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PRODUCTION AND MARKETING OF COMPOUND FISH FEED FOR CYPRINID FAMILY FISH FARMING

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Abstract. This article is dedicated to the organization of the production and marketing of compound fish feed in the North-Western region of Azerbaijan for pond fish farms that are growing carp and plant eating fish (family *Cyprinidae*). The aim of our research was to study ways of a possible increase in production capacity in existing carp (*Cyprinus carpio*) ponds in the North-West region of Azerbaijan by changing the composition of compound feed and feeding technology during their cultivation. We carried out the production of an experimental batch of compound feed for carp fish at the Girkhbulag farm for the cultivation of rainbow trout (*Oncorhynchus mykiss*), located in the city of Sheki, Azerbaijan Republic. For a comparative assessment of the effectiveness of the produced experimental versions of compound feeds in two ponds of private fisheries in the city of Zagatala, their production test was performed. Fifteen days after the start of testing, pond fishing was performed and the growth rate of experimental fish from both ponds was compared.

The compound feed, by using the new formula, makes it possible to reach good results when planting density is between 2-5 thousand pieces of yearling carps per 1 ha. Also, the fish capacity grows on average from 2 to 3 tons from 1 ha, providing up to 2 additional tons of marketable carp from a 1 hectare pond. Using the compound feed instead of wheat has the potential to provide an additionally 2,800 manats income from 1 hectare of pond area. Considering that the pond area in the country is 4000 hectares, farmers can potentially earn an additional 11,2 million manats per year.

Keywords: *compound feed, carp ponds, traditional food, growth rate, fish capacity.*

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1. Introduction

Nutrition is the basis of the life of any organism. The nutritional value of feed can be evaluated from a purely biological and physiological point of view. From a biological point of view, the nutrition should be affordable in size and in the necessary concentration so that the fish can consume it without significant energy costs. And from a physiological point of view, nutrition should be acceptable in terms of organoleptic properties (taste and smell) and color, have a chemically complete structure, be easily digested and assimilated in maximum quantities, and provide all the energy and plastic needs of the body, its maximum growth rate during normal development (Sklyarov *et al*., 1984; Ostroumova, 2001; Mamedov *et al*., 2009).

When developing new recipes for starter compound feeds for young valuable commercial fish, the main task is to improve their composition using a new effective feed material (Bondarenko, 1985; Scherbina & Gamigin, 2006), as well as balancing the total composition of nutrients, fractional composition of protein, lipids, essential fatty acids available for the absorption of carbohydrates (Abrosimova, 1997). The

development of more effective artificial feeds based on the physiological needs of different age groups of farmed fish, as well as the organoleptic properties of individual components, is an important element in the cultivation of fish in industrial enterprises.

This article is dedicated to the organization of the production and marketing of compound fish feed in the North-Western region of Azerbaijan for pond fish farms that are growing carp and plant eating fish (family *Cyprinidae*).

The initial monitoring of carp farm operations conducted in the northwestern part of the country has discovered that activities of those fish farms are not always efficient. Fish density is not up to international standards nor is growth rates. The key reason for the low-density (600-800 units per hectare) is the lack of feed and/or unplanned, random fish feeding.

Traditional fish feeding utilizes primarily wheat or barley only and as a result the fish growth is limited to the natural fish capacity of those ponds. The result is low carp production originating from ponds, reaching approximately 0.5-0.8 t/ha. According to the international best practices of carp pond stocking the density rate should average 2,5-4 t/ha. Overall this means that the fish businesses are not able to make profit sufficient to cover their expenses.

It should also be noted that wheat and barley contain high levels of carbohydrates, and their consumption by carp reduces the rate of muscle growth, while increasing the overall fat content in the body and the mortality rate. In addition, greasy carp is of lower quality and therefore has a lower market price.

The aim of our research was to study ways of a possible increase in production capacity in existing carp ponds in the North-West region of Azerbaijan by changing the composition of compound feed and feeding technology during their cultivation.

2. Materials and methods

Initial monitoring of the activities of carp farms in the North-West region of Azerbaijan and the production of an experimental batch of feed were carried out by us in 2011. We carried out the production of an experimental batch of compound feed for carp fish at the Girkhbulag farm for the cultivation of rainbow trout (*Oncorhynchus mykiss*), located in the city of Sheki, Azerbaijan Republic. The farm already had a compound feed mill, which required only minor improvements to ensure the production of the necessary compound feed.

The feed production equipment for production of fish food consists of a raw material receiver, mixer/blender, granulator and assembly line. The installation's capacity was assessed at 1.2 tons of feed production an hour, with energy consumption of 65 KWatt/hour. The line lacked the necessary sizing equipment for production of 3.2mm, 4.5mm, and 6 mm diameter compound feed.

Additional equipment was also delivered to cover the compound feed with a thin layer of oil in order to minimize the contact of the granules with water, thereby protecting the nutritional properties of the feed and improving its quality.

According to an objective the feed granules must be produced in sizes relative to the age and size of the fish being fed to ensure a proper mix of ingredients and for improved digestibility.

Table 1. Describes the optimal size of the compound feed granules as determined by the weight of the carp

Fish weight, grams	Granule size, mm	Granule code
10-40	3.2	7
40-150	4.5	8
150-500	6.0	9
over 500	8.0	10

Table 2. Separate recipes of compound feed for growing carp in ponds were introduced and produced

Components by %	Option № 1	Option № 2
1	2	3
Soy meal	25	18
Sunflower meal	30	10
Corn meal	15	17
Barley	6	24
Wheat	5	21.5
Yeast.	-	2
Grass meal	5	4
Fish flour	3	2
Meat-bone flour	-	1
Wheat bran	10	-
Lime	1	-
Premix	-	0.5
Total:	100	100
Nutritional values in %:		
Protein	27.1	21.2
Fat	1.9	2.3
Fiber	8.2	6.0
Calcium	0.8	0.5
Phosphorus	1.1	1.2

After according the carp feed recipes we covered the sources of raw material supply for feed production and their prices, terms and conditions for delivery to the farm. A number of raw material suppliers were also contacted to check on availability.

Table 3. Indicates approximate prices of carp feed ingredients necessary for production

Feed Components	Price manat/kg	Option № 1		Option №2	
		% Ingredient / Kg Feed	Total Price in manats	% Ingredient / Kg Feed	Total Price in manats
Soy meal	0.57	25	14.25	18	10.26
Sunflower meal	0.60	30	18.00	10	6.00
Corn meal	0.40	15	6.00	17	6.80

Barley	0.40	6	2.40	24	9.60
Wheat	0.35	5	1.75	21.5	7.53
Yeast	3.00			2	6.00
Grass meal	0.15	5	0.75	4	0.60
Fish flour	1.50	3	4.50	2	3.00
Meat-bone flour	0.60			1	0.60
Wheat bran	0.23	10	2.30		
Lime	0.10	1	0.10		
Premix	6.00			0.5	3.00
Subtotal components:		100	50.05	100	53.39
Energy consumption			0.40		0.40
Salaries and wages			0.33		0.33
Taxes			1.10		1.20
Communication			1.00		1.00
Subtotal operation costs:			52.88		56.32
Distributor, 15%			7.92		8.45
Total: price for 100 kg of feed		60.80		64.77	

The table above demonstrates that Option 1 is more attractive for potential consumers, both in terms of nutrition and for the price at just 0.61 Manat per 1 kg.

For a comparative assessment of the effectiveness of the produced experimental versions of compound feeds in two ponds of private fisheries in the city of Zagatala, their production test was performed. The number of fish and their average weight in each pond were identical. In one pond, experimental fish were fed with traditional food (wheat) (Option I), and in another pond, fish were fed with the compound feed we made (Option II). Using special instruments, constant monitoring of the hydrochemical parameters of water ($t^{O}C$, pH, O_2, NO_3, NO_2, and NH_4 +) was carried out in both ponds.

Fifteen days after the start of testing, pond fishing was performed and the growth rate of experimental fish from both ponds was compared. As the main indicators for the bulk selection, we used the mass of fish (W, g), the total biological length (L, cm) and the fatness coefficient according to Fulton (F, units). These indicators are the main criteria for a qualitative assessment of farmed fish. Obtained data were processed by the standard methods of the statistical analysis (Lakin, 1973) and software package Stadia is used.

3. Results and Discussion

Hydrochemical analysis showed that the saturation of water with oxygen in the upper layers of water in both ponds during the study period ranged from 9.1 to 10.2 mg/l. The active reaction of the medium (pH) from a slightly alkaline - 8.7 shifted to a neutral - 7.6. The concentration of nitrite nitrogen did not exceed 0.01 mg/l, and the concentration of nitrate and ammonium nitrogen amounted to a maximum of 0.9 mg/l and 0.1 mg/l, respectively.

In order to more accurately determine the nutrient composition of the compound feed according to the formula of “Number 1”, a test was conducted using special software. After processing the software provided the following data about the composition of the compound feed (Table 4).

Table 4. Composition of carp compound feed using special software

Components	Number 1 % ingredient / Kg feed
Soy Meal	25
Sunflower Meal	30
Corn Meal	15
Barley	6
Wheat	5
Grass flour	5
Fish flour	3
Wheat bran	10
Lime	1
Total	100
Raw protein	27. 561
Fat	1. 457
Cellulose	10. 965
Ashes	6. 836
Calcium (Ca)	0. 694
Phosphorus (P)	0. 925
Potassium (K)	1. 402
Chlorine (Cl)	0. 098
Sodium (Na)	0. 056
Lysine	1. 318
Methionine	0. 523
Gross energy	2695. 800 kcal
Digestible energy	2277. 350 kcal

As of this report the mill in Girkhbulag has been re-inspected, and feed ingredients have been purchased in preparation for the pond tests. The most current price is represented in the table below (Table 5).

Table 5. Optimal prices of carp feed ingredients necessary for production

Feed Components	Price per 1 Kg in Manats	% Ingredient / Kg Feed	Total Price in Manat
1	2	3	4
Soy meal	0.70	25	17. 25
Corn	0.45	15	6. 75
Barley	0.40	6	2. 40
Wheat	0.35	5	1. 75
Grass flour	0.10	5	0. 50
Fish flour	1.60	3	4. 80
Wheat bran	0.35	10	3. 50
Lime	0.20	1	0. 20
Total:		100	52 .40
Used electricity			0.40
Salary			0.33
Tax			1.10
Communication			1.00
Total			52.88
Distributor, 15%			8. 00
Total: price per 100 kg of feed			63. 23

Table 6. Price comparison analysis

№	Locally produced feed (Manat/kg)		Imported Feed (Manat/kg)	
1	Cost of produced feed	0,53	Price of feed according to exporter's rate cards	0,91
2	Price of produced feed	0,63	Sales price of feed in Azerbaijan	1,9
Difference: 1,27 Manat/kg				

4. Conclusion

For sample purposes the Girkhbulag mill produced 100 kilograms of compound feed for carp using the wet milling method in 3 sizes, according to the requirements of the fish by age groups. The compound feed samples were then packed into relevant packages according to their calibration (4.5 mm, 6 mm and 8 mm) and were delivered to fish- breeders/farmers. The compound feed was distributed to farmers for sample testing on their own fish. Overall production volume of Girkhbulag feed mill is 8 - 10 tons of feed per shift (10 hours).

In the future, the formula of the compound feed, both for cultivation of fry and marketable fish, can be changed and improved by adding components as such as peas, hydrolytic yeast, sunflower oil, fish fat, premix, antioxidants, and others. But the main condition is that, the feed must be as inexpensive as possible, but of sufficient quality for the fish to want to eat it and have the rates of gain necessary to improve profits.

The purpose of the compound feed is to cultivate two year old marketable carp in ponds, provided that natural foodstuffs will continue to make up at least 10-15% of the carp's diet. The compound feed, by using the new formula, makes it possible to reach good results when planting density is between 2-5 thousand pieces of yearling carps per 1 ha. Also, the fish capacity grows on average from 2 to 3 tons from 1 ha, providing up to 2 additional tons of marketable carp from a 1 hectare pond. The table below compares cultivation of carp using traditional wheat with the new, compound feed, without taking into account the other uncontrolled expenses (Table 7).

Table 7. Comparative results of carp cultivation using traditional and new compound feed

Names	Feeding with wheat	Feeding with compound feed
Planting of yearling carp, pieces/ha	1000	3000
Average weight of a yearling carp, g	100	100
Total weight of the planting material, kg	100	300
Wastage for the period of cultivation, %	10	10
Output of marketable carp, pieces	900 2700	
Average weight of the marketable carp, kg	1	1
Total weight of the marketable carp, kg	900	2700
Feed consumption perl kg growth offish, units	5	3.5
Total feed consumption, kg	4500 9450	
Price per 1 kg of feed, manats	0.35	0.63
Total price of feeds, manats	1575	5953

Price of 1 kg of the marketable carp, manats	4	4
Selling price of the marketable carp, manats	3600	10800
Profit, manats	2025	4847
Difference, manats		+ 2822

As seen from the table, using the compound feed instead of wheat has the potential to provide an additionally 2, 800 manats income from 1 hectare of pond area. Considering that the pond area in the country is 4000 hectares, farmers can potentially earn an additional 11,2 million Manats per year.

Recommendation for the phase two

The major requirement in this assignment has been accomplished. Girkhbulag fish farm has successfully produced a good quality carp feed sample. The second step is testing the compound feed in an independent and unbiased pond enterprise in Sheki-Zagatala region. As mentioned, two nearly identical ponds should be allocated and the same type of fish should be weighed and released into these ponds for testing. All interested regional farmers should be invited to participate in the initial weighing process. Pond A will be fed the regular feeds that farmers are accustomed to feeding, and pond B will be feed the newly produced compound feed. After 1.5-2 months the testing period will be finished and farmers will be invited to witness the results at the demo farm. At that meeting all information about the types of feed, their ingredients, nutritional value and price/cost will be provided to the farmers. Fish will be sample counted and weighed again to see the difference between feeding patterns. Based on the results of the test, the final conclusions and recommendations for using this compound feed in pond enterprises throughout the country will be issued to the industry and other interested parties.

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