IJABR

International Journal of Advanced Biotechnology and Research (IJABR)
ISSN 0976-2612, Online ISSN 2278–599X,
Vol-10, Issue-1, 2019, pp33-40
http://www.bipublication.com

Research Article

The Conversion of Protein and Feed Energy to Protein and Energy of Meat Products

[1]Kibkalo L. I., [2]Mamontov N. S., [3]Pokhodnya G. S., [4]Soloshenko V. M., [5]Li A. H., [6]Kulachenko V. P. and [7]Tatyanicheva O. E.

[1]Doctor of Agricultural Sciences (Advanced Doctor), Professor at the Department of Private Animal Science, Kursk State Agricultural Academy, Karl Marx St., 70, Kursk, Russia, 305021,
[2]Postgraduate, Kursk State Agricultural Academy, Karl Marx St., 70, Kursk, Russia, 305021,
[3]Doctor of Agricultural Sciences (Aadvanced Doctor), Professor, Professor of the Department of General and Private Zootechnics at Belgorod State Agrarian University named after V.Ya. Gorin, Belgorod district, Belgorod region, setl. Maysky, Vavilova St., 24, Faculty of Technology, Russia, 308503,
[4]Doctor of Agricultural Sciences (Advanced Doctor), Professor, Editor-in-Chief of Kursk State Agricultural Academy, Karl Marx St., 70, Kursk, Russia, 305021,
[5]Doctor of Biological Sciences (Advanced Doctor), Professor, Scientific Consultant on poultry, UNIC Agrotehnopark, Belgorod State Agrarian University named after V.Ya. Gorin, Belgorod district, Belgorod region, setl. Maysky, Vavilova St., 24, Faculty of Technology, Russia, 308503,
[6]Doctor of Biological Sciences (Advanced Doctor), Professor, Professor at the Department of General and Private Zootechnics at Belgorod State Agrarian University named after V.Ya. Gorin, Belgorod district, Belgorod region, setl. Maysky, Vavilova St., 24, Faculty of Technology, Russia, 308503,
[7]Candidate of Agricultural Sciences (Ph.D.), the Head of the Department of General and Private Zootechnics at Belgorod State Agrarian University named after V.Ya. Gorin, Belgorod district, Belgorod region, setl. Maysky, Vavilova St., 24, Faculty of Technology, Russia, 308503

[Received: 15/11/2018; Accepted: 29/12/2018; Published: 02/01/2019]

ABSTRACT.

In accordance with the rational norms of nutrition, the main task is to meet the needs of the population in animal protein. In this regard, it is necessary to improve further the structure of nutrition and product quality. The issues of conversion of feed protein into food protein were not studied sufficiently to date. Therefore, this area of research is relevant. The experiment was conducted on three groups of bulls of Simmental breed. In the first group there were bull-calves of meat-and-milk production type, in the second – dairy and meat, in the third – dairy type. Growing and fattening of bulls was carried out up to 18 months of age and live weight, respectively, in the groups of 518.3 kg, 486.8 and 480.9 kg. After the removal of animals from fattening, a control slaughter of three heads from each group was carried out. When calculating the energy value of the edible part of the carcasses of experimental animals, it was found that the carcasses of meat and milk type bulls accumulated more energy than the carcasses of other groups due to the fact that the carcasses of animals of meat and milk type contained more fat. At the same time, their carcasses contained less protein by 5.7 and 3.6% in comparison with the other groups. It was found that the higher conversion rate of feed protein into food protein in bulls of meat and milk production type (11.41 %), then in dairy and meat (11.36 %). In the animals of the milk type conversion ratio of protein amounted to 10.65 %.

Keywords: bulls, production types, conversion, feed protein, protein.

INTRODUCTION.

Beef is the main source of meat for the population of the Russian Federation. In comparison with pork and poultry producers bear higher costs. Unfortunately, in recent years there has been a decline in the production and consumption of these products. Each person should consume on average 82 kg of meat per year, including 32 kg (40 %) of beef. At the same time, we consume 16-20 kg, almost half of the norm.

Therefore, increasing the production of meat and at first beef is the primary task of producers [1, 2, 3, 4, 5].

The task is quite feasible. There are several ways to solve this problem. The main one is the increase in the number of beef cattle and its breeding in those regions where there is a sufficient number of pasture.

From cattle of the meat productivity direction they usually receive more production, than from animals of dairy and meat and dairy breeds. Young growth of meat breeds is capable to show good average daily gains in short terms and to reach high live weight.

For example, young animals of Aberdeen-Angus breed, which is characterized by precocity, already at 14 months of age they have a live weight of 450-480 kg or more.

But in the Russian Federation, the increase in beef cattle in recent years is practically not happening. Its specific weight averages 2.5-3.0 %. Such, judging by the literature sources, data can be observed in the last two or three decades.

Many farms do not use such reserves as interbreed crossing and receiving in the process highly productive crossbred calves. From the resulting hybrids, it is possible to get gains 8-10 % higher than that of the existing analogues [6, 7, 8].

This is evidenced by numerous studies carried out by co-workers of scientific institutions for several years (D.L. Levantin, I.I. Cherkaschenko, S.Ya. Dudin, G.S. Azarov, E.N. Dorotyuk, L.Z. Mazurovsky, I.A. Boyko, V.I. Gudymenko, I.P. Zadnepryansky, A.V. Cherekaev, N.F. Rostovtsev, B.A. Bagriy, N.I. Strekozov).

A number of studies in the Central Black Earth region is devoted to this issue (A.V. Vostroilov, V.V. Alifanov, L.I. Kibkalo, N. I. Zherebilov, R.N. Lyashchuk, N.A. Goncharova, I.A. Skorkina, T.O. Groshevskaya, L.G. Khromova).

Considerable experimental data in this respect are presented in the monographs by I.P. Zadnepryansky (2002), L.I. Kibkalo, N.I. Zherebilov (2015), N.F. Rostovtsev, I.I. Cherkaschenko (1971), G.P. Legoshin, A. F. Shevkhuzhev (2006), academician A.V. Cherekaev (2010), etc.

As a result of their experiments it is proved that purebred animals of dairy and dairy-meat breeds are currently the main reserve to increase the production of high-quality beef. From animals on fattening high average daily gains (850-950 g) and live weight in 14 months of age, exceeding 400 kg were received.

By the way, according to various estimates, the dependence of the Russian meat market on imports is 30-40 %. Three leaders of beef exporting countries to Russia in recent years are Brazil, Uruguay and Paraguay, the total share of which in the total volume of imports is more than 40 %.

In our country, the issues of obtaining offspring from crossing dairy and combined breeds with meat breeds are studied little. This method, in our opinion, will significantly increase the production of high quality beef.

At calculating the conversion of energy and feed protein into food energy and protein of carcass pulp of experimental young animals at the age of 18 months, the advantage of this indicator in cross-bred animals was established [9, 10, 11, 12].

Studies showed that the industrial crossing of breeding stock of Simmental cattle with bulls of limousine breed can significantly increase not only the productive performance, but also to improve the quality of beef.

In the country and the region a lot of research on crossing of cattle of meat breeds with breeds of dairy and combined is carried out. These experimental data confirm the possibility of increasing beef production and improving its quality when using high-value producers in crossing. So, for example, in experiments of M. F. Gordienko in crossing Black-pied and Aberdeen

Angus cows were used. Crossbreeds reach more than 350 kg at the age of 12 months.
Research of different types of animals of Simmental breed is an actual subject.

The purpose and objectives of the study.
The study of changes in the productive qualities of bulls of different types and the transformation of protein and energy of feed into protein and energy of meat products was the purpose of research. To achieve this goal, the following tasks are solved:
- the identification of peculiarities of feed transformation at bulls of different types;
- the conversion of feed energy and protein into protein and energy of meat products.

METHODS AND MATERIALS.
The studies were conducted in the conditions of Kommunar LLC in Khvastovichi district of Kaluga region in the period from 2015 to 2018.
Three groups of Simmental bulls of different types were selected for the experiment. The first group included bulls of meat and milk type, the second – dairy and meat, and the third – dairy.
It is known that one of the important conditions for obtaining comparable and reliable data in scientific and economic experience is the correct acquisition of groups of animals. According to the principle of analogues three groups were equipped. This takes into account body weight, age, fatness of the animals. 12 heads were in each group.
Rations for intensive growing of bulls were based on the feed available on the farm. In winter, silage, hay, haylage, mixed fodder and mineral feed were introduced into the rations.
Taking into account the given feeds, their palatability was calculated. Every month, weighting of the experimental bulls was carried out.
After control slaughter meat productivity of experimental animals was studied. The following parameters were taken into account: carcass weight, slaughter weight, mass of by-products. Then the slaughter yield was calculated taking into account the production types and experimental groups. The morphological composition of carcasses was studied. They were divided into five parts: spinal, shoulder, cervical, hip, and lumbar. The number of pulp, bones, ligaments and tendons was determined in each anatomical part. The average sample of meat was selected for research in the laboratory. The presence of dry matter in meat, protein, moisture, ash was determined. The samples were examined for the presence of interchangeable and essential amino acids. Caloric content of meat was calculated (method of UIAH, 1977). In the longest back muscle pH, tenderness, color, moisture capacity was determined. Commodity quality of skins was studied by the RRIMS method (1980). At the end of the study, the calculation of the economic efficiency of growing and fattening bulls of Simmental breed of different production types was made. The obtained data were processed by the method of variation statistics.
Currently, the main part of beef in the Central region is derived from dairy cattle and combined breeds. Mostly young are fattened up to 20-24 months with a live weight of less than 400 kg.
Due to the fact that for animals feeding conditions and accomodation corresponding to zootechnical standards are not created, their genetic potential is used by 55-65 %. Therefore, agricultural enterprises should take into account the opportunities of young animals and create conditions for them. First of all, the animals in the experiment were received dairy food (milk, skim milk) according to the norms. From about three days of age the calves were given boiled and cooled to 37 °C water. Feeding was carried out at certain hours, at regular intervals. Starting from a week of age, the calves were accustomed to hay in order to start working the rumen. The calves were accustomed to grain feeds from the age of two weeks. We started with oatmeal. Special compound feed was moistened with warm water. Calves from 4 weeks of age were accustomed to juicy feeds.
In winter, the diet was silage, haylage, hay, feed, mineral fertilizing. Green fodder in summer, were the basis of the diet. Feeding of all groups of calves was almost at the same level.
Studies showed that the cultivation and fattening of Simmental bulls of different production types under good conditions of feeding and maintenance contributes to the production of high quality products, and farms can receive additional profits.

RESEARCH RESULTS.

As you know, the main source of protein is animal products: milk, meat, eggs. Therefore, the main challenge is to increase continuously these and other livestock products.

Characteristically, in recent years, in connection with the application and use in diets of cattle sufficient quantities of concentrates there is the significant increase of excessive adiposity of the carcasses after the fattening and slaughter of young animals. This suggests that veterinarians pay little attention to the technology of animal breeding, breeding work, the use of balanced diets in accordance with the methodological developments of the All-Russian Research Institute of Animal Husbandry. Therefore, in recent years, attention has been paid to the development of diets taking into account the level and type of feeding, breed, sex of animals, lines, methods and system of maintenance, terms of fattening of animals.

At the same time, as many scientists note (I. F. Gorlov, A.I. Belyaev, D.A. Randelin, V.I. Levakhin, V.V. Kalashnikov), it is necessary to assess correctly the efficiency of conversion of protein into meat products by animals.

In our work, we evaluated the meat productivity of animals on various indicators: live weight, daily gain, slaughter characteristics (carcass weight, carcass yield, slaughter yield, natural anatomical parts of the carcass, meat ratio, physico-chemical parameters of the longest back muscle, chemical analysis of the average meat sample), feed costs per 1 kg of growth. At the same time, we cannot give an objective assessment of the ability of animals to produce the right amount of protein. To do this, it is necessary to conduct research on the conversion of nutrients into products during the cultivation and fattening of young cattle. The caloric value of the edible part of the carcasses of fattened animals is presented in table 1.

Table1 – Caloric value of the edible part of the carcass of experimental animals

Indicator	Production types		
	Milk and meat	Dairy and meat	Dairy
Content in 1 kg of pulp, g: protein	200,7	212,2	208,1
fat	72,1	29,9	32,8
Contained energy in 1 kg of pulp, kJ, total	6308,3	4830,4	4875,1
including: protein energy	3446,0	3643,4	3573,0
fat energy	2862,3	1187,0	1302,1
Gross energy in carcass pulp, MJ	1276,1	887,3	876,5

Analyzing table 1, we can see that in the carcasses of bull-calves of the meat and milk type more energy accumulated than in the animals of the other two production types. They were superior to bulls of dairy and meat type on the fat content of 59.6 % and calves of milk type by 54.6 %. Protein in the carcasses of meat and milk type bulls was less than in the carcasses of other groups by 5.7 and 3.6%, respectively. In this regard, more energy is contained in 1 kg of meat and milk production type bulls' pulp. The difference with other groups was 23.5% and 22.8%. This resulted in a change in gross energy in the flesh of carcasses (MJ) in favor of meat and milk type bulls.

Further, we were interested in the conversion of feed nutrients into meat products. The materials we received are shown in table 2.

Table 2 – Transformation of nutrients in the edible tissues of experimental animals

Indicator	Production types		
	Milk and meat	Dairy and meat	Dairy
Spent raw protein per 1 kg of live weight gain, g	692	730	735
Spent feed energy per 1 kg of live weight gain, MJ	60,74	64,42	63,12
Contained in the flesh of the carcass, kg: protein	40,61	38,98	37,41
fat	14,58	5,49	5,89
Output per 1 kg of pre-slaughter live weight, g: protein	79,0	83,0	78,29
fat	28,3	12,0	12,32

energy, MJ	3,02	2,43	2,37
Conversion rate, %:			
protein (CRP)	11,41	11,36	10,65
energy (CRE)	4,97	3,77	3,75

Looking at the data of table 2, we see that the higher conversion rate of feed protein into food protein in bulls of meat and milk production type (11.41 %), then in dairy and meat (11.36 %) and in milk it was 10.65 %. Similar data were obtained for the feed energy conversion coefficient.

It should be noted that in order to increase meat production and improve its quality (increase in food protein primarily) it is necessary to use more widely in animal husbandry feed crops rich in protein (alfalfa, clover, sainfoin, pea-oats, etc.). At the same time, animals should be provided with such conditions that they can better transform feed nutrients into food products.

In the literature available to us, there is insufficient information about scientific research on the conversion of protein into food protein in animal products.

The first studies to assess the release of essential nutrients and conversion of feed protein to food protein according to L. K. Lepayye (1981) were conducted in the early 70-ies of the last century in Estonian UIAH on the calves of Black-pied Estonian breed. It was found that the food protein was processed from feed protein 8,7-10,0 %.

In the experience of P. Buynaya (1979) research on the calves of red steppe breed and crosses with Charolais, Shorthorn and Santa Gertrudis were conducted. At 18 months of age at all the hybrid animals the conversion rate was equal to 9.3 to 10.2 per cent. A higher coefficient at the age of 12 months was in the cross red steppe x shorthorn. It was equal to 14.0 %.

Similar materials R. Petraytite received (1979) on the butts of the Lithuanian red breed. The protein conversion rate in this experiment in bulls aged 18 months was 10.0 %.

In the literature we used, it is found that the conversion rate in the experiments and the results obtained varies significantly. In some experiments, the conversion rate is 5-10%. At the same time, in other studies, where apparently better growing and fattening conditions were created, animals processed 20% and more feed protein into food protein.

In recent years, more and more postgraduates and employees of scientific institutions and educational institutions conduct research on the conversion of protein and energy in the production of beef.

As a result of the research carried out on this subject, calculations of protein and energy conversion are carried out to determine the implementation of animals for meat in the optimal time and evaluation of breeds bred in farms. At the same time, it is important to investigate the protein conversion depending on the animals belonging to different lines and different production and intrabreed types.

DISCUSSION OF THE RESULTS.

The chosen theme for the study is not accidental. In the literature available to us there is very little information to study the meat productivity of Simmental cattle of different production types. But Simmental cattle are a unique combined breed. It is characterized by high milk and meat productivity, it has a good reproductive ability, strong constitution, is not demanding to feed, resulting in using a variety of feed better than other breeds. From it they receive high- quality production – milk and beef.

According to literary sources, the Simmental breed was formed in Switzerland. As a result of good acclimatization it is grown in many countries of the world where it is used for milk and meat.

In our country Simmental cattle began to be bred in the 80s of the last century. In recent years it has been used as an improvement breed.

M.D. Dedov (1971) notes that formation of Simmental cattle in our country was influenced by such factors as conditions of feeding and keeping of animals, climatic conditions, selection and choice, quality of local cattle.

Despite holsteinizing, which is held in the country in recent years, the Simmental breed is bred

in many farms and is characterized by high meat productivity.

According to such scientists as N.F. Rostovtsev (1970), M.D. Dedov (1975), E.N. Dorotyuk, (1995), A.V. Cherekaev (2005) the cattle is of great interest not only for milk production, but also meat.

A.I. Khrapkovsky reports that the intensive growing and fattening of young Simmental breed can reach a high weight and give full-bodied carcasses. At the age of 15 months, the heifers had live weight 480-500 kg, while carcass yield was 60 %.

According to the data of A.P. Kostin (1983), the bulls were fattened up to 18 months of age. After the control slaughter and study of the morphological composition of carcasses it was found that the carcasses contained 63.2 % of the flesh, adipose tissue – 16.2 and bones-17 %.

D.L. Levantin (1996) reports about high meat qualities of Simmental young animals. He notes that the mass of different anatomical parts of the carcass of Simmental bulls is at the level of many specialized meat breeds.

Experiences of A. I. Khrapovsky, D.A. Smirnov, I.I. Cherkaschenko, B.A. Bagriya etc. also say in favor of this.

It should be noted that to date, not enough studies have been conducted to compare the meat productivity of Simmental cattle of different types. At the same time, we note that a lot of work is devoted to the study of meat productivity of animals of the Simmental breed and in most of them low rates are obtained, as animals were grown according to traditional technology. Also in the literature there is no or very little information about the environmental friendliness of beef.

There is very little material in scientific research about the conversion of feed protein into carcass pulp protein.

In this regard, the study of the above problems and the scientific development of rational use of Simmental cattle of different production types are important, both for science and for practical purposes.

At the same time, to determine the ability of animals to accumulate protein and its transformation, it is necessary to calculate the conversion of nutrients into products.

Such studies started according to L. K. Lepayye (1981) in the early 70-ies of the last century.

We found that in the carcasses of bull-calves of meat and milk type energy is stored more than in the animals of other production types, and therefore more energy is enclosed in 1 kg of pulp.

Higher conversion rate of feed protein into food protein is in meat and milk type of bulls. It reached 11.41 %, at animals of dairy and meat type –11.36 and dairy – 10,65 %. Similar results were obtained for the feed energy conversion coefficient.

T.O. Groshevskaya (2013) conducted research on animals of Holstein breed. Control slaughter was carried out at the age of 14 and 16 months. As a result, it was found that the conversion rate at 14 months of age was 12.89 % (on average for three groups), and in 16 months – 12.17, that is, with age there was a decrease in protein conversion by 0.72 %. At the same time, the conversion rate of feed energy to energy of the flesh of the carcass increased by 0.17 %.

Significant experimental material is presented in the studies of T.V. Matveeva (2012). Three groups of bulls were used in the experiment: Simmental, Aberdeen-Angus and first generation hybrids. As calculations showed, the protein in the carcasses was accumulated more by crossbred and Simmental bulls. Conversion rate of feed protein to food protein of the flesh of the carcasses was as follows: Simmental animals of 11.2 %, Aberdeen Angus –10.9 and cross – 11.1 %. The conversion rate of feed energy was 6.5%; 6.6% and 7.3%, respectively.

Similar rates of conversion of feed protein were obtained in studies of P. Buynaya (1979), R. Petraytite (1979), V.V. Bychkov (2011) and others.

Thus, the conversion rate of feed protein and feed energy into protein and carcass energy of experimental animals in our studies averaged 11.14 and 4.14%, respectively. Similar results were obtained by other researchers.

At the same time, in the literature available to us there is evidence that the protein conversion rate can reach 20 %. To do this, it is necessary to use

as much feed containing protein as possible in the feeding of cattle and in addition to create comfortable conditions for animals that meet veterinary standards.

CONCLUSION.

Thus, our studies found that the growing bulls of Simmental breed of different production types had an average protein conversion rate (11.14 %) with an average removable live weight of animals 495 kg at the age of 18 months. With such a live weight of all calves in sale high profits were obtained.

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