A method for increasing the productivity of meat gobies thanks to the use of cavitated sunflower oil sludge in the diet

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Abstract. The paper presents the results of studies on the use of cavitation-treated sunflower oil sludge in the diets of young cattle, when grown for meat. The analysis of the data showed that the introduction of native and cavitated oil sludge into the diet of bulls affects the indicators of the intensity of their growth with a pronounced effect for cavitated oil sludge. So, bulls of the II experimental group in live weight exceeded their herdmates from the control and I experimental groups at the age of 18 months - by 4.6% (P≤0.05) and by 2.0%. In terms of the average daily gain, the animals of the II experimental groups, for the entire period of the experiment, exceeded the control and I experimental groups by 5.1-14.2%, respectively. The use of oil sludge, subjected to cavitation treatment, in feeding young cattle is economically profitable. Additional profit is 1105.2 rubles. per head, and the level of profitability of beef production at the same time increases by 2.75%. This testifies to the economic feasibility of the practical application of cavitated sunflower oil-sludge.

1. Introduction

One of the real ways to increase meat production is the widespread use of various wastes from the food and processing industries including oil sludge in feeding farm animals. This production waste is released from vegetable oil during storage and consists of phospholipids, triglycerides, and protein impurities. Replacing scarce and expensive energy components with more affordable and cheaper waste from this industry will allow increasing the productive qualities of farm animals without significantly reducing the nutritional value of the diets [1, 2].

The level of economic feasibility of the production largely depends on the organization of feeding and preparation of feed [3, 4]. To date, the technology of cavitation treatment of by-products of the fat and oil industry in feeding young cattle has been sufficiently studied. The use of concentrates in the composition of the diets of young cattle prepared using the technology of cavitation treatment makes it possible to increase the nutritional value of feed, reduce its cost and consumption, and obtain additional growth at relatively low costs [5-8].

Thus, the study of the efficiency of using diets, into the structure of which cavitation-treated oil sludge was introduced when raising young cattle for meat, makes it possible to provide a scientifically based approach to organizing the preparation of wastes from the fat and oil industry used in animal husbandry.
2. Materials and methods

2.1. Object of the research
Young cattle of the Kazakh white-headed breed. Animal care during the research was performed in accordance with the instructions and recommendations of Russian Regulations, 1987 (Order No. 755 on 12.08.1977 the USSR Ministry of Health) and “The Guide for Care and Use of Laboratory Animals (National Academy Press Washington, DC 1996).

2.2. Experiment scheme
The studies were carried out on the basis of the Center for Collective Use of the Federal Scientific Center for Biological Systems and Agricultural Technologies of the Russian Academy of Sciences.

During the period of the experiment, the bulls of the experimental groups were divided into three groups (n = 10), where after the preparatory period the animals were transferred to the main period, which lasted until 18 months of age. According to the experimental scheme, the feeding of the bulls was carried out with the only difference that the animals of the control group received a standard diet, and the animals of the experimental groups instead of 10% of the concentrated part received: I - sunflower oil sludge in the native form, II - cavitation-treated sunflower oil sludge. The technology of cavitation of sunflower oil sludge was carried out using an ultrasonic cavitator, impact of 28 kHz, at t = 28˚C, unit 220 V, power 5 W., cavitation threshold 19 kHz, hydromodule 1: 2 (Russia).

Control over the growth of experimental animals was carried out by individual, monthly weighing in the morning before feeding and drinking. Based on the data obtained, the absolute and average daily gains, as well as the relative growth rate, were calculated. When assessing the economic efficiency of the growing experimental bulls, the consumption of feed per 1 quintal of gain, production costs, the cost of 1 quintal of growth, an increase in net income, and profitability were determined.

2.3. Statistical processing
The data are expressed as mean values ± standard error of the mean. Statistical analysis was performed using Statistica 10.0 (StatSoft Inc., USA) and Microsoft Excel (Microsoft, USA). Significance of the group differences was estimated using Student’s t-test with p≤0.05 considered as significant.

3. Results
The results of the studies have shown that the use of native and cavitated sunflower oil sludge in feeding young cattle has a positive effect on increasing their live weight.

Already after a month of the experimental period, there was an advantage in this indicator of animals that received sunflower oil sludge in the diet. Moreover, the greatest effect was observed when feeding oil sludge subjected to cavitation. So, bulls of the II experimental group exceeded in live weight their herdmates from the control and I experimental groups at the age of 14 months by 1.8 and 0.9%, at 16 months - by 3.2 and 1.6% and at 18 months - by 4.6% (P≤0.05) and 2.0% (table 1).

| Age, months | control | I | II |
|-------------|---------|---|----|
| M       | m       | M | m   | M | m   |
| 12       | 301.7   | 1.12 | 300.2 | 0.96 | 301.3 | 1.34 |
| 13       | 324.4   | 1.37 | 325.3 | 1.19 | 327.0 | 1.60 |
| 14       | 348.5   | 1.63 | 351.3 | 1.39 | 354.6 | 1.87 |
| 15       | 372.9   | 1.92 | 377.9 | 1.62 | 382.7 | 2.13 |
| 16       | 399.7   | 2.24 | 406.1 | 1.86 | 412.6 | 2.41 |
| 17       | 425.6   | 2.58 | 433.8 | 2.12 | 442.3 | 2.72* |
| 18       | 450.7   | 2.94 | 462.1 | 2.41 | 471.4 | 3.04* |

Significant difference in relation to control; * p ≤ 0.05.
More clearly, the growth intensity and dynamics of the live weight of the experimental young animals can be assessed by the indicator of their average daily gain (table 2).

**Table 2.** Average daily gain of the experimental bulls, kg.

| Group | Age, months | control | I | II |
|-------|-------------|---------|---|----|
|       | M | m | M | m | M | m |
| 12-13 | 757 | 9.47 | 837 | 10.32 | 857 | 9.54 |
| 13-14 | 777 | 10.11 | 839 | 13.53 | 890 | 12.31 |
| 14-15 | 787 | 12.03 | 858 | 15.11 | 906 | 11.71 |
| 15-16 | 957 | 9.54 | 1007 | 17.53 | 1068 | 18.52 |
| 16-17 | 835 | 14.33 | 894 | 15.21 | 958 | 14.37 |
| 17-18 | 837 | 16.27 | 943 | 15.63 | 970 | 15.55 |
| 12-18 | 823 | 19.43 | 894 | 20.11 | 940 | 19.64 |

The analysis of the average daily gain showed that the animals of the experimental groups, which received oil sludge as part of their diet, surpassed their herdmates from the control group at the age of 13-14 months by 8.0-14.5%, 15-16 months - by 5.2-11.6%, 17-18 months - by 12.7-16.0%, and over the entire period of experience, respectively - by 8.6-14.2%.

To calculate the economic efficiency of using sunflower oil sludge in native and cavitation-prepared form in the structure of the diet of young cattle raised for meat, actual indicators of labor, feed and material costs were taken, as well as the realizable cost of carcasses of gobies at the time of completion of the experiment (table 3).

**Table 3.** Economic efficiency of raising young cattle for meat using cavitated sunflower oil sludge.

| Indicator                              | control | Group |
|----------------------------------------|---------|-------|
| Absolute gain, kg                      | 149.0   | 161.9 | 170.1 |
| Expenses per 1 quintal of growth: feed units | 908.1   | 852.2 | 825.2 |
| exchange energy, MJ                    | 10060.0 | 9464.5 | 9105.4 |
| digestible protein, kg                 | 89.2    | 84.8  | 81.6  |
| Production costs, rub / head           | 31177.2 | 31523.2 | 31935.0 |
| Cost of 1 q of increment, rub          | 6917.5  | 6821.7 | 6774.5 |
| Profit, rub / goal                     | 9385.8  | 10065.8 | 10491.0 |
| Profitability level,%                  | 30.10   | 31.93 | 32.85 |

The analysis of economic data showed that the introduction of native and cavitated sunflower oil sludge into the diet of experimental young animals caused a decrease in the consumption of feed units per 1 quintal of live weight gain by 6.1-9.1%, metabolic energy - by 6.0-9.5%, digestible protein - by 5.0-8.5% respectively. At the same time, lower feed costs were observed in animals that received oil sludge subjected to cavitation.

The production costs in monetary terms in the experimental groups were higher, but they were paid off by additional products.

As a result of the higher intensity of growth of the bulls of the experimental groups, the cost of 1 quintal of growth was 1.4-2.1% lower in them compared to the control.

The use of oil sludge in the diets of experimental gobies contributed to the additional profit per animal, which amounted to 680.0 and 1105.2 rubles. At the same time, the level of profitability of beef
production increased in the experimental groups, relative to the peers of the control group, by 1.83 and 2.75%.

Thus, the use of waste from the fat- and- oil industry in the diets of young cattle, in the form of sunflower oil sludge, subjected to cavitation technology, makes it possible to reduce the cost of production while increasing its profitability.

4. Discussion
The effectiveness of the use of by-products of the fat-and-oil industry in cattle is being studied both in our country and abroad, but the results obtained are contradictory and insufficient for their widespread use in livestock production [9, 10]. The known methods of using sunflower oil-sludge in animal feeding are not effective enough, which is caused by the technological difficulties of introducing it into the diet. In this connection, there is a need to develop an optimal technology for preparation for feeding and the introduction of oil sludgeinto the diet, to study the quantitative aspects of the formation of meat productivity in young cattle when feeding compound feed balanced in fats. In this regard, it seems relevant to develop a technology for the use of cavitation treatment to prepare for feeding sunflower oil sludge and to study its effect in the composition of compound feeds on the productive qualities of young cattle [11, 12]. The material obtained by us from the conducted studies on the advisability of preparing the fat part of the diet by cavitation technology when raising young cattle for meat has found positive confirmation. The introduction of processed oil sludge into the diet of young cattle in an amount of 10% in terms of nutritional value instead of the concentrated part of the diet, allows increasing the growth rate of young animals by 5.1-14.2%, additionally making a profit of 425.2 and 1105.2 rubles / head, while increasing the level of production profitability beef by 0.92-2.75%. This allows to significantly minimize the cost of feeding and give a higher economic efficiency of the use of this technology in feeding ruminants.

5. Conclusion
Thus, the results obtained indicate the effectiveness of using cavitationally prepared sunflower oil sludge in the composition of the diets of young cattle, which is expressed by a decrease in the cost of a unit of production, an increase in productivity and the level of profitability of beef production.

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References
[1] Nurzhanov BS, Levakhin Yu I, Ryazanov VA, Dzhulamanov EB and Poberukhin M M 2019 Variety of different fat-containing preparations c the inclusion of micro- and nanoelements in animal feeding (review) Livestock and fodder production 102 (1) 149-63 doi : 10.33284 / 2658-3153-102-1-149
[2] Lebedev SV, Sheida EV, Vershinina IA, Gubaidullina IZ, Miroshnikov IS, Ryazanov VA, Makaeva AM, Markova IV and Ushakov AS 2019 The effect of different sources of fat in the diet on the digestibility and activity of the digestive enzymes in calves Livestock and fodder production 102 (4) 198-207 doi: 10.33284 / 2658-3153-102-4-198
[3] Miroshnikov SA, Muslyumova DM and Bykov AV 2012 Influence of cavitation on the bioavailability of fatty acids from oil and fat industry waste Bulletin of the Russian Academy of Agricultural Sciences 3 53-5
[4] Korneichenko VI, Muslyumova DM and Kurilkina M Ya 2015 Comprehensive assessment and development of new methods to improve the quality of feed produced in the Orenburg region Bulletin of beef cattle breeding 2 (90) 111-4
[5] Radhakrishnan K, Bader K B and Haworth K J 2013 Relationship between cavitation and loss of echogenicity from ultrasound contrast agents Phys Med Biol 58 (18) 6541-63
[6] Bykov AV, Kvan O V and Duskaev G K 2021 The influence of cavitation processing on
biotechnological aspects of feed application *IOP Conference Series: Earth and Environmental Science* 624 (1) 012192

[7] Zubiria I, Garcia-Rodriguez A and Atxaerandio R 2019 Effect of Feeding Cold-Pressed Sunflower Cake on Ruminal Fermentation, Lipid Metabolism and Bacterial Community in Dairy Cows Animals (Basel) 9 (10) 755

[8] Bunkin AF and Pershin SM 2010 Four-photon spectroscopy of rotational transitions in liquids: registration of changes in the chemical composition of water under the action of cavitation *Quantum Electronics* 40 (3) 189-91

[9] Yue C, Ben H, Wang J, Li T and Yu G 2019 Ultrasonic Pretreatment in Synthesis of Caprylic-Rich Structured Lipids by Lipase-Catalyzed Acidolysis of Corn Oil in Organic System and Its Physicochemical Properties *Foods* 8 (11) 566

[10] Baikov AS 2020 On the expediency of using cavitated feed grain and flour-grinding waste in the diets of young cattle *Livestock and fodder production* 103 (1) 158-67 doi: 10.33284 / 2658-3135-103-1-158

[11] Rakhimzhanova IA, Baykov AS, Shirmina NM and Galiev BX 2020 Productive and meat qualities of young cattle when using cavitated concentrates in the diet *Izvestiya of Orenburg State Agrarian University* 6 (86) 275-80 doi: 10.37670 / 2073 -0853-2020-86-6-275-280

[12] Lebedev S V, Gavrish I A, Shejda E V, Miroshnikov I S, Ryazanov V A, Gubajdullina I Z and Makaeva A M 2019 Effect of various fats on digestibility of nutrients in diet of calves *IOP Conference Series: Earth and Environmental Science* 341(1) 012066