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PRODUCTIVE AND ECONOMIC EFFICIENCY OF REARING TABLE CARP WITH THE USE OF NON-TRADITIONAL FEED ADDITIVES

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Purpose. *To establish the efficiency of the use of such minerals assaponite, analcime and bentonite used as feed additives in the main diet of age-1+ carp on their majorfeatures and the economic component of their cultivation in ponds.*

Methodology.*The experimental works were carried out in the conditions of ponds of the State Enterprise ExperimentalFarm "Nyvka" of the Institute of Fisheries of NAAS during the growing period of 2018. The object of the study were age-1+carp of Nyvka scaly intrabreed type. The study included three experimental and control groups of fish and was conducted in analogous ponds with an area of 0.5 ha each. The diet of fish of the first experimental group ws supplemented with 3% of saponite, the diet of fish of the second experimental group was supplemented with 3% of analcime, and the diet of fish of the third experimental group was supplemented with 2% of bentonite. The control group of fish was fed with a balanced feed, without additives. Hydrochemical and fish farming studies were carried out according to generally accepted methods.*

Findings.*The study demonstrated that majorhydrochemical parameters during the growing period were within normal limits, but there was an increase in the level of permanganate oxidation of waterwith an increase in water temperature during the summer. However, the level of chlorides was slightly increased during the entire growingseason in the experimental and control ponds.*

In the experimental variants, when supplanting the main diet of age-1+ carp with saponite, analcime and bentonite, the total fish productivity of ponds was higher by 0.7%, 13.4% and 3.5%, respectively, with a decrease in feed costs for cultivation compared to control. At the same time, the best survival rate of fish was 69.1% when fish were fed with the feed supplemented with bentonite, versus 64.2% in the control pond.

When analyzing the economic efficiency of the use of these minerals in the feeding of age-1+ carp, a 2% increase in profitability was observed as a result of the supplementation of fish diet with saponite, 16.4% after addinganalcime and 4.2% after adding bentonite compared to control.

As a result of comparative characteristics of the studied minerals, it should be noted that the most promising for use in the feeding of age-1+carp can be analtsim, given the highest rates of weight gain of fish, fish productivity of ponds and as well as the earned profit.

Originality.*The efficiency of the use of such minerals as saponite, analcime and bentonite in the feeding of age-1+ carp as non-traditional feed additives was analyzed for the first time. A comparative assessment of their effects on the main fish features and economic parameters of cultivation was performed.*

Practical value*. Based on obtained positive results of the introduction of the studied minerals into the diet of carp, it is possible to increase fish growth and fish productivity of ponds. The low cost of these non-traditional additives leads to a positive economic effect in the process of fish cultivation. Accordingly, the use of saponite, analcime and bentonite in the conditions of commercial carp cultivation is justified and relevant.*

Key words: *age-1+ carp, saponite, analcime, bentonite, minerals of natural origin, fish productivity, economic efficiency.*

ПРОДУКТИВНА ТА ЕКОНОМІЧНА ЕФЕКТИВНІСТЬ ВИРОЩУВАННЯ ТОВАРНОГО КОРОПА ЗА ВИКОРИСТАННЯ В ГОДІВЛІ НЕТРАДИЦІЙНИХ КОРМОВИХ ДОБАВОК

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Мета. *Встановлення ефективності застосування мінералів сапоніт, анальцим і бентоніт в якості кормових добавок у складі основного раціону дволіток коропа та впливу на основні рибогосподарські показники та економічну складову вирощування в умовах ставів.*

Методика. *Експериментальні роботи проведено в умовах ставів ДП ДГ «Нивка» Інституту рибного господарства НААН впродовж вегетаційного періоду 2018 року. Об'єктом дослідження були дволітки нивківського лускатого внутрішньопородного типу коропа. Дослідження складалося з трьох дослідних та контрольної груп риб і було проведене в ставах-аналогах площею 0,5 га кожен. Рибам першої дослідною групи до складу основного раціону вводили сапоніт у кількості 3% в складі корму, рибам другої дослідної групи — 3% анальциму, а рибам третьої дослідної групи — 2% бентоніту. Контрольній групі риб згодовували збалансований комбікорм без введення до його складу добавок. Гідрохімічні і рибницькі дослідження проводили за загальноприйнятими методиками.*

Результати. *У результаті проведених досліджень встановлено, що впродовж періоду вирощування основні гідрохімічні показники знаходилися у межах норми, проте при підвищенні температури води у літній період відмічено зростання рівня перманганатної окиснюваності води. Разом з тим, протягом всього вегетаційного сезону у дослідних та контрольному ставах рівень хлоридів був дещо підвищений.*

У дослідних варіантах при введенні до складу основного раціону дволіток коропа сапоніту, анальциму та бентоніту загальна рибопродуктивність ставів була вищою відповідно на 0,7, 13,4 та 3,5%, разом зі зниженням витрат кормів на вирощування в порівнянні з контролем. Поряд з цим, найкращий показник рівня виживання риб становив 69,1% при годівлі їх кормом із додаванням бентоніту, проти 64,2% у контрольному ставу.

Аналізуючи економічну ефективність використання даних мінералів у годівлі дволіток коропа, слід зазначити збільшення рівня рентабельності на 2% у результаті введення до складу раціону риб сапоніту, на 16,4% — анальциму та на 4,2% — бентоніту відносно контролю.

За результатами порівняння характеристик досліджуваних мінералів, слід зазначити, що найперспективнішим для використання в годівлі дволіток коропа може бути анальцим, з огляду на найвищі показники приросту маси риб, рибопродуктивності ставів та отриманого прибутку.

Наукова новизна. *В результаті експерименту вперше проаналізовано ефективність використання мінералів сапоніт, анальцим та бентоніт в годівлі дволіток коропа в якості нетрадиційних кормових добавок. Здійснено порівняльну оцінку їхнього впливу на основні рибогосподарські та економічні показники вирощування.*

Практична значимість. *На основі отриманих позитивних результатів введення досліджуваних мінералів до раціону коропа, можна забезпечити збільшення приростів риб та рибопродуктивності ставів. Невисока вартість даних нетрадиційних добавок зумовлює отримання позитивного економічного ефекту в процесі вирощування. Відповідно, використання сапоніту, анальциму та бентоніту в умовах товарного вирощування коропа є обґрунтованим і актуальним.*

Ключові слова: *дволітки коропа, сапоніт, анальцим, бентоніт, мінерали природного походження, рибопродуктивність, економічна ефективність.*

ПРОДУКТИВНАЯ И ЭКОНОМИЧЕСКАЯ ЭФФЕКТИВНОСТЬ ВЫРАЩИВАНИЯ ТОВАРНОГО КАРПА ПРИ ИСПОЛЬЗОВАНИИ В КОРМЛЕНИИ НЕТРАДИЦИОННЫХ КОРМОВЫХ ДОБАВОК

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Цель. *Определение эффективности применения минералов сапонит, анальцим и бентонит в качестве кормовых добавок в составе основного рациона двухлеток в контексте на основные рыбохозяйственные показатели и экономическую составляющую при выращивании в прудовых условиях.*

Методика. *Экспериментальные работы проведены в условиях прудов ГП ОХ «Нивка» Института рыбного хозяйства НААН в течение вегетационного периода 2018 года. Объектом исследования были двухлетки нивчанского чешуйчатого внутрипородного типа карпа. Исследование состояло из трех опытных и контрольной групп рыб и было проведено в прудах-аналогах площадью 0,5 га каждый. Рыбам первой опытной группы в состав основного рациона добавляли сапонит в количестве 3% в составе корма, рыбам второй опытной группы — 3% анальцима, а рыбам третьей опытной группы — 2% бентонита. Контрольной группе рыб скармливали сбалансированный комбикорм без введения в его состав добавок. Гидрохимические и рыбоводные исследования проводили по общепринятым методикам.*

Результаты. *В результате проведенных исследований установлено, что в течении периода выращивания основные гидрохимические показатели находились в пределах нормы, однако при повышении температуры воды в летний период отмечен рост уровня перманганатной окисляемости воды. Вместе с тем, в течение всего вегетационного сезона в опытных и контрольном прудах уровень хлоридов был несколько повышен.*

В опытных вариантах при введении в состав основного рациона двухлеток карпа сапонита, анальцима и бентонита общая рыбопродуктивность прудов была выше соответственно на 0,7, 13,4 и 3,5%, вместе со снижением затрат кормов на выращивание по сравнению с контролем. Наряду с этим, лучший показатель выживаемости рыб составил 69,1% при кормлении рыб кормом с добавлением бентонита, против 64,2% в контрольном пруду.

Анализируя экономическую эффективность при использовании данных минералов в кормлении двухлеток карпа, следует отметить повышение уровня рентабельности на 2% в результате введения в состав рациона рыб сапонита, на 16,4% — анальцима и на 4,2% — бентонита по отношению к контролю.

По результатам сравнения характеристик исследуемых минералов, следует отметить, что наиболее перспективным для использования в кормлении двухлеток карпа может быть анальцим, учитывая высокие показатели прироста массы рыб, рыбопродуктивности прудов и полученной прибыли.

Научная новизна. *В результате эксперимента впервые проанализирована эффективность использования минералов сапонит, анальцим и бентонит в кормлении двухлеток карпа в качестве нетрадиционных кормовых добавок. Осуществлена сравнительная оценка их влияния на основные рыбохозяйственные и экономические показатели выращивания.*

Практическая значимость. *На основе полученных положительных результатов введения исследуемых минералов в рацион карпа, можно обеспечить увеличение приростов рыб и рыбопродуктивности прудов. Невысокая стоимость данных нетрадиционных добавок приводит к получению положительного экономического эффекта в процессе выращивания. Соответственно, использование сапонита, анальцима и бентонита в условиях товарного выращивания карпа является обоснованным и актуальным.*

Ключевые слова: *двухлетки карпа, сапонит, анальцим, бентонит, минералы природного происхождения, рыбопродуктивность, экономическая эффективность.*

PROBLEM STATEMENT AND ANALYSIS OF LAST ACHIEVEMENTS AND PUBLICATIONS

Nowadays, in the conditions of market economy of the state, there is a need to identify reserves for the development of fish industry and to search for new economically sound approaches to management. The priority tasks of fish farming are: reducing the cost of technologies, resource saving, improving the quality and ensuring the competitiveness of fish products while increasing productivity and ensuring environmental safety [1]. The task of optimizing and reducing the cost of production of final products requires additional costs and cannot always guarantee an effective increase in fish productivity. Therefore, one of the main areas of competitiveness in the market of fish products is fish feeding because the majority of the cost in the process of fish cultivation falls on feeds [2].

In this regard, it is of great interest to use non-traditional feed additives in fish feeding that can satisfy the needs of fish not only in nutrients but also in minerals, which ensures the normal growth and development of fish body [3]. Therefore, due to the positive results in the field of fish farming [4], such additives can be natural minerals with sorption properties –saponite, analcime and bentonite. Scientific studies demonstrated that the use of these minerals of natural origin in the diet of farm animals and poultry has a positive effect on the physiological state of their body and productivity [5, 6]. The high efficiency of their use is due to the content of approximately forty macro- and microelements, as well as adsorption, ion exchange and catalytic characteristics [7, 8]. Especially important for fish farming is the property of these minerals to sorb mycotoxins in finished feed and to slow down the passage of feed into the intestines of fish depending on the temperature that has a positive effect on the digestibility of feed [9 – 10].

HIGHLIGHT OF THE EARLIER UNRESOLVED PARTS OF THE GENERAL PROBLEM. AIM OF THE STUDY

According to their physicochemical properties, the use of these minerals in the cap feeding in ponds is a very promising task. Analcime, saponite and bentonite are little-studied mineral additives in fish farming; however, our previous studies showed the effectiveness of their use in feeding age-1+ and brood carp [11 – 12]. At the same time, other authors studied the use of bentonites in the feeding of sturgeon and trout [6, 13], which is of considerable scientific interest for further studies in fish industry.

The study examines the feasibility of the use of these additives in the feeding of age-1+ carp with a purpose of increasing fish productivity of ponds and establishing the economic efficiency of fish cultivation.

The aim of the study was to determine the efficiency of the use of analcime, saponite and bentonite in the feeding of age-1+ carp in terms of productivity, feed consumption and economic component of fish cultivation.

MATERIALS AND METHODS

The study was carried out in the conditions of the State Enterprise Experimental Farm "Nyvka" of the Institute of Fisheries of NAAS. Three experimental ponds and one control pond with an area of 0.5 ha each were used in the experiment. The object of the study were age-1+ carp of Nyvka scaly intrabreed type. The stocking density of the

experimental groups of fish was 4000 specimens/ha. Fish of the first experimental group (Experiment 1) were fed during the growing period with a feed supplemented with 3% saponite, the diet of fish of the second experimental group (Experiment 2) included 3% analcime, the diet of fishof the third experimental group (Experiment 3) included 2% bentonite. Fish of the control group (Control) was fed with the compound feed PKS 111-2/2/4, manufactured at the Dnepropetrovsk plant of fish feed. In total, the growing season lasted 120 days, from May 14 to September 10, 2018. Feeds were introduced into ponds to the feeding places from the shoreline once a day. The daily amount of feed was 3 – 5% of the weight of fish, taking into account the growth rate and hydrochemical regime. Feeding of carp was carried out according to the established feeding schemes [14] with semi-intensive technology of fish farming. Water sampling for chemical analysis and their processing in the laboratory were performed according to conventional hydrochemical methods. Water quality was assessed according to general requirements and regulations in fish farming [11 – 12]. At the end of the experimental work, fish were caught, their total and average weight were measured, the survival rate was calculated in accordance with the objectives set at the beginning of the study.

STUDY RESULTS AND THEIR DISCUSSION

Water temperature in the ponds was optimal for fish farming and reached its highest values in mid-July and early August — 26.0 – 27.5°C.

The chemical composition of water was monitored during the growing period in the experimental and control ponds with the determination of the content of nutrients, organic matter and salt composition. No significant differences in the chemical composition of water were recorded in the experimental ponds because they hadthe same source of water supply (Table 1).

Table 1. **Chemical analysis of water of experimental ponds during growing season of 2018, State Enterprise Experimental Farm "Nyvka" of the Institute of Fisheries NAAS (min–max /average)**

Parameters	Control	Experiment 1	Experiment 2	Experiment 3	Normative value [16]
pH	7.3-8.3 7.8	7.6-8.1 7.9	6.9-8.0 7.5	7.1-8.3 7.7	6.5-8.5
Free ammonium, NH_3, mgN/dm^3	0.00-0.05 0.025	0.01-0.05 0.03	0.00-0.06 0.03	0.00-0.05 0.025	0.05
Permanganate oxidation, mgO/dm^3	10.6-23.9 17.3	13.2-20.1 16.7	9.8-22.4 16.1	11.1-20.8 16.0	15
Ammonium nitrogen, NH_{4+}, mgN/dm^3	0.03-0.64 0.335	0.02-0.51 0.256	0.03-0.60 0.315	0.01-0.52 0.265	2.0
Nitrites, NO_{2-}, mgN/dm^3	0.01-0.05 0.03	0.01-0.05 0.03	0.00-0.04 0.02	0.02-0.04 0.03	0.100
Nitrates, NO_3^-, mgN/dm^3	0.01-0.24 0.13	0.00-0.22 0.11	0.01-0.19 0.1	0.00-0.22 0.11	up to 2.0

Continuation of the table. 1

Parameters	Control	Experiment 1	Experiment 2	Experiment 3	Normative value [16]
Mineral phosphorus, $PO4^{3-}$, mgP/dm^3	0.02-0.15 0.09	0.02-0.16 0.09	0.01-0.14 0.08	0.02-0.22 0.12	0.7
Total iron, Fe^{2+} + Fe^{3+}, mgFe/dm^3	0.22-0.36 0.29	0.26-0.41 0.34	0.24-0.42 0.33	0.24-0.39 0.32	1.0
Calcium, Ca^{2+}, mg/L	50.0-55.2 52.6	48.4-50.4 49.4	36.2-42.8 39.5	33.1-51.7 42.4	40-60
Magnesium, Mg^{2+}, mg/dm^3	8.4-12.8 10.6	10.0-12.1 11.0	3.2-13.2 8.2	2.3-12.4 7.4	≤30
Sodium + potassium, Na^+ + K^+, mg/dm^3	77.6-104.8 91.2	60.2-100.2 80.2	81.1-102.1 91.6	50.4-104.0 77.2	50
Hydrocarbonates, HCO_{3-}, mg/dm^3	120.0-146.5 133.3	113.4-140.2 126.8	132.1-143.4 137.8	121.0-136.8 128.9	300-400
Chlorides, Cl-, mg/dm^3	71.4-163.9 117.7	55.2-159.4 107.3	60.0-147.4 103.7	112.4-156.1 134.3	50-70
Sulfates, $SO4^{2-}$, mg/dm^3	31.4-47.3 39.4	30.2-49.0 39.6	29.6-44.2 36.9	33.0-41.4 37.2	50-70
Hardness, mg-eq./dm^3	2.1-3.8 2.9	2.3-4.1 3.2	2.8-3.9 3.4	2.2-3.8 3.0	5-7
Mineralization, mg/dm^3	447.1-530.4 488.8	485.0-515.6 500.3	490.6-522.7 506.7	414.8-540.0 477.4	1000

The pH was in the range of 6.9 – 8.3 that was an acceptable normal value for fish ponds. Free ammonia was absent at the beginning of the season and increased to 0.06 mgN/dm^3 in late July, indicating an intensification of algal blooms. As for permanganate oxidation, its increase indicates the presence of easily oxidizable organic compounds in water. Thus, the lowest average value during the seasonwas 16.0 mgO/dm^3 in Experiment 3. This value was the highest in the control – 17.3 mgO/dm^3. The average value of water oxidation in all ponds generally exceeded the normal limits, which indicates increased water pollution by organic matter.

As for the dynamics of changes in nutrients, it was found that ammonium nitrogen and mineral phosphorus were present in all experimental and control ponds, but in small quantities, which were acceptable for fish farming. The average seasonal index of nitrite nitrogen ranged from 0.02 to 0.03 mgN/dm^3, which did not exceed the normative values. Nitrate nitrogen was absent or present in minimal amounts in all ponds at the beginning of the season and increased in late July to a maximum of 0.24 mgN/dm^3, which may indicate the active development of phytoplankton in the ponds. However, its average seasonal content ranged from 0.1 to 0.13 mgN/dm^3, which did not exceed the established standards.

The content of total iron during the season varied, ranging from 0.22 to 0.42 mgFe/dm^3, which did not exceed the normative values in all ponds. Water of the experimental ponds was characterized by almost the same average hardness, slowly

increasing until the middle of the season (2.1–4.1 mg-eq/dm^3), respectively, and the calcium content was within the normative values with slightly lower values in Experiment 2.

Water contamination with chlorides during cultivation was observed. On average, their content ranged from 55.2 to 163.9 mg/dm^3, which significantly exceeded the normative values (50–70 mg/dm^3).

The average seasonal sulfate concentration ranged from 36.9 to 39.6 mg/dm^3 in Experiment 2 and Experiment 1, respectively, which did not exceed the normative values.

The total hardness and mineralization of water of the studied ponds were characterized by the average value of acceptable concentrations and belonged to the hydrocarbonate class according to the classification of O.O. Alekin [15].

Thus, the chemical composition of water in the experimental ponds during the study period differed little because of having the same source of water supply. However, there was an increased content of chlorides in the water of all ponds throughout the season and an increase in permanganate oxidation compared to the normative values at the end of the growing season.

After the autumn harvests of experimental and control ponds, the major fish features were analyzed, which showed that the fish survival rate was highest in Experiment 3 (69.1%)when fish were fed witha feed supplemented with bentonite (Table 2). The lowest survival rate was observed in Experiment 1 (60%), where fish were fed with a feed supplemented with saponite. The average weight of farmed carp was 162.5 g in Experiment 1, where fish diet was supplemented with saponite, which was 9.2% more than in Control, 166 g in Experiment 2 where fish were fed with a feed supplemented with analzyme, which is higher than the control by 11.5%, and 141.8 g in Experiment 3, where fish were fed with a feed supplemented with bentonite. As for the survival rate and weight of harvested carp, the fish productivity of all experimental ponds was higher compared to Control. Thus, fish productivity in Experiment 1 was 284 kg/ha, 320 kg/hain Experiment 2 and292 kg/ha in Experiment 3 versus 282 kg/ha in Control that washigher by 0.7%, 13, 4% and 3.5%, respectively.

Table 2. **The results of growing age-1+ carp fed with a feed supplemented with bentonite, saponite and analcime during the growing season**

Fish groups	Pond area, ha	Stocked			Harvested				Fish productivity, kg/ha	Feed costs. units
		quantity, ind.	ave. weight, rg	total weight, kg	yield, %	quantity, ind.	ave. weight, rg	total weight, kg		
Control	0.5	2000	25	50	64.2	1284	148.8	191	282	6.4
Experiment 1	0.5	2000	25	50	60.0	1200	162.5	195	284	6.2
Experiment 2	0.5	2000	25	50	66.9	1338	166	210	320	5.7
Experiment 3	0.5	2000	25	50	69.1	1382	141.8	196	292	6.2

As for the cost of feeds for fish production, these parameters were the highest in the Control and amounted to 6.4 units, they were slightly lower in the experimental groups: 6.2 unitsin Experiment 1 and 3, 5.7 unitsin Experiment 2.

Thus, when comparing the results of the obtained fish productivity, it can be noted that its best valueswere demonstrated in Experiment 2, where fish received analcime in their diet.

When assessing the efficiency of aquaculture enterprises, attention should be paid to increasing profitable potential not only by increasing prices or productivity, but also to reducing the cost of the product through targeted measures to optimize feeding or improving the diet of fish. In this regard, the analysis of the effectiveness of the use of minerals of natural origin in the feeding of age-1+ carp, primarily aimed at determining the level of profitability of their introduction into the main diet.

Thus, the profit from cultivation was calculated as the difference between the market value of the grown products and the total value of fish feed, feed additives and fish seeds used for cultivation, as these costs are basic. Other total farm costs cannot be divided on these experimental ponds due to their small area, so we consider them equal in all variants, as ponds of the same area with the same amount of fish stocked for farming were used.

The cost of feed per 1 kg of grown products was the lowest in Experiment 2, where fish were fed with a feed supplemented with analcime — 17.9 UAH. In Experiment 1, these costs amounted to 19.2 UAH, in Experiment 3 —18.8 UAH. In Control, this amount was 19 UAH (Table 3).

Table 3. **Economic efficiency of using feeds supplemented with saponite, analcime and bentonite when growing age-1+ carp**

Fish group		Control	Experiment 1	Experiment 2	Experiment 3
Pond area, ha		0.5	0.5	0.5	0.5
Fish yield, kg		191	195	210	196
Feed costs*, UAH.	Combined feed	3620	3620	3620	3620
	Saponite	-	116	-	-
	Analcime	-	-	132	-
	Bentonite	-	-	-	66
	Total	3620	3736	3752	3686
Feed costs per 1 kg of obtained product, UAH		19	19.2	17.9	18.8
Fish seed costs**, UAH		1750	1750	1750	1750
Market cost of obtained product***, UAH		9550	9750	10500	9800
Attributable profit (based on feed and fish seed costs), UAH /ha		4180	4264	4998	4364
Profit relative to Control,%		-	2.0	16.4	4.2

Note: * — feedprice — 4 UAH/kg, saponite — 3.5 UAH/kg, aanalcime — 4.0 UAH/kg, bentonite — 3 UAH/kg, ** — fishseedprice — 35 UAH/kg, *** — tablefishprice — 50 UAH/kg.

The obtained conditional profit from cultivation was divided by the area of ponds and the highest profit was obtained in Experiment 2 — 4998 UAH/ha, which was 16.4% higher than the Control. In Experiment 2 the conditional profit was 4264 UAH/ha, which was 2% more than the Control, in Experiment 3 — 4364 UAH /ha, which was 4.2% more than the control.

The calculations showed that each of the additives added to the diet of carp had an effect on increasing the profitability after their use. However, supplementation withanalcimewas the most effective and promising for carp feeding.

CONCLUSION AND PERSPECTIVES OF FURTHER DEVELOPMENT

The study showed a positive effect of the supplementation of fish feed with 3% saponite, 3% analcime and 2% bentonite on growing age-2+ carp in pond conditions on fish survival rate, fish productivity and economic efficiency.

Hydrochemical parameters during the experiment were satisfactory, but there was some increase in chloride concentration and permanganate oxidation during the growing season.

When supplementing the fish feed forage-1+ carp with bentonite (Experiment 3), the fish survival rate was the highest: 69.1% versus 64.2% in the control group. At the same time, the highest fish productivity of ponds was in Experiment 2 when supplementing the feed with analcime that exceeded the values of Experiment 1 and Experiment 3 by 12.7 and 9.9%, respectively. Compared to the Control, fish productivity in this experimental pond was higher by 13.4%, which indicates the advisability of using analcime in carp feeding.

Use ofsaponite, analcime and bentonite in the feeding of age-1+ carp, the profit in creased by 2, 16.4, and 4.2%, respectively, compared to the control group.

Thus, summarizing the results of the experiment, the most promising among the studied additives may be the use of 3% analcime in a balanced feed in the feeding of age-1+ carp during the growing season that allows increasing overall fish productivity of ponds, reducing feed costs and gaining additional profits.

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