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TRANSLATIONS ON USSR AGRICULTURE
(FOUO 3/79)

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BEEF CATEGORIES REVIEWED

Moscow DOKLADY VASKhNIL in Russian No 1, Jan 79 pp 29-31

[Article by D. L. Levantin, doctor of agricultural sciences; A. I. Mglinets, candidate of technical sciences (Presented by VASKhNIL academician L. K. Ernst), All-Union Order of the Red Banner Scientific and Research Institute of Livestock Farming: "The Quality of Beef in Various Categories of Cattle"]

[Text] The production of meat in our country increases from year to year. The average weight of one head of cattle going to slaughter has been increasing steadily and in 1977 was 352 kilograms. Among the calves over 7 million were heavy, with an average weight of 407 kilograms. Consequently, with the growth of meat production there is an increase in its quality.

In addition to a solution to the problem of increasing beef production and of raising its quality, a no less important problem is that of the more efficient use of beef for human nutrition while taking into account its quality, which is based on biological and physiological factors (age, sex, breed, feeding conditions and upkeep conditions). With sufficient and full-value feeding a large role in meat productivity and quality is played by the age and castration of the animal.

At the present time most of the beef weight (about 70 percent) is obtained from the slaughter of calves at the age of from 1 to 2 years and from discarded cows. There are a series of works on the study of meat quality (1-5).

We performed comparative tests on meat quality of cows at the age of 6-10 years and calves 15-24 months old. Muscle samples were taken for the study--the long back muscle, the shoulder triceps, the semi-tendinous, the biceps and hip muscles. In them scientists looked for the content of total nitrogen and connective fiber protein (collagen and elastine), for the breakdown of collagen during heat application, for the tenderness of the raw and cooked meat in resistance to cutting and in an organoleptic evaluation.

The content of connective tissue protein and the resistance to cutting in three raw muscles (biceps, hip and long back) were higher in the carcasses of calves than of adult animals. For the semi-tendinous muscle the indices are the same. The triceps of calves have more connective tissue protein than adult animals (1.32 and 0.86 percent respectively), whereas the resistance to cutting is higher in the carcasses of adult animals (3.5 and 4.3 kilograms). Almost double (43 percent) the amount of collagen breaks down in the meat of calves during frying than in the meat of adult animals (22 percent).

The hydrothermal resistance of collagen in various muscles of adult animals is also not uniform. The collagen of the long back muscles and the hip muscles exhibited the greatest labiality (the breakdown of collagen was 27.7 and 28.0 percent respectively). The smallest amount was exhibited by the semi-tendinous muscles (13 percent). In contrast, in the meat of the calves these differences were less obvious and the proportion of broken-down collagen was significantly higher (35.2, 49.4 and 39.0 percent respectively).

The resistance to cutting in the meat of calves as a result of frying decreases to the larger degree (by 44-55 percent) and more uniformly than in the meat of adult animals (by 3-28 percent). In tenderness the fried muscles of calves were practically uniform (4-4.6 points), whereas in adult cattle there are significant differences (2.6-3.8 points).

To prepare the meat of adult cattle more heat and water are required, and for this reason it is more expedient to use it in canning where stricter regiments of heat processing are employed.

No essential differences among age groups were found in content of extract substances. In the long back muscles of adult animals there is 0.42 percent nitrogen of extract substances; of calves--0.40 percent. The total amount of creatine and creatinine is 470 and 448 mg% respectively.

Our tests of meat productivity and quality in the calves of the Black Spotted, Simmental, Kalmytsk, Shvitsk, Ayrshire, Red Steppe, Yaroslav, Kholmogor, Red Hunchback, Kostroma and Brown Latvian breeds and their crosses with meat breeds (castrated and non-castrated bulls) showed that there are prerequisites for improving the standardization of slaughter conditions of calves that are to be used for beef production.

The optimal indices for meat productivity in animals and for meat quality are presented in the table.

Animals in such condition produce carcasses with a high yield of the most valuable scraps (coxofemoral--34-35 percent) and of large sections of semi-prepared products (thick and thin edges--4-4.5 percent; inner portions of back legs--2.3-2.4 percent; external portions--6.2-6.5 percent; side--4.0-4.3 percent and shoulder--2.5-3.0 percent). The optimal ratio of

Optimal Indices of Meat Productivity and Quality in Calves

Показатель (1)	(2) Бычки	
	(3) кастрированные	некастрированные (4)
(5) Предубойная масса животного (кг)	380—430	430—480
(6) Масса туши (кг)	205—230	225—250
(7) Содержание жира (%):		
(8) в средней пробе	13—16	12—14
(9) в длиннейшей мышце спины	2,0—3,5	1,5—2,5
(10) Содержание белка (общ.×6,25) (%):		
(8) в средней пробе	18—19	19—20
(9) в длиннейшей мышце спины	21—22	21—22

Key:
1. Index
2. Bullcalves
3. Castrated
4. Not castrated
5. Pre-slaughter weight of animal (kg)
6. Carcass weight (kg)
7. Fat content
8. In average sample
9. In long back muscle
10. Protein content (general)

meat to bones (4.6-5.2) and high biological (ratio of tryptophan to hydroxyproline of 5.1-5.7) and nutritional values of the meat are achieved.

A study of the biological values of the meat of castrated and non-castrated bulls as concerns the content of full-value and non-full value proteins using the test organism Tetrahymena pyriformis did not reveal any essential differences between the aforementioned animal groups.

The greater reaction of the organism of non-castrated bulls to external stimuli, their heightened exciteability, pre-slaughter stress result in a greater breakdown of glycogen into carbon dioxide and water with the release of a great quantity of energy. Because of this the meat of such animals (according to our data) has a pH of 6.2-6.8, whereas the meat of castrated animals has a pH value of 5.6-5.8. Because of the low content of glycogen in the muscle fiber of non-castrated bullcalves the anaerobic breakdown of glycogen into lactic acid does not result in a significant lowering of the pH to the required value. This affects meat qualit --the color, water-binding capacity, structural-mechanical properties, organoleptic indices and resistance during storage in low relative temperatures.

With a high pH value most of the water is bound with the proteins(the meat of non-castrated bullcalves contains 65 percent bound water, of castrated bullcalves 54 percent). For this reason the fibers become denser, creating a barrier to atmospheric oxygen. This hinders the formation of the bright red oximyoglobin and thus there is a reddish color to the meat from the myoglobin.

Tests on the content of reduced sugars (glucoses) showed that their quantity is closely related to pH. With a decrease in pH value the glucose content in meat increases--with a pH of 5.7 percent it is 45 mg%; with a pH of 6.0--25 mg%. With a pH of 6.8 glucose was absent. In the meat of cows with a pH value of 5.5 the amount of glucose was 60 mg%.

Taking into account the possibility that during the process of heating the glucoses can react with free amino acids with the formation of melanoidines we can conclude that glucose is very important for the development of the taste properties of meat.

The studies made by us of the structural and mechanical properties of meat from castrated and non-castrated bullcalves as well as from cows revealed some notable differences, especially in toughness and viscosity, which have a noticeable effect on the technological parameters of the final product.

Thus, the meat of various categories of cattle has different qualitative properties. For this reason we should bring up the question of the differential use of beef from different categories of cattle. It is also essential to reexamine the existing standards for cattle and meat, which are based on a visual evaluation of the quality of the animal and carcass. The basic index for an evaluation of calves should be the weight of the animal on the hoof and the weight of the carcass because there is a direct relationship between the weight of the animal and the quality and quantity of the final product. Such a principle will stimulate the introduction of intensive methods for fattening animals to bring weight up to 380-430 kilograms at the age of 14-15 months. Moreover, the requirements for the weight of live animals and carcasses must be differentiated according to sex and the efficient use of meat for consumption. Such a principle of standardization will encourage an improvement in the quality of the final product.

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DEFINING PARAMETERS FOR SILAGE TRENCHES IN LIVESTOCK COMPLEXES

Moscow DOKLADY VASKhNIL in Russian No 1, Jan 79 pp 41-43

[Article by A. A. Artyushin, A. M. Pashkov, candidates of technical sciences; V. A. Savin; (presented by VASKhNIL academician L. G. Prishchep), Central Scientific and Research and Planning and Technological Institute of Livestock Farming of the Southern Zone of the USSR: "Defining the Parameters of Silage Trenches for Livestock Complexes"]

[Text] The norms for the technological planning of silage and haylage storage facilities have defined the nomenclature of silage trenches with a minimum capacity of 325-3,900 tons. Typical designs of storehouses have been developed. They are 6-18 meters wide and the walls are 3-3.5 meters high. Naturally, under conditions of concentration in livestock farming the aforementioned areas are not the limit. Large livestock-farming complexes and farms require the annual procurement of from 20,000 to 150,000 tons or more of silage. Thus, for a feedlot of 20,000 animals using the silage-concentrate type of feeding, the annual silage requirement is about 130,000 tons. To procure this amount it is necessary to have 33 trenches with a capacity of 3,900 tons. Without doubt, on such complexes it is more efficient to use storehouses with larger capacities and with parameters exceeding those of the recommended nomenclature.

We are presenting the methodological bases and results of studies to define the efficient parameters of silage trenches for large livestock farms and complexes. For the studies the basic data included the type and size of the livestock complex, the type of feeding method, the daily consumption and annual need of silage in the complex, the daily duration of feeding, the terrestrial type of silage trenches with wall construction of reinforced concrete elements as well as the characteristics of machines and mechanisms involved in the technological processes of procurement and unloading of feed.

The efficient parameters of silage trenches were defined according to the criteria for the mimimum total of proportional expenditures in accordance with the integral function:

$$Z = (I_{\text{ст}} + I_{\text{т.п}} + I_{\text{п}})/V \longrightarrow \min \qquad (1)$$

with the limitations:

$$1.\ F < F_{max} = \frac{q}{\rho_c \cdot h_2};\ 2.\ \Pi_з > \Pi_з^1 = S \cdot \rho_c \cdot h_1$$

$$3.\ \Pi_p > \frac{q}{t_к};\ 4.\ \frac{Q}{\Pi_з} < T,$$

where Z--total proportional deduced expenditures (rubles/ton);

V--trench capacity (tons);

$I_{ст} = \sum_{i=1}^{n} U_{к.э}^{i} + E \sum_{i=1}^{n} K_{к.э}^{i}$ --deduced expenditures for equipping (rubles);

$I_{т.п} = \sum_{j=1}^{m} U_{т.о}^{j} + E \sum_{j=1}^{m} K_{т.о}^{j}$ --deduced expenditures for technological processes (rubles);

i and j--number of constructive elements (wall supports, floor, land work) and operations within the technological process (loading and unloading of trenches, covering feed);

$\sum_{i=1}^{n} U_{к.э}^{i},\ \sum_{j=1}^{m} U_{т.о}^{j},\ \sum_{i=1}^{n} K_{к.э}^{i},\ \sum_{j=1}^{m} K_{т.о}^{j}$ --total operational expenses and capital investments for construction elements and technological operations;

E--normative coefficient of the effectiveness of capital investments;

I_n--expenditures from feed losses (rubles);

F--area of trench cross-section (m^2);

F_{max}--maximal allowable area of trench cross-section for given complex (m^2);

q--daily silage consumption at complex (tons);

ρ_c--density of silage in trench (tons per m^3);

$\Pi_з$--productivity of trench loading line (tons per day);

$\Pi_з^1$--minimal required pace of daily loading of one trench (tons per day);

S--area of feed surface (m^2);

h_1 and h_2--minimal allowable level of daily loading and unloading of feed (m);

Π_p--productivity of unloading line (tons per hour);

t_k--daily duration of feeding (hours);

Q--annual silage requirement in complex (tons);

T--agrotechnical schedule for the procurement of silage (days).

The equations

$$K_{з.р}^{i} = V_{з.р} \cdot C_i, \quad (2)$$

$$K_{с.о} = \int_{V_t} \sum_{t=1}^{n} V_t \cdot C_t \cdot dV_t, \quad (3)$$

$$K_{дн} = F_{дн} \cdot C_д, \quad (4)$$

are used to calculate deduced expenditures for building capital investments for land work ($K_{з.р}$), wall supports ($K_{с.о}$) and floor ($K_{дн}$) where

$V_{з.р}$--volume of land work (m3);
C_1--production costs per 1 m3 of land work (rubles);
V_i--expenditure of basic building materials (concrete, working and construction fittings);
C_i--cost of a unit of measure for expenditures of basic building materials;
$F_{дн}$ --area of floor (m^2);

$C_д$ -- cost of 1 m^2 of floor (rubles).

The work volume and expenditure of materials for all construction elements of the trenches were determined on the basis of existing norms for planning similar structures and designs.

Expenditures for technological processes consist of expenditures for filling trenches, unloading them and for covering feed. The following complex of machinery is used to complete these operations: for cutting grasses--the KS-2.6 silage-harvesting combine in a unit with the DT-75 tractor; for transporting the mass from the field to the trench--the ZIL-MMZ-554 truck; for ramming the mass--T-130 tractors.

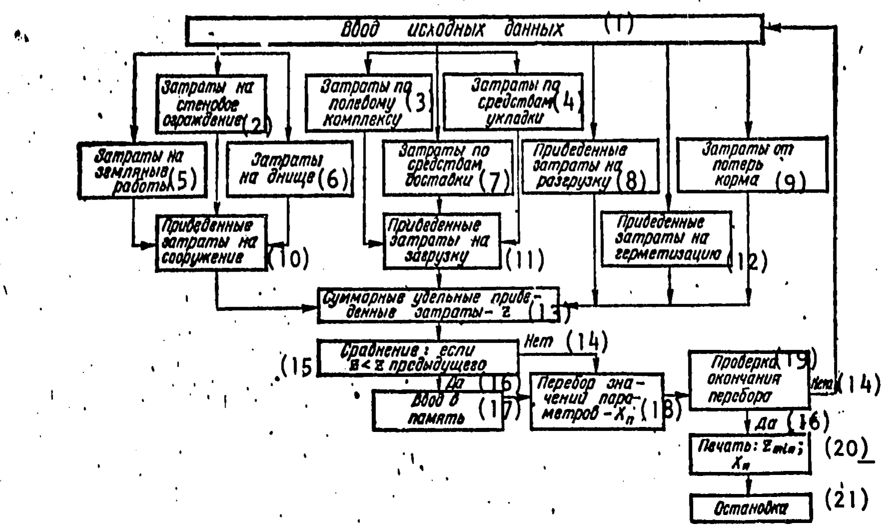
The removal of silage from trenches and its loading onto KTU-10 feed distributors and the transporting of silage from the storehouse to the feed shop is done using PSK-5 loaders if the walls of the trenches are up to 4.2 meters high. No loaders are manufactured for walls over 4.2 meters high. In connection with this their possible costs in the calculations are made in proportion to the height of the feed clamp in the trench.

The daily productivity of the complex of machines for loading trenches was calculated according to the second and fourth limitations of the entire function and the larger of the two values was used in the calculations. The productivity of the unloading line was calculated according to the third limitation.

The number of machines for fulfilling technological operations was determined on the basis of the productivity of technological lines and machines per hour of shift time--the radius of silage shipments--while taking into account the volume of feed procured on the farm. Expenditures from feed losses were calculated according to the empirical formula:

$$I_п = \frac{\eta \cdot C_к}{100} \cdot 1{,}07, \qquad (5)$$

Block-Scheme of Calculations of Efficient Parameters for Silage Trenches in Livestock Complexes with x_n – as the Parameters of the Trench (Height, Width, and Length)



Key to Sketch:

1. Recording of basic data
2. Expenditures for wall supports
3. Expenditures for field complex
4. Expenditures for resources for stacking
5. Expenditures for land work
6. Expenditures for floor
7. Expenditures for the means of shipment
8. Deduced expenditures for unloading
9. Expenditures due to feed losses
10. Deduced expenditures for equipping
11. Deduced expenditures for loading
12. Deduced expenditures for hermetization
13. Total proportional deduced expenditures
14. No
15. Comparison:if z is greater than preceding z
16. Yes
17. Store in computer
18. Sorting . . . parameter values
19. Check end result of sorting
20. Print
21. Stop

---

where $\eta = 17+7\cdot S/V$ — total losses of feed (percent);

C_k--deduced expenditures per 1 ton of feed (rubles);

1.07--coefficient taking into account feed losses during storage.

An analysis of the entire function (1) is made with the Mir-1 computer using a complex method as seen in the block diagram. The aim of the analysis is to determine the efficient parameters of silage trenches for various livestock complexes.

Recommended Parameters of Silage Trenches and
their Economic Effectiveness

(1) Размер ферм (голов)	(2) Тип кормления	(3) Потребность силоса (т)		(4) Рекомендуемые траншеи					(8) Снижение затрат по сравнению с ТП811—29 т. 2 (%)		(9) Годовой экономический эффект (руб.)
				(5) параметры (м)		(6) вместимость (т)	(7) затраты (руб/т)				
		(10) за сутки	(11) за год	(12) ширина	(13) высота		(14) капвложения	(15) приведенные	(16) капвложения	(17) приведенные	
(18) Молочные фермы и комплексы											
800	III	24	6 800	15	3,6	2 000	4,83	5,82	17,6	8,7	3 750
1 200	I	24	7 200	15	3,6	2 000	4,83	5,82	17,6	8,7	3 990
	II	36	10 100	21	4,2	3 000	3,71	5,45	17,4	8,2	4 260
1 600	I	32	9 000	18	4,2	3 000	4,13	5,61	8,1	3,7	1 900
	II	48	13 600	24	4,2	3 000	3,39	5,43	24,5	8,6	6 950
2 000	I	40	11 300	21	4,8	3 000	3,7	5,35	17,6	8,7	5 750
	II	60	16 900	24	4,8	4 000	3,36	5,38	25,2	11,4	10 480
(19) Откормочные комплексы											
5 000	III	44	16 370	24	4,8	4 000	3,36	5,42	25,2	9,4	9 110
10 000	III	89	32 600	30	4,8	8 000	2,89	5,40	35,7	16,0	28 320
(20) Откормочные площадки											
5 000	III	89	32 400	30	4,8	8 000	2,89	5,40	35,7	16,0	28 300
10 000	III	178	65 000	30	4,8	16 000	2,89	5,71	35,7	14,3	61 720
20 000	III	256	129 900	30	4,8	16 000	2,89	6,26	35,7	13,5	126 000
30 000	III	434	194 900	30	4,8	16 000	2,89	6,69	35,7	12,8	191 000

Key:
1. Size of farm (herd)
2. Type of feeding
3. Silage consumption (tons)
4. Recommended trenches
5. Paramters (meters)
6. Capacity (tons)
7. Expenditures (rubles/ton)
8. Decrease in expenditures in comparison to TP811-29 t.2
9. Annual economic effect (rubles)
10. Per day
11. Per year
12. Width
13. Height
14. Capital investments
15. Deduced
16. Capital investments
17. Deduced
18. Dairy farms and complexes
19. Fattening complexes
20. Feedlots

The table presents the data for trench parameters that provide the fewest expenditures for the procurement and storage of silage for each livestock complex.

The studies show the expediency of using trenches that are 18-24 meters wide, with walls 3.6-4.8 meters high and a capacity of 3,000-4,000 tons for dairy complexes. For fattening complexes and feedlots the respective figures are 24 and 30 meters, 4.8 meters and 4,000-16,000 tons. It would be expedient to design a loader of stemmed feeds able to collect feed from a height of 7 meters in order to fulfill the technological process of unloading trenches having walls 4.8 meters high.

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