової тканини. Біологічною особливістю цієї худоби, на відміну від молочної породи, є те, що приріст їх маси до 20-22-місячного віку, в основному, відбувається за рахунок накопичення м'язової тканини та помірного росту жирової тканини.

Ключові слова: яловичина, українська чорно-ряба молочна порода, українська м'ясна порода, *m. Longissimus dorsi*, хімічний склад.

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