The using of a paste of fermented fish feed in gestation sows feeding

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Abstract. The article presents the results of using fermented forage fish paste prepared from waste from processing of Far Eastern commercial fish in the diets of pregnant sows. The use of this additive in feeding sows had a positive effect on their reproductive qualities, which allowed to increase the multiplicity of sows' livestock by 3.8-9.7%, large-scale fertility by 1.7-5%, the average daily growth of piglets by 5.4-7.8%, and increase the safety of newborn piglets by 2.2-4.4%. The absolute increase in live weight of sows in the experimental groups during pregnancy was higher by 2.0 kg, 4.4 kg and 4.9 kg compared to their counterparts from the control group. At the same time, the average daily increase in live weight in sows of the experimental groups compared to animals of the control group was higher by 3.7-9.9%, respectively. The best indicators were noted when feeding fish paste fermented feed at a dose of 3 and 6.2% of the nutritional value of the diet.

1. Introduction

Russian pig breeding today is a dynamically developing industry in terms of technology and breeding. It is one of the most efficient sub-sectors of animal husbandry, and it is also a fairly competitive type of agricultural business. It is difficult to overestimate the importance of Russian pig breeding in the development of the entire industry [1]. The fundamental basis of the pig industry is a functional food of pigs, combining nutritious food with a set of components that provide the formation on one side of the fortress of the Constitution, natural resistance, reproductive capacity, with another - reproduction high growth rate, high meat index and excellent meat quality. Functional nutrition of pigs is based on the principles and methods of creating the necessary physiological status of each gender and age group involved in the production process. Productive health is the greatest value. Good condition of the animal [2].

The use of various additives that affect the metabolism, digestive processes and the use of nutrients at a sufficiently high level accelerates the growth and development of animals, increases their productivity, adaptation to the external environment, and ultimately has a decisive impact on their quality indicators. However, effective use of feed nutrients, primarily protein and amino acids, as well as obtaining the highest productivity is possible only with an optimal ratio of protein and energy components of the diet. Reducing the level of protein and available lysine in the diet slows down growth, increases feed costs per 1 kg of growth and worsens the quality of carcasses.

Cameron C. D. T. (1962) determined the feed value of cod and haddock offal on pigs. Three experiments were conducted on Yorkshire pigs during rearing and fattening. The growth rate, feed efficiency, and carcass characteristics showed that this product was a satisfactory source of additional
protein [3]. Kim S. W., Easter R. A. (2001) tested four types of fish meal (Menhaden; mackerel dried at 85°C and 70°C; and herring dried at 70°C). Compared to Menhaden fish meal, mackerel and herring flour showed higher ileal digestibility values (P<0.05) for threonine, serine, alanine, valine, histidine, lysine, and arginine, as well as for the average value of all amino acids. The average daily weight gain was higher (P<0.07) in pigs fed a diet containing either mackerel or herring fish meal than in pigs fed Menhaden fish meal [4].

Zivković, B. and etc. (2007) studied the use of high-protein feed in feeding sows during lactation, suckling piglets and weaning piglets. The research was conducted at the experimental pig farm of the Institute of animal husbandry Belgrade-Zemun in Serbia. The results showed that the introduction of the studied feed as a substitute for fish meal had a positive effect: 6.18% less loss of live weight of sows during lactation, with almost identical growth in suckling piglets [5]. Pigs, especially pregnant sows, are very sensitive to a lack of protein, the quality of which is determined by the number and ratio of amino acids in it, and primarily essential. The health, normal course of pregnancy and successful surveys in sows depend on feeding. Feeding should be organized in such a way that pregnant women with full and balanced diets receive enough energy, nutrients and biologically active substances necessary for the formation of a healthy diet.

In the Far Eastern region of Russia, it is possible to use non-traditional feeds of local origin to improve the quality of pig feeding, increase the efficiency of feed use and reduce the cost of livestock products. Non-traditional feeds include fish processing waste, which can be used as a protein supplement to feed, but they are not always used efficiently, which leads not only to the loss of valuable raw materials, but also to environmental pollution. In Primorsky Krai, various additives obtained from fish processing enterprises' waste were studied [7,8]. The TINRO-Center has developed a resource-saving technology for the production of fermented feed products from waste of processed Far Eastern commercial fish [9,10,11].

2. Methods and materials

In our research, the goal was to establish the effectiveness of using a feed additive in the diets of sows - fermented fish feed paste (PRFC) obtained from waste processing of Far Eastern fish. The research objectives were to study changes in the live weight of pregnant and suckling sows, as well as piglets of the dairy growing period. To solve these tasks, we conducted a scientific and economic experiment on Landrace sows on the basis of the LLC «Ariaran-N» pig farm in Primorsky Krai. The animals were divided into groups based on age, live weight, and gestation period. Experimental animals during pregnancy were kept in a group method, and in the suckling period - in individual machines of a typical room. Control of the fullness of animal feeding was carried out in accordance with a detailed system of normalized feeding [12]. The scheme of scientific and economic experience is presented in table 1.

| Table 1. Research scheme. |
|---------------------------|
| Group | Amount, head | Diet |
| Control | 10 | Basic ration (BR) |
| 1 experimental | 10 | BR+2% fermented fish paste forage |
| 2 experimental | 10 | BR+3% fermented fish paste forage |
| 3 experimental | 10 | BR+6.2% fermented fish paste forage |

Against the background of the main feeding ration, which was received by sows of all groups (mixed feed SK-5, SK-6), sows of the 1st experimental group were fed 3% of the nutritional value of the ration, 2 experimental group 5% of the nutritional value of the ration, and 3 experimental group - 8% of the nutritional value of the ration. Control over changes in the live weight of sows was carried out during the preparatory period, on the 84th and 112th days of gestation, on the 5th day after farrowing and when weaning piglets at the age of 60 days. From the reproductive indicators of sows, we took into account the multiplicity, large-scale fertility and safety of piglets in the nest.
3. Results
The chemical composition of fermented fish paste from waste from cutting herring and saury includes: water - 70.62%; protein - 22.71%; lipids - 4.75%; minerals - 1.23%. When studying the amino acid composition, it was found that fish paste contains a complex of essential and non-essential amino acids. The amino acid composition of PRFC shows that the sum of essential amino acids is 41.94 g of AC/ 100 g of protein. Of these, the largest amount contains phenylalanine+tyrosine - 8.71 g of AC/ 100 g of protein, leucine - 8.40 g of AC/ 100 g of protein, and lysine - 7.41 g of AC/ 100 g of protein. The amount of substituted amino acids is 56.6 g of AC/ 100 g of protein. It is composed of glutamic acid of 13.63 g AK/ 100 g protein aspartic acid of 10.07 g AK/ 100 g protein arginine 7.85 g AC/ 100 g of protein, Proline - 6.46 g AK/ 100 g protein, etc. The mineral composition of the dry substance of PRFC in mg/kg: sodium - 2284.4; potassium - 2837.2; phosphorus - 1927.82; magnesium - 838.9; iron - 320.0, etc. Observations of changes in live weight of sows in table 2.

**Table 2. Dynamics of live weight of sows during gestation and suckling periods (on average per head).**

| Index                        | control       | 1 experimental | 2 experimental | 3 experimental |
|------------------------------|---------------|----------------|----------------|---------------|
| Live weight at the begging of the research, kg | 132.3±0.49    | 132.6±0.45    | 133.0±0.51    | 131.9±0.51    |
| At 112-day age of pregnancy, kg | 180.3±0.57    | 182.4±0.58    | 185.2±0.42    | 184.6±0.40    |
| Absolute increase of gain, kg | 47.8±0.64     | 49.8±0.92c    | 52.2±0.64c    | 52.7±0.60c    |
| Daily gain, g                | 516±6.91      | 535±95c       | 561±6.88c     | 567±6.48c     |
| Live weight at 5-day of lactation | 164.3±0.21    | 166.9±0.27    | 166.5±0.48    | 167.7±0.42    |
| Live weight at weaning       | 148.1±0.41    | 148.2±0.37    | 147.3±0.77    | 146.8±0.43    |
| Loss of body weight during lactation, kg | 16.2±0.51     | 18.7±0.39a    | 19.2±0.89b    | 20.9±0.41b    |
| % to control                 | 100           | 115.4         | 118.5         | 129.0         |

* P<0.05; ** P<0.01; *** P<0.001.

In the course of studying the dynamics of live weight of experimental sows in different physiological periods, it was found that the use of fermented fish paste in animal feeding had a positive effect on the intensity of their growth. In the control group, the absolute increase in live weight of sows was 47.8 kg, in animals of the experimental groups it was higher by 2.0 kg, 4.4 kg and 4.9 kg (P< 0.001), respectively. At the same time, the average daily increase in live weight in animals of the experimental groups compared to animals of the control group was higher by 3.7%, 8.7% and 9.9%, respectively (P< 0.001). Weighing sows on the 5th day after farrowing showed that the live weight of pigs in the experimental group was the lowest and amounted to 164.3 kg, and their counterparts from the 3 experimental groups have the highest live weight - 167.7 kg.

Feeding fish paste fermented feed to sows during the suckling period showed that their live weight at the time of weaning piglets at two months of age in groups remained almost the same 147.3 - 148.2 kg. At the same time, the highest body weight loss during lactation was observed in sows of the 3rd experimental group and was at the level of 20.9 kg (P< 0.01), individuals in the 1st and 2nd experimental groups lost less - 18.7 and 19.2 kg, which in relative terms was 15.4, 18.5 and 29.0%, the lowest losses in animals of the control group - 16.2 kg.
Table 3. Reproductive index of sows.

| Index                             | control       | 1 experimental | 2 experimental | 3 experimental |
|-----------------------------------|---------------|----------------|----------------|----------------|
| Multiple pregnancy, head          | 10.3±0.35     | 10.7±0.33      | 11.0±0.34      | 11.3±0.37      |
| Large-fruited, kg                 | 1.19±0.31     | 1.21±0.29      | 1.23±0.22      | 1.25±0.20      |
| Live weight of 1 piglet at weaning, kg | 16.6±0.41     | 17.5±0.14      | 17.7±0.09      | 17.9±0.06      |
| Increase of live weight, kg       | 15.4±0.41     | 16.29±0.14     | 16.47±0.09     | 16.65±0.06     |
| Daily gain, g                     | 257±6.86      | 271±2.36       | 274±1.54       | 277±1.04       |
| % to control                      | 100           | 105.4          | 106.6          | 107.8          |
| Quantity of piglets in group      |               |                |                |                |
| at birth                          | 103           | 107            | 110            | 113            |
| at weaning                        | 92            | 98             | 102            | 106            |
| safety, %                         | 89.4          | 91.6           | 92.7           | 93.8           |

The reproductive functions of sows are an important indicator of the economic use of animals. The data obtained during the study of the reproductive functions of experimental animals showed that the used fermented fish feed paste increases the multiplicity of sows by 0.5-1 Piglet, while the large-fruited piglets in all experimental groups were 1.21-1.25 kg and slightly differed from the animals of the control group by 1.7 - 5.0%. Good development in the embryonic period of piglets contributed to their better development in the subsequent period, as can be judged by the increase in live weight before weaning from sows. Piglets obtained from sows whose diet included the PRFC Supplement had high growth rates. The growth of piglets of these groups exceeded this indicator of animals obtained from sows from the control group by 1.7-5.0%. The growth of piglets from the experimental groups exceeded the control group by 1.7-5.0%. The average daily increase in live weight in the control group was 257 g during the suckling period, in the experimental groups it was higher by 5.4, 6.6 and 7.8% (P< 0.001), which was 271, 274 and 277 g, respectively.

The safety of piglets during the suckling period was 92% in the control group, 91.6% in the first experimental group, 92.7% in the second experimental group, and 93.8% in the third experimental group. Indicators of the morphological and biochemical composition of the blood of animals of all groups were within the acceptable physiological norm.

4. Discussion

Thus, the use of fermented fish paste forage in feeding sows has a positive effect on their reproductive qualities, which can increase the multiplicity of sows livestock by 3.8-9.7%, large-scale fertility by 1.7-5%, the average daily growth of piglets by 5.4-7.8%, and increase the safety of newborn piglets by 2.2-4.4%. The absolute increase in live weight of sows during pregnancy in animals that received fermented fish paste in the diet was higher by 2.0 kg, 4.4 kg and 4.9 kg (P< 0.05). At the same time, the average daily increase in live weight in sows of the experimental groups compared to animals of the control group was higher by 4.4-10.6%. The Best indicators were noted when feeding PRFK at a dose of 3 and 6.2% of the nutritional value of the diet.

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