Conference Paper

Improvement of Pork Quality at Different Values of Pig Productivity

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Abstract

This article examines how to increase pork meat productivity and quality indicators through the use of crossbreeding. The aim is to increase the meat productivity of animals; reduce losses during production and processing; and improve the criteria for assessing the quality of meat and the organization of its rational use. The purpose of our research is to study the productive quality of the steppe type of pigs, used in the Rostov region in breeding and crossing systems, and the complex of biological and internal indicators in connection with the defects in the quality of pork. Four groups with 16 animals in each were formed: the first group – with the intensive cultivation technology, included pigs of the DM-1 breed, the second – SM-1, the third – the SM-1 × DM-1 crossbreed, the fourth – the DM-1 × SM-1 crossbreed. Analysis of the raw meat showed that the pork had a good ability to emulsify and gel, and had a high nutritional value. The toxicity index in the muscle and fat tissue samples corresponded to the first permissible toxicity group. The study shows the advantages of crossbred individuals over purebred ones, which can be explained by the consequences of heterosis. According to the research results, the use of pig breeding in the industrial production of pork can be recommended in order to improve feedstock and meat productivity, biological and interior indicators, as well as the quality of raw meat.

Keywords: pork, crossbreeding, meat productivity, meat quality, steppe type of pigs, interior indicators, fattening qualities, biological and nutritional value of pork

1. Introduction

Meat is one of the most valuable human foods. It is used as a material for building tissues, accelerates metabolism, and is a source of energy. Meat and meat products contain proteins, fats and other lipoids, carbohydrates, minerals, vitamins, which are easily digested [1].

The need to meet the growing needs of the population in high-quality meat, with good taste, culinary and technological properties, and high nutritional value makes it necessary to improve properties of the feedstock [2].

More than 211 million tons of meat are produced annually, of which the share of pork is 41%, beef – 27%, poultry – 26 %, lamb – 4%, and rabbits – 2% [3]

Due to unique biological features (high fecundity, etc.), pigs are one of the leading types of farm animals raised for meat production. The possibilities of using the broodstock in pig breeding are 6.5 times higher than in cattle breeding. By nutrients used by humans for food and taste qualities, pork carcasses have no analogues. If the pig's body, which has reached slaughter conditions, contains up to 54% of edible substances, in ruminants, their amount does not exceed 21%, in poultry - 25%. Pork fat contains essential amino acids - lysine, tryptophan, methionine, as well as vitamins and unsaturated fatty acids [4].

After intensive fattening, the yield of all slaughter products is 75-80%, and the meat yield in carcasses is 55-60%. This is much higher than the corresponding indicators in other animals.

The meat production volume can increase due to the development of pig breeding, as the industry of the most precocious animal husbandry. This can be achieved by increasing the number of pigs and their early maturity [1].

The active breed-formation process in Russia and abroad requires an assessment of pork quality by the nature and level of productivity. This issue is especially relevant in the conditions of industrial technology used by pig farms. For Rostov region, research aimed at studying meatiness and quality of products of natural resistance of steppe pigs is of great scientific and practical interest [5].

2. Methods and Equipment

The aim of this research is to study productive qualities of steppe-type pigs bred in Rostov region and a set of biological indicators of pork quality.

For the experiment, 4 groups consisting of 16 animals were created: the first group was raised using the intensive technology (DM-1 breed), the second group included SM-1 pigs, the third group included crossbreeds SM-1 × DM-1, and the fourth group included crossbreeds DM-1 × SM-1 (Table 1).

Control weighing of experimental gilts was carried out after they reached the age of 45, 78, 105, 125, 160 and 180 days.

Table 1: Research scheme

Group	Genotype	Number of animals	Research
1. Control	DM-1	16	1. economically useful qualities;
2. Control	SM-1	16	2. reproductive qualities; 3. fattening qualities;
3. Experimental	SM-1 * DM-1	16	4. meat qualities;
4. Experimental	DM-1 * SM-1	16	5. interior indicators; 6. degree of manifestation of PSE and DFD; 7. storage and processing of pork, depending on the initial quality; 8. biological and nutritional value of pork depending on quality.

3. Results

During the experiment, the absolute live weight gain in DM-1 was 80.9 kg, in SM-1 - 79.2 kg, in the third experimental group - 84.5 kg, in the fourth group - 83.4 kg. Thus, the superiority of the 3rd experimental group over the control one was as follows: 4.4% over DM-1 pigs and 6.7% over DM-1 pigs (P> 0.95). The advantage of animals of the 4th experimental group was 3.1% and 5.3%, respectively (P> 0.99). By the absolute live weight gain, an insignificant advantage of animals of the 3rd experimental group over the 4th one was observed. It amounted to 1.3% [6].

The growth rate in all groups was relatively high and increased with age, especially in animals of the experimental groups, which can be explained by the effect of heterosis. The average daily gain in live weight of gilts aged 45-180 days was as follows: in DM-1 - 599 g, in SM-1 - 587 g; in the 3rd experimental group - 626 g, in the 4th group - 618 g [7].

Table 2: Dynamics of live weight of experimental gilts, kg

Age, days	Group			
	1	2	3	4
45	13,8 ± 0,45	14,0 ± 0,32	14,9 ± 0,44	14,8 ± 0,43
78	29,4 ± 0,67	29,2 ± 0,63	30,7 ± 0,67	30,6 ± 0,85
105	41,1 ± 0,75	42,3 ± 0,99	45,1 ± 0,83	44,2 ± 1,11
125	54,4 ± 1,26	55,4 ± 1,63	57,5 ± 1,17	56,0 ± 1,66
160	81,7 ± 2,01	79,9 ± 1,93	85,4 ± 2,21	82,3 ± 2,59
180	94,7 ± 2,15	93,2 ± 2,58	99,4 ± 1,97	98,2 ± 2,27

The control slaughter and deboning of carcasses were carried out in accordance with the requirements of regulatory documents. Control slaughter data are shown in Table 3.

TABLE 3: Results of the control slaughter of experimental gilts aged 180 days

Indicator	Group			
	1	2	3	4
Slaughter live weight, kg	94,7 ± 2,15	93,2 ± 2,58	99,4 ± 1,97	98,2 ± 2,27
Slaughter weight, kg	60,3 ± 2,6	60,0 ± 2,5	65,1 ± 3,1	64,2 ± 2,9
Slaughter output, %	63,7 ± 1,1	64,4 ± 1,3	65,5 ± 1,7	65,4 ± 1,6
Fat thickness, cm	3,18 ± 0,05	3,12 ± 0,05	3,02 ± 0,06	3,05 ± 0,06
Carcass length, cm	113,8 ± 4,7	112,0 ± 4,6	119,4 ± 4,9	118,3 ± 4,9

In the third group, the slaughter yield was higher by 2.8% (P> 0.95) and 1.7% (P> 0.95), and in the 4th group – by 2.7 % (P> 0.99) and 1.6% (P> 0.99) than in the control groups.

TABLE 4: Chemical composition and technological properties of an average sample of carcass pulp of experimental gilts aged180 days

Indicator	Group			
	1	2	3	4
Moisture	65,1	65,3	64,8	64,9
Dry matter	34,9	34,7	35,2	35,1
Protein	18,86	18,81	19,39	19,26
Fat	15,47	15,62	15,40	15,42
Ash	0,99	0,98	0,99	0,99
pH	5,8	5,8	5,6	5,7
Water holding capacity, %	58,47	58,30	59,80	59,72
Color intensity, units ext. × 1000	44,1	44,7	50,3	49,9
Digestibility, %	35,73	35,38	33,85	34,02

In the pulp of carcasses of experimental animals, a higher content of total protein was observed (in the 3rd group - by 2.8% (P> 0.95) and 3.1% (P > 0.95); in the 4th group - by 2.1% (P> 0.99) and 2.4% (P> 0.99), respectively) [9].

The fat thickness was lower than that in the control groups. In gilts of the 3rd group, this indicator was lower by 0.16 cm (P> 0.95) and 0.10 cm (P > 0.99). In gilts of the 4th group, the fat thickness was less by 0.13 cm (P> 0.99) and 0.07 cm (P> 0.95), respectively [8].

The chemical analysis of raw meat indicated that meat met the raw meat requirements (Table 4).

4. Discussion

The live weigh gain in the 3rd experimental group exceeded that in the control groups by 4.5% and 6.6%, respectively. In the 4th experimental group, the live weight gain was also higher by 3.1% and 5.3%, respectively [10].

According to the slaughter results, relatively high indicators of meat productivity were revealed in the 3rd and 4th groups with some advantage of the 3rd group. Gilts of the 3rd group had larger carcass weight by 8.0% ($P > 0.95$) and 8.5% ($P > 0.95$), respectively. Gilts of the 4th group exceeded the control ones by 6.5% ($P > 0.99$) and 7.0% ($P > 0.95$), respectively [11]. Carcass flesh was more water-retaining. A similar trend was observed for the digestibility of carcass flesh.

The color of meat is one of the main quality indicators assessed by the consumer. Gilts of the experimental groups had better color of meat. In the 3rd group, intensity of muscle tissue staining was 6.2 and 5.6 units higher compared with the 1st and 2nd groups, respectively; in animals of the 4th group, it was higher by 5.8 and 5.2 units, respectively [12].

The pH value of muscle tissue determines functional and technological properties of meat and is associated with water-holding ability, color and losses during heat treatment. No disturbances in the glycolytic processes of the muscle tissue were found. The average pH level of meat was in the normal range [12].

The organoleptic and tasting evaluation of meat and broth indicated that pork of the experimental groups was of good quality [13].

An analysis of raw meat showed that pork has a good ability to emulsification and gelation; it has a high nutritional value. The toxicity index corresponded to the first acceptable toxicity group.

5. Conclusion

Studies have shown that crossbreeds are superior to purebreds due to the effects of heterosis. The meat raw materials meet the requirements of meat processing enterprises for meat raw materials and can be used for producing meat products, including high quality environmentally friendly semi-finished products [14].

Based on the results obtained, in order to increase the indicators of fattening and meat productivity, biological and interior indicators, as well as quality of meat raw materials, crossbreeding of meat breeds was recommended [15].

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Conflict of Interest

The authors have no conflict of interest to declare.

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