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IMPACT OF NUTRITION ON REARING RESULTS AND METABOLIC PROFILES OF KAZAKH WHITE HEAD BREED HEIFERS AND BREEDING BULLS

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Key words: nutrition, metabolic profile, body weight, urea, protein, alkaline phosphatase.

Abstract

This study analysed the feeding of young breeding cattle of the Kazakh White Head race, from birth to the age of 450 days at a Kazakh farm called "Dinar's Ranch". In the final stage of the research, the animal health condition was assessed, based on the biochemical blood parameters. The level of nutrition in the first period of life of the animals significantly influenced the growth and development of young breeding cattle. 1,250 liters of milk, besides solid feed, is recommended for calves from birth to the age of 240 days. Applied nutrition in subsequent life periods, including hay, silage, concentrated feed and mineral additives ensure that the assumed daily body weight increases were real. The average daily dry weight absorption by the heifers was from 5.3 to 7.1 kg, whereas bulls absorbed from 6.5 to 8.7 kg. The daily increase of heifers at the age of 361–450 days was 833 g, whereas for bulls it was 1055 g/day. The metabolic profile parameters of bulls (hepatic enzymes – AST and ALT, urea, protein, alkaline phosphatase – ALP, as well as Ca, Na, K, Mg and P content) were in the range of the reference standards, which reflected the good health status of the animals.

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WPŁYW ŻYWIENIA NA WYNIKI ODCHOWU I PROFIL METABOLICZNY JAŁÓWEK I BUHAJKÓW HODOWLANYCH RASY KAZACHSKIEJ BIAŁOGŁOWEJ

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Słowa kluczowe: żywienie, profil metaboliczny, masa ciała, przyrosty dobowe, mocznik, białko, fosfataza alkaliczna.

Abstrakt

Celem pracy była analiza żywienia młodego bydła hodowlanego rasy kazachskiej białogłowej od urodzenia do wieku 450 dni w jednym z gospodarstw Kazachstanu o nazwie „Ranczo Dinara". Na końcowym etapie doświadczenia oceniono zdrowie zwierząt na podstawie biochemicznych parametrów krwi. Poziom żywienia w pierwszym okresie życia zwierząt istotnie oddziaływał na przebieg wzrostu i rozwoju młodzieży hodowlanej. Cielętom od urodzenia do wieku 240 dni zaleca się podanie 1250 litrów mleka poza paszami stałymi. Zastosowane żywienie w kolejnych okresach życia oparte na sianie, kiszonce, paszy treściwej i dodatkach mineralnych zapewniło osiągnięcie zakładanych przyrostów dobowych masy ciała. Średnie dzienne pobranie suchej masy przez jałówki wynosiło od 5,3 do 7,1 kg, a buhajki pobierały od 6,5 do 8,7 kg. Przyrosty dobowe jałówek w wieku 361–450 dni wynosiły 833 g, zaś buhajków – 1055 g/dobę. Parametry profilu metabolicznego buhajów (enzymy wątrobowe – AST i ALT, mocznik, białko, fosfataza zasadowa – ALP, jak również zawartość Ca, Na, K, Mg i P) mieściły się w zakresie norm referencyjnych, świadcząc o dobrym statusie zdrowotnym zwierząt.

Introduction

Grassland is a purveyor of cheap feed. Feed manufactured from grasslands can be fed only when fresh and on a pasture or preserved as silage, haylage or hay (HUUSKONEN et al. 2009). Pure-bred herds of meat calves born in the early spring can stay with their mothers, using the pasture until the end of October. Further rearing of calves takes place in the alcove (BADIEJEVA 2012). In Kazakhstan, most beef is derived from dual purpose animals, however White Head race meat breed, Kazakh Herefordand imported pure-bred Hereford have also a large share of beef production. Both genetic and environmental factors affect the quality of beef (AMANZHOLOV et al. 2012, BADIEJEVA 2012). The influence of the breed cattle for fattening is also very important (DYMNICKA et al. 2004, POGORZELSKA et al. 2013). Cattle of different races or genotypes are characterized by diverse physiological features (i.e. early ripening, growth and sex) which consequently affect the quality of meat (WHEELER

1994, BINDON and JONES 2001, BURROW et al. 2004, ISABJEKOV and MALCZEWSKI 2012,). The main factors affecting beef quality, among environmental factors,are the feeding and housing system (POGORZELSKA 1999, POGORZELSKA et al. 2013), the age at slaughter, pre-slaughter trading (stress resulting from transport, residing in a slaughter warehouse, starvation) and meat treatment after slaughter (*The new national*... 2012). Fodder is the main cost component in both breeding and production (fattening) herds. Nutritional strategy is a factor used as a tool for monitoring bulls and heifers reared in breeding herds, as well as to improve and control cattle fattening, animal welfare, safety, nutritional value and the nutritional and technological quality of meat (STENN 1995). Research conducted on the effects of nutrition on the course of rearing has covered not only the diversity of cow breeds, but also the types and availability of used feed (JELMANOWET al 1983). Research into which feeding affects the muscle and slaughter efficiency growth and allows the introduction of components and chemical compounds into the feed is extremely valuable. Such compounds could be potentially absorbed from the gastrointestinal tract and subsequently incorporated into cellular structures or by accumulating in tissues and improving meat nutritional or biological qualities (MINKIEWICZ et al. 2013). An example of this is modifying the feed composition (GRANIT et al. 2001, WOOD et al. 2004). WARREN et al. (2008) found that bovine meat originating from cattle fattened with silage from green forage has a 2–3 day longer shelf life, due to slow progressive changes in lipid oxidation and, thus, has a more stable color compared to the meat of cattle fed with concentrated feeds. LEE et al. (2008) demonstrated that the addition of sulfur and vitamin E to feedincreases the stability of lipids and myoglobin during meat storage. Vitamin E effectively slows down the oxidation of lipids and sulfur preferably affects the stability of oxymyoglobin. PEDREIRA et al. (2003) supplemented feed with Vitamin D3 and found that it affects the improvement of meat tenderness, which is inherently hard, whereas it is irrelevant for animals which are the source of such meat (ANDERSEN et al. 2005). The results of both tests show the high efficiency of such a feeding system and encourage further scientific research in this field (MAKULSKA and WĘGLARZ 2001).

Aim of the work. The aim of this study was an analysis of the nutritional impact of Kazakh White Head race heifers and bulls, which achieved optimal growth and development indicators for young breeding cattle in the period from birth to 450 days of life and to assess health status based on selected biochemical blood parameters.

Material and Methods

The research was conducted on the "Dinara's Ranch" farm near Almaty, Kazakhstan. The material consisted of a beef Kazakh White Head race cattle herd. The first stage of the study determined the details of the nutrition of cows and bulls born in the early spring and staying with their mothers in the pasture up to the age of 7–8 months old. The second stage involved the following months of life in two periods, i.e. from 240 to 360 days and from 361 to 450 days of life, specifying the two feeding periods – summer and winter. The types of feed were specified. Feed doses in subsequent months of heifers and bulls lives were also specified, taking gender into account. Nutrition was based mainly on roughage produced on grasslands, i.e. green forage or silage from grass or corn silage, hay and concentrated feed addition. The total consumption of each feed used in nutritional doses for heifers and bull feeding, from birth to 15 months of their lives, was also presented. Daily gains in body weight at certain ages were used as indicators of growth and development of farm animals.

During alcove feeding, the basic *ad libitum* feed was corn silage supplemented with hay in an amount of 2.5–6 kg (heifers) and 3–7.5 kg (bulls). The addition of roughage is as follows: 1.5–2.5 kg (heifers) and 2.5 kg bulls. Daily doses of silage were increased in 30-day intervals, not to exceed 10% of unused feed per dose.

Young cattle nutrition in the specified periods of breeding in the summer proceeded as follows: heifers (aged 240–360 days) consumed 20 kg of fodder and 1kg of concentrated feed supplemented with microelements, whereas bulls during this period consumed 20 kg of fodder and 3 kg of concentrated feed. In the next period (361–450 days), there was an increase to 22 kg in forage intake by heifers (concentrated feed remained the same, while bulls consumed 23 kg of fodder and 4 kg of concentrated feed during this period).

From 450 days of age (±10 days), randomly-selected bull blood was collected from the jugular vein to determine blood biochemical parameters. Blood samples were collected into heparinized tubes and allowed to coagulate. After two hours, the blood was centrifuged for 10 minutes at 3,000 rpm (in an MPW 223e centrifuge) and the resulting serum was collected by pipette and stored in Eppendorf tubes at -18°C until determination. The total protein (TP) [g dl^{-1}] level was determined in blood serum. The content was determined using the LOWRY'S et al. (LOWRY 1951) colorimetric micro-method (Sigma Diagnostic Kits). Further indications of blood serum were performed on a Mindray BS-120 photometer. These included the following biochemical indicators: serum alanine aminotransferase (ALT) [U l^{-1}], alkaline phosphatase (ALP) [U l^{-1}] and urea concentration (UREA) [mg dl^{-1}].

To interpret the results of blood biochemical parameters, the reference levels adopted in developed standards for cattle were used. These standards were as follows: ALT – 25 – 74 U/l, AST – 58–100 U/l, ALP – 41–116 U/l, UREA – 10–45 mg dl^{-1} (ANDREWS 2004, DIRKSEN et al. 2007, WINNICKA 2008) and protein level – 51–71g (WINNICKA 2008). The content of some macroelements, i.e. calcium (Ca), sodium (Na), potassium (K), magnesium (Mg) and phosphorus (P) was also determined in the collected blood.

The achieved results were statistically analyzedusing a one-way analysis of variance in the orthogonal system. The mean (x) and standard deviation (Sd) were determined. The significance of differences was verified using Fisher LSD test (RUSZCZYC 1981). The results were analyzed statistically using Statistica ver. 9.0 (StatSoft 2011).

Results and Discussion

Three groups of factors determine the economic results of beef cattle breeding and production of beef: correct breeding (64–65%), an appropriate system of breeding and production technology (approx. 32%) and the correct choice of race (3–4%). Therefore, the choice of feeding system, grazing and winter maintenance of the basic herd technology, calf rearing method, type of rooms, care of animals, etc. are the most important elements influencing the profitability (DOBICKI 2000).

Race, type of utility, cattle sex, age, conditions of living and (most of all) nutrition, have a decisive impact on the achieved rearing results. Nutrition is one of the most important production factors, constituting a major component of the production cost of animals for slaughter. Since the basic aim of modern cattle feeding methods is to achieve a high rate of daily weight growth, there is a tendency to intensify nutrition. While an increased fattening intensity is possible in almost all production circumstances, which involves the use of large quantities of concentrated feed in rations, in breeding herds such feeding is not recommended.

Nutrition is a major cost factor. It is therefore reasonable to seek the possibility of its reduction. Grasslands are by far the cheapest source of feed, because the production cost of one food unit on pastures is 3 times lower than cereal production (MAKULSKA and WĘGLARZ 2001*)*. WĘGLARZ'S (2010) research on the impact of fattened cattle category on beef quality indicates the impact of slaughter season (winter or summer). In another experiment, bulls from 3 races (Limousine, Hereford and Simmental) were fattened. They were fed with unified rations, composed of corn silage and meadow grass with an addition of hay (1 kg/day) and concentrated feed (1% of body weight/day).

In the experiment, weight was determined, along with the chemical composition of feed, fatty acid profile of the feed, slaughter efficiency and the chemical composition of beef. In terms of fattening and slaughter value, Herefords produced less-favorable results than Limousine and Simmental (CHOROSZY et al. 2006).

A determinant of the nutrition intensity are fodder resources of the farm and feeding systems applied by the manufacturer. However, good results in a breeding herd requires the appropriate rearing of calves. Veal period is a time of the most intense changes taking place in the body (NIWIŃSKA and STRZETELSKI 2005).

Table 1 shows the scheme of calf feeding from birth to 240 days. The basis for calf feeding was milk, but the dose was supplemented with concentrated feed and hay (or green forage in the summer time). The administered doses guaranteed daily increments required to obtain the body weight of calves indicated in Table 1.

Table 1

Nutrition scheme of calves to the age of 240 days – numbers are approximate, regardless of gender

Calf age [days]	Body weight [kg]	Feed consumption [pcs/day]						
		milk [l]	hay [kg]	silage [kg]	green forage [kg]	concentrated feed [kg]	salt [g]	feed Phosph. [g]
5–30	50	5.3	*ad libitum*	–	–	*ad libitum*	–	–
31–60	80	5.3	0.1	–	–	0.4	8	10
61–90	100	6.5	0.3	1.0	–	0.4	12	15
91–120	130	6.5	0.6	–	3.3	0.5	16	20
121–150	150	5.5	–	–	6.0	0.5	18	25
151–180	170	5.5	–	–	12.0	1.0	20	30
181–210	200	3.5	–	–	14.0	1.0	25	35
211–240	220	3.5	2.0	7.0	–	2.3	30	40
Total [kg]		1250	120	240	1060	250	3.90	5.25

These results are comparable with those obtained in other studies (ZWIERZCHOWSKI et al. 2016). The level of nutrition in the first period of animal life significantly affects the growth of muscle tissue. Proper nutrition in subsequent periods of life ensures the achievement of daily weight gains (AMANZHOLOV et al. 2012, BADIEJEVA 2012, *The new national*... 2012).

Table 2 presents the average daily quantity and types of feed absorbed by the heifers and bulls in the subsequent months of their lives. In the period of alcove feeding, the food rations included: hay, corn silage and concentrated feed supplemented with mineral additives. The amount of feed and achieved

body weight affected the dry weight indicator in the dose per 1 kg of animal growth, from birth to an age of 450 days (Table 2). One of the factors affecting the consumption of various types of feed was the sex of animals. Generally, the nutritional needs of young bulls outweigh the needs of heifers. Therefore, in the period from 240 to 360 days of age, hay consumption in a heifer dose ranged from 2.5 kg to 4 kg, while bulls consumed from 3 to 5.5 kg. The increase in silage consumption by heifers was as follows: from 7 kg at the age of 240–270 days to 12 kg at the age of 331–360 days. Bulls of the same age consumed 10kg and 13kg, respectively. The dose was supplemented with concentrated feed in the amount from 1.5 kg to 2 kg for heifers and 2.5 kg for bulls. The feed consumption by animals of both sexes increased significantly after 360 days of life. In the last month of analysis (421–450 days), heifers ate 6kg of hay, 10 kg of silage and 2.5 kg of concentrated feed, while the dose for bulls contained 7.5 kg of hay, 11 kg of silage and 3 kg of concentrated feed.

Table 2

Nutrition scheme of young breeding cattle at the age of 240–450 days (spring births)

Age	Gender	Body weight	Feed consumption pcs/day]				
			hay [kg]	silage [kg]	concentrated feed [kg]	salt [g]	feed phosphate [g]
240–270	heifers	193	2.5	7	1.5	0.03	0.03
	bulls	220	3	10	2.5	0.04	0.04
271–300	heifers	223	2.8	9	1.5	0.03	0.03
	bulls	245	4	10	2.5	0.04	0.04
301–330	heifers	250	3.5	10	1.5	0.03	0.03
	bulls	270	5	11	2.5	0.04	0.04
331–360	heifers	275	4	12	2.0	0.04	0.03
	bulls	305	5.5	13	2.5	0.05	0.04
361–390	heifers	297	5	11	2.5	0.04	0.03
	bulls	335	6	13	2.5	0.05	0.05
391–420	heifers	323	5.5	10	2.5	0.04	0.03
	bulls	365	6.5	11	2.5	0.05	0.05
421–450	heifers	350	6	10	2.5	0.04	0.03
	bulls	400	7.5	11	3.0	0.05	0.05

The global consumption of feed for heifers and bulls in the specified periods of alcove feeding is given in Table 3. It shows the diversity resulting from the size of the rations set for animals of different sexes. The daily consumption of dry matter per dose (Table 3) confirms the increased feed absorption of bulls compared to heifers. Continuous improvements of animal breeds, as well as innovative rearing practices, as well as modifications to the composition of the feed, largely contribute to changes in nutrient concentrations (SCOLLAN et al.

2006). ŁOZICKI et al. (2010) conducted a study on Hereford race bulls fattening from 250 kg of weight to about 550 kg, feeding them with corn silage, hay and concentrated feed, supplemented with a vitamin-mineral mixture. The average daily dry matter intake by bulls amounted from 7.92 to 8.15 kg and the increases exceeded 1300 g/day.

Table 3

Feed consumption by the young breeding cattle in the alcove feeding [kg]

Feed	Age [days]			
	240–360		361–450	
	heifers	bulls	heifers	bulls
Straw/hay	384	525	495	600
Corn silage	1140	1320	930	1050
Concentrated feed	195	300	225	240
Salt	3.9	5.1	3.6	4.5
Feed phosphate	3.6	4.8	2.7	4.5
Dry weight use in dose	5.3	6.5	7.1	8.7

The situation is different for feeding heifers and bulls during the summer using green forage (Table 4). Regardless of gender, the intake of silage was 20–23kg, but heifers were additionally fed only with 1 kg of concentrated feed, while the bulls received it in an amount of 3 kg of 360 days and 4 kg above that age. WAJDA et al. (2006), studied the fattening of bulls from 260 kg of *ad libitum* hay feeding, as well as cereal grits in the amount of 3.5 kg – to a body weight of approximately 350 kg, 4 kg – from the weight of 430 kg (+ mineral additives), and achieved increases in the control fattening (lasting 270 days) exceeding 0.9 kg.

Table 4

Summer type feeding system of the young breeding cattle

Age [days]	Sex	Green forage [kg]	Concentrated feed	Salt [kg]	Feed phosphate [g]
240–360	heifers	20	1	0.03	0.03
	bulls	20	3	0.04	0.03
361–450	heifers	22	1	0.05	0.04
	bulls	23	4	0.05	0.05

The fattening system and nutrition level of cattle has a major impact on the growth rate of animals (O'SULLIVAN 2004). The course of growth and development of animals is best characterized by body weight and achieved daily gains (Table 5).

Table 5

Body weight and daily gains of the young breeding cattle ($\bar{x}$ ± Sd)

Traits	Age [days]	Numbers	
		heifers	bulls
Body weight [kg]	birth	27 ± 1.4	30.0 ± 1.6
	240	193 ± 5.1	221 ± 6.3
	360	275 ± 7.2	305 ± 9.3
	450	350 ± 10.3	400 ± 12.9
Daily gains [g]	birth – 240	692 ± 4.3	796 ± 5.4
	240–360	683 ± 5.8	700 ± 4.7
	360–450	833 ± 4.4	1055 ± 7.2
	birth – 450	718 ± 3.2	822 ± 5.9

The average weight of heifers at birth was 27 ± 1.4 kg and bulls 30 ± 1.6 kg. These are sizes differing significantly from the body weight of calves of specialized meat breeds. Hereford at birth – 33–36 kg, Angus – 26–30 kg, Limousine – 35–40 kg (*Chów bydła...* 2009). The feeding system used in practice influenced the achieved body weight and daily mass gains in specified periods of life. At the age of 360 days, bulls reached weights exceeding 300 kg with increases from the age of 240 days amounting to 700 g/day. Heifers at the same age weighed 275 kg, which was a consequence of the daily gains at 683 g. The next life period is significant, because a daily gain of heifers of over 830 g allows for a 350 kg body weight achievement by the age of 450 days. The daily growth of bulls after 360 days of age exceeded 1050 g. This resulted in a body weight of bulls of 400 kg at the age of 450 days. These results are comparable with those of hybrids fed in a semi-intensive system (NOGALSKI 2014, POGORZELSKA et al. 2013).

To evaluate the metabolic profile of the tested animals, the following indicators were selected: the level of liver enzymes (ALT and AST), urea (UREA), alkaline phosphatase (ALP). Alanine aminotransferase (ALT) (EC 2.6.1.2) and aspartate aminotransferase (AST) (EC 2.6.1.1) are enzymes carrying the amino groups of the amino acids to α-keto acids. Their increased levels can indicate muscle damage or malfunction of the liver (DOORNENBAL et al. 1988, BAIROCH 2000, JACKSON and COCKROFT 2002). WINNICKA (2008) gives a reference range for ALT amounting to 25–74 U/l and AST – 58–100 U/l. The authors' own study has shown that both the level of ALT as well as AST (Table 6) in the serum of bulls is in a range of reference values for the cattle presented by WINNICKA (2008). It can therefore be assumed that the tested animals were characterized by the normal activity of these enzymes. Any significantly increased activity could indicate potential metabolic problems.

Table 6

Biochemical blood parameters of bulls ($\bar{x}$ ± Sd)

Biochemical parameters	Bulls in the age of 450 days
Quantity [pcs]	15
AST [U l]	75.54 ± 2.93
ALT [U l]	25.80 ± 3.43
Ca [mg dl]	2.20 ± 0.20
UREA [mg dl]	5.87 ± 3.43
ALP [U l]	102.63 ± 13.93
Na [mg l]	160.40 ± 16.10
K [mg/l]	3.60 ± 1.20
Mg [mg l]	1.00 ± 0.43
P [mg l]	2.07 ± 0.17
Protein [g dl]	75.63 ± 1.83

Alkaline phosphatase (ALP) (EC 3.1.3.1.) is an enzyme responsible for the release of the phosphorous from esters. It occurs in almost all tissues of the body. In mature animals, ALP is produced in the liver, whereas in maturing animalsit occurs mainly in the bones. Its high level of activity is associated with a rapid growth of bones (BAIROCH 2000, DOORNENBALET al. 1988). When examining the content of alkaline phosphatase in the serum of bulls (Table 6), it was shown to be within a reference standard (WINNICKA 2008). Urea (UREA) is a water-soluble compound formed in the liver during the ornithine cycle, as a derivative of aminoacid changes. Its level indicates the state of protein transitions in the body. An increased concentration is characteristic of dehydration, disease conditions or excessive protein intake in the diet, while a reduced level occurs in the event of a liver malfunction (JACKSON and COCKROFT 2002). The data reported in Table 6 shows the level of urea in serum of bulls was correct and was within the reference standards provided by WINNICKA (2008). A larger supply of proteins in the feed results in more intensive biodegradation carried out in pre-stomachs by bacteria. The amount of ammonia increases which, in turn, is converted to urea (KNOWLES et al. 2000, MOHRI et al. 2007).

The level of total protein in the serum of bulls and, especially, its fluctuations may be an indicator of proper nutrition or the appearance of inflammation. This is an important element in the diagnosis of the state of hydration (JEŽEK et al. 2006, MOHRI et al. 2007, KHAN 2011). In Table 6, the level of TP in the serum of bull samounts to 75.63 g/l. JEŽEK et al. (2006) found that in bulls above the ageof 84 days, the level of total protein was lower and amounted to 56.71 g/l. Inother authors, the level of total protein amounted to: KNOWLES et al. (200) – 62 g/l, NOWAK et al. (2005) – 50.5 g/l, MOHRI et al. (2007) – 63 g/l.

In ŁOZICKI et al. (2010), data from 450 kg Hereford breeding bulls was collected and selected biochemical indicators (glucose, total protein, albumin and urea) were determined in serum, as follows: 51.5 mg/dl, 6.53 g/dl, 2.66 g/dl and 4 mg/dl.

Calcium, together with phosphate and magnesium, ensure normal mineralization (AGUILERA and VAUGHAN 2000, RODRIGUEZ 2001) of bones and teeth. Calcium is also responsible for regulation of the nervous and muscular system and is involved in blood clotting. It acts as an activator of certain enzymes such as lipase, ATP-ase (KOLDOVSKY 1989). Phosphorus also plays an important role in numerous metabolic processes, playing a key role in receiving and transporting energy, phosphorylation processes and is important in the metabolism of glucose, fructose and proteins (MWAURA and AKINSOYINU 2010). Sodium and potassium are essential for regulation of osmotic pressure and normal muscle function. Magnesium is involved in many metabolic processes and is present in the nucleus, whose function it supports. The most important function of magnesium in the body is involvement in the synthesis and breakdown of high energy compounds, mainly adenosine triphosphate (ATP).

Magnesium is a co-enzyme or activator of many enzymes, especially those related to the transfer of phosphate groups. It is involved in many metabolic pathways associated with the metabolism of proteins, nucleic acids, lipids and carbohydrates and in the processes of electrolyte transport across cell membranes. It is a factor in living cell regeneration and calcium balance control. In addition, it has a positive effect on blood clotting, regulates the development of the skeletal system, increases the defensive reactions of the body, acts preventively to inflammation of the veins in post-operative situations and strengthens the cardiovascular system. It functions as an anti-stress, anti-anaphylactic and anti-inflammatory factor and lowers the cholesterol level and protects against myocardial damage (TOUYZ 2004). Magnesium and potassium play a regulatory role in the control of blood pressure, reducing the risk of cardiovascular disease.

To sum up, the level of nutrition in the first period of life of the animals significantly influences the growth and development of young breeding cattle. 1,250 liters of milk, in addition to solid feed, is recommended for calves from birth to the age of 240 days. The applied nutrition in subsequent life periods, including hay, silage, concentrated feed and mineral additives ensure that the assumed daily body weight increases were real. The average daily dry weight absorption by the heifers was from 5.3 to 7.1 kg, whereas bulls absorbed from 6.5 to 8.7 kg. The daily increase for heifers at the age of 361–450 days was 833 g, whereas for bulls it was 1,055 g/day. The metabolic profile parameters of bulls (hepatic enzymes – AST and ALT, urea, protein,

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