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Адреса для переписки:

65039, Odessa, str. Kanatnaya 112



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B. IEGOROV, Dr of Science, Professor, Department of Feed and Biofuel Technologies  
 L. FIIHURSKA, PhD, Associate Professor, Department of Feed and Biofuel Technologies  
 M. TERZI, O. RUHLENKO, Master degree student, grain and grain business department  
 Odessa National Academy of Food Technologies, Odessa, Ukraine

## THE CHARACTERISTIC OF COMPOUND FEEDS FOR CLARIAS GARIEPINUS

### Abstrakt

The article states that industrial fish farming in inland waters has become increasingly important in the recent years and it is one of the sources for satisfying the needs of people in the high-protein foods. The fish meat is an extremely rich source of proteins, which are easily digested, vitamins, polyunsaturated fatty acids, macro- and microelements. One of the priorities of the development of the fish farming in Ukraine is the cultivation of the *Clarias gariepinus*. *Clarias gariepinus* or African sharp-tooth catfish is a species of catfish of the family Clariidae, the air-breathing catfishes. In 2017, with the support of the Ukrainian State Agency, the Institute of Fisheries of Ukraine on the part of the state and the companies Vismar Aqua, Aquaprom and the Dutch company Trouw Nutrition («Skretting»), the program was developed to increase the cultivation of the *Clarias gariepinus* under the name *Clarias gariepinus* - 2020. The objective of the program is to provide 2020 tons of *Clarias gariepinus* until 2020. Today, the production of the *Clarias gariepinus* in Ukraine is about 500 tons per year; about 50 farms are engaged in cultivation. That is why the production of balanced domestic compound feeds for *Clarias gariepinus* is an important task of the feed industry of Ukraine.

The theoretical study was devoted to the problem of the production of compound feeds for the *Clarias gariepinus*. The nutritional value of compound feeds for *Clarias gariepinus* depends on the stage of the life cycle of this species of fish. The above world leaders are manufacturers of compound feeds for *Clarias gariepinus*, the analysis of granule size and nutritional value of compound feeds on the content of crude protein in prestarting, starting, growth and finishing periods respectively. The requirements for the content of essential and non-essential amino acids, minerals (micro and micronutrients), water and fat soluble vitamins and restrictions on the content of crude fiber are given. Indicated the main and additional raw materials, traditionally used in the manufacture of data feed advanced companies. The main components are fish meal, produced under relatively low drying conditions, wing meal, corn and wheat gluten, soy products, by-products of extraction oil and press production oil (soya, sunflower and other cakes and meals), premix, carotenoids like astaxanthin. The feeding programs of the *Clarias gariepinus* of various manufacturers have been analyzed and their own feeding program has been developed for this species of fish; it divides the period of cultivation of the *Clarias gariepinus* into prelaunch, starting, growth and finishing ones. For prestart mixed feeds, the content of crude protein should be at least 45%, raw fat at least 12%, raw fiber not more than 1.8%, gross energy not less than 13.7 MJ, raw ash not more than 8%. For starter feed, the content of crude protein should be at least 42%, raw fat at least 12%, raw fiber not more than 3%, gross energy not less than 13.1 MJ, raw ash not more than 9.5%. For grower's feeds, the content of crude protein should be at least 38%, raw fat at least 12%, crude fiber not more than 3%, gross energy not less than 12 MJ, raw ash not more than 9.5%.

**Key words:** compound feed for *Clarias Gariepinus* or African sharp-tooth catfish, feed manufacture technology for *Clarias Gariepinus*'s feeds, requirements for *Clarias Gariepinus* feeds.



## Introduction

Inland industrial fish farming has become increasingly important in recent years and is one of the sources to meet the needs of people in high-protein foods. Fish meat is a very rich source of proteins (18.4%), which are easily digested, vitamins (groups B, C, E, D), polyunsaturated fatty acids, macro- and micro elements.

The structure of fish production in Ukraine is shown in Fig. 1. Catfish occupies 0.5%. Tacon A. (2008) notes that in freshwater aquaculture, the main fish species that are gaining ever-growing production are tilapia - 17% and carp fish - 15% [1].

European aquaculture is dominated by salmon, sea bass, sea bream, carp, but a significant increase was due to more valuable species of fish, in particular, plaice, tuna and sturgeon. Carp is the dominant species in Central and Eastern Europe (75% of total production) [1].

According to expert estimates, more than 30,000 tons of catfish are currently produced annually in the countries of Central and Eastern Europe, including 900 tons in Russia, 2000 tons in Bulgaria, 700 tons - in Romania, 800 tons - in Ukraine, in Belarus - 300 tons, in Poland - 2000 tons, in Moldova - 300 tons, in other countries: Baltic (Latvia, Estonia, Lithuania), Hungary, Czech Republic, Slovakia, about 2000 tons [2].

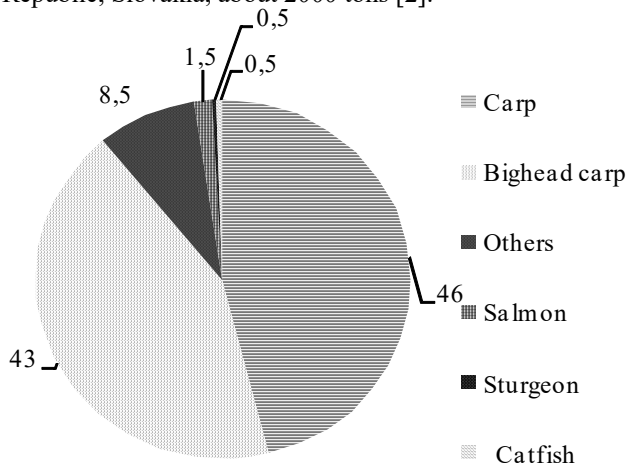


Fig. 1 Structure of fish production in Ukraine

In 2017, with the support of the State Agency, the Institute of Fisheries of Ukraine on the part of the state and the companies Vismar Aqua, Aquaprom and the Dutch company Trouw Nutrition (TM Skretting), a program was developed to increase the cultivation of the culinary catfish under the name "Clarium catfish – 2020". The objective of the program is to provide 2020 tons of Clarium catfish by 2020 [10]. *Clarias gariepinus* or African sharp-tooth catfish is a species of catfish of the family Clariidae, the air-breathing catfishes [17].

Today, the production of the Clarium catfish in Ukraine is about 500 tons per year, about 50 farms are engaged in cultivation. In the Kiev region is a farm with a capacity of 50 tons per year. Clarium catfish are grown on this farm using the ARS technology (aquaculture recycling system), which creates optimal conditions for the rapid growth of fish. Each month, 5 000 catfish fry are delivered to the farm from the Odessa region [11].



## Purpose and objectives of the analysis

The advantages of cultivating of Clarium catfish are as follows: it easily adapts to the basin growing conditions, has high resistance to oxygen deficiency, the ability to grow at high planting density, has high resistance to water turbidity, simple reproduction, simple and profitable feeding programs, high disease resistance [3].

## Analysis of the literature data

For farming the catfish catfish feeds are needed. A certain assortment of catfish fodder feeds is on the market, but most of them are of foreign production. Therefore, the domestic market requires the development of domestic production technology and recipes of compound feeds for *Clarias Gariepinus*. The use of imported feed hinders the development of domestic fish farming, making it dependent on customs policy, exchange rate fluctuations, etc.

The physical properties of mixed feeds for fish are characterized by such indicators as size, moisture content level, durability, bulk weight, angle of repose, etc. To date, feeds for *Clarias Gariepinus* are produced in extruded and granulated form. Pasty feeds for fish were made in the 70s of the 20th century, but due to the high (up to 50%) leaching of nutrients with water, they were not used.

The length of the granules for all numbers of groups should not exceed 1.5 diameters. The fragility of the granules is not more than 8%, water resistance not less than 25 minutes [5, 7, 8]. The size of the pellets (crumbles) of feed depends on the body weight of the fish [9].

Also, assessing the quality of animal feed for the soma indicate the mass fraction of protein, fat, ash, fiber, calcium, phosphorus, lysine, methionine and cysteine, some vitamins, the presence of metallomagnetic and harmful impurities, pest infestation [5, 7, 9, 14].

In the production of animal feed and take into account the habits of this fish. For *Clarias Gariepinus*, feed must be floating, because this type of fish eats from the surface of the water, as a rule [18].

The size and chemical composition of the feed differs depending on a number of factors. Depending on the weight of the fish, you should choose the size of the feed pellets: for example, for fry up to 80 g, feed with



dimensions of 3 mm is produced, and 1 kg of individuals need pellets of 5-6 mm. Differs feed for young and adult individuals in composition. The amount of feed consumption depends on the age of the fish and the water temperature.

Young fish, having a high growth rate, require a higher concentration of protein in the feed than older age groups, which is associated with a decrease in the potential for fish to grow with increasing body size [15].

The value of fats in the feeding of *Clarias Gariepinus* is determined by their high calorie content compared to other nutrients, however, this does not exhaust their biological significance. The physiological usefulness of fats depends on the composition and availability of fatty acids and vitamins.

Since energy and plastic metabolism are two sides of the same process, the need for fat and protein are interrelated - the higher the protein content in the feed, the more fat must be [6].

The modern requirements of *Clarias Gariepinus* in amino acids (Table 1), minerals (Table 2), the water and fat soluble vitamins (Table 3) were analyzed.

**Results and discussion**

It was considered the current programs for feeding of *Clarias Gariepinus* (firms Aquarex, Ananda Group, Clarias). They represent the latest advances in science in the field of fish feeding, practice and advanced technologies for the production of animal feed. The authors analyzed the feeding programs for *Clarias Gariepinus*, on the basis of which the following conclusions can be drawn (Fig. 2, Table 4):

- all feed manufacturers use feeding programs that differ in growing periods and nutritional value of feed;

- modern feeding programs mainly divide the catfish breeding period into pre-start, start, grower's and production (finisher's);

**Table 1 - Requirements of *Clarias Gariepinus* in amino acids [12, 16]**

% protein	Requirements	
	1993	2011
Arginin	1,20	1,20
Histidine	0,42	0,60
Isoleucine	0,73	0,80
Leucine	0,98	1,30
Lysine	1,43	1,60
Methionine	-	0,60
Methionine+Cystine	0,64	0,90
Phenylalanine	-	0,07
Phenylalanine+Tyrosine	1,40	1,60
Threonine	0,56	0,70
Tryptophan	0,14	0,20
Valin	0,84	0,80

**Table 2 - Requirements of *Clarias Gariepinus* in minerals [12]**

%	Requirements	
	1993	2011
<b>Macroelements, %</b>		
Calcium	-	0,45h
Chlorine	-	0,17
nesium	0,04	0,04
Phosphorus	0,45	0,33
Potassium	-	0,26
Sodium	-	0,06
<b>Microelements, mg/kg</b>		
Copper	5	5
Iodine	1,10E	1,10
Iron	30	30
Manganese	2,4	2,4
Selenium	0,25	-
Zink	20	20

**Table 3 - The needs of *Clarias Gariepinus* in water and fat soluble vitamins [12]**

Name of vitamin mg/kg dry matter	Requirements	
	1993 year	2011 year
<b>Water-soluble vitamins</b>		
Thiamine	1	1
Riboflavin	9	9
B6	3	3
Pantothenic acid	15	15
Niacin	14	14
Folyat	1,50	1,50
Choline	400	400
Ascorbic acid C	25-50	15
<b>Fat-soluble vitamins</b>		
Vitamin A, mg/kg	1000-2000	0,6
Vitamin D, mg/kg	500	12,5
Vitamin E mg/gk	50	50

- or fish of the same age within the same manufacturer make feed, which differ in nutritional value (Table 4),

- note the tendency to a decrease in the content of crude protein with an increase in the body weight of *Clarias Gariepinus*.

The composition of compound feed recipes for catfish include up to 18 components with a content ranging from 0.02% (medicinal components, antioxidants) to 55% (fish meal) (Table 5) [8, 9, 13].

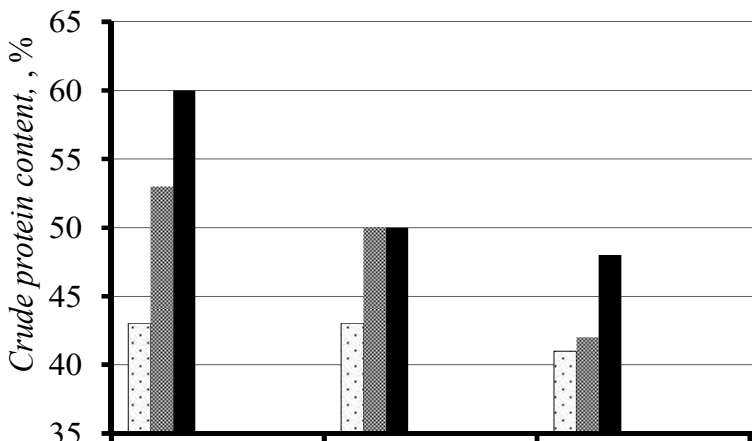


Fig. 2 - Content of raw protein in recipes for mixed feed for *Clarias Gariepinus* depending on the growing period (own research)

Table 4 - Nutrient content in recipes of feed of the growing growth period for *Clarias Gariepinus* from various manufacturers

Indicator	Coppens	Multi	Zeigler	Vital	Rannau
Crude protein, %,	42	45	44	45	42
Crude fat, %,	13	12	10	11	12
Crude fiber,%,	2,5	2,5	2,0	2,8	2,5
Crude ash,%,	6,7	8,5	-	5,0	6,0
Phosphorus, %	0,9	1,2	-	1,1	0,8
Calcium, %	1,0	1,2	-	2,7	1,3

Table 5 – Components of mixed feeds for *Clarias Gariepinus* fish of different manufacturers [13,19].

№	Name	Ingredients
1	Skretting	low-temperature fish meal, squid flour, gluten (wheat and corn), corn, fish oil, soy flour, soy concentrate, hemoglobin, linseed oil, rapeseed oil, premix, amino acids;
2	AQVAREX	low-temperature fish meal, blood meal, wheat, soybean meal, pea protein, wheat germ, choline chloride, fish oil, premix;
3	Aller Aqua	low-temperature fish meal, fish meal "Digestor", krill meal, offal, soy flour, wheat, vegetable oil, fish oil, gluten, vitamins, mineral supplements, immunostimulants, astaxanthin, cakes.

In order to meet the specific needs of the organism of catfish in nutrient and biologically active sub-

stances, on the basis of the analysis of the feeding programs of the world's leading feed manufacturers and the recommendations of scientists, our own feeding program for the *Clarias Gariepinus* was developed. According to it, the use of four periods of *Clarias Gariepinus* feeding is envisaged: pre-start, start, grower and finishing period.

For prestart mixed feeds, the content of crude protein should be at least 45%, raw fat at least 12%, raw fiber not more than 1.8%, gross energy not less than 13.7 MJ, raw ash not more than 8%.

For starter feed, the content of crude protein should be at least 42%, raw fat at least 12%, raw fiber not more than 3%, gross energy not less than 13.1 MJ, raw ash not more than 9.5%.

For grower's feeds, the content of crude protein should be at least 38%, raw fat at least 12%, crude fiber not more than 3%, gross energy not less than 12 MJ, raw ash not more than 9.5%.

### Conclusions

In the article, it is noted that cultivation of the *Clarias Gariepinus* has significant prospects both in the world and in Ukraine, the advantages of cultivation of the *Clarias Gariepinus* in Ukraine are investigated. The requirements of

water and fat-soluble vitamins, minerals (microelement and macro elements and amino acids, features of feed recipes are analyzed. The feeding programs of the *Clarias gariepinus* of various manufacturers have been analyzed and their own feeding program has been developed for this species of fish; it divides the period of cultivation of the *Clarias gariepinus* into prelaunch, starting, growth and finishing ones. For prestart mixed feeds, the content of crude protein should be at least 45%, raw fat at least 12%, raw fiber not more than 1.8%, gross energy not less than 13.7 MJ, raw ash not more than 8%. For starter feed, the content of crude protein should be at least 42%, raw fat at least 12%, raw fiber not more than 3%, gross energy not less than 13.1 MJ, raw ash not more than 9.5%. For grower's feeds, the content of crude protein should be at least 38%, raw fat at least 12%, crude fiber not more than 3%, gross energy not less than 12 MJ, raw ash not more than 9.5%. The main components are fish meal, produced under relatively low drying conditions, wing meal, corn and wheat gluten, soy products, by-products of extraction oil and press production oil (soya, sunflower and other cakes and meals), premisex, carotenoids like astaxanthin.

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Б.В. ЄГОРОВ, д-р техн. наук, професор, член-корр. НААНУ,  
Л.В. ФІГУРСЬКА, канд. техн. наук, доцент,  
кафедра технології комбікормів і біопалива,

М. ТЕРЗІ, О. РУХЛЕНКО, студенти ОКР «Магістр», Факультет зерна і зернового бізнесу  
Одеська національна академія харчових технологій, м. Одеса

## **ХАРАКТЕРИСТИКА КОМБІКОРМІВ ДЛЯ КЛАРІЄВОГО СОМУ**

### **Анотація**

У статті зазначено, що промислове рибицтво на внутрішніх водоймах набуло в останні роки усе більшого значення і являється одним із джерел задоволення потреб людей у високобілкових продуктах харчування. М'ясо риби є надзвичайно багатим джерелом білків, які легко засвоюються, вітамінів, поліненасичених жирних кислот, макро- і мікроелементів. Одним з пріоритетних напрямків розвитку рибицтва в Україні є вирощування кларієвого сому. У 2017 році за підтримки Держрибаземства, Інституту рибицтва господарства України із сторони держави та компаній Vismar Aqua, Акванром та голландської компанії Trouw Nutrition (TM Skretting) була розроблена програма з нарощування об'ємів вирощування кларієвого сому під назвою «Кларієвий сом — 2020». Завдання програми – забезпечити 2020 т кларієвого сому до 2020 року. Сьогодні виробництво кларієвого сому в Україні становить близько 500 т на рік, вирощуванням займаються приблизно 50 ферм. Саме тому виробництво збалансованих вітчизняних комбікормів для сомових рыб є важливим завданням комбікормової промисловості України.

Теоретичне дослідження було присвячено проблемі виробництва комбікормів для кларієвого сому. Поживна цінність комбікормів для кларієвого сому залежить від етапу життєвого циклу даного виду рыб. Наведені світові лідери-виробники комбікормів для кларієвого сому, проведено аналіз розмірів гранул та поживної цінності комбікормів за вмістом сирого протеїну у престартовий, стартовий, ростовий та фінішний періоди вирощування відповідно. Наведено вимоги до вмісту основних замісних та незамінних амінокислот, мінеральних речовин (мікро та мікроелементів), водо- та жиророзчинних вітамінів та обмеження до вмісту сирової клітковини. Зазначено основну та додаткову сировину, яку традиційно використовують при виробництві даних комбікормів передові фірми. Основними компонентами є рибна мука, виготовлена за порівняно низьких режимів сушіння, крилева мука, кукурудзяний та пшеничний глютен, соєві продукти, побічні продукти олії екстракційного та олії пресового виробництва. Проаналізовано програми годівлі кларієвого сому різних виробників та розроблено власну програму годівлі даного виду рыб, що поділяє період вирощування кларієвого сому на передстартовий, стартовий, ростовий та продукційний.

**Ключові слова:** комбікорми для кларієвого сому, технологія виробництва комбікормів кларієвого сому, вимоги до комбікормів для кларієвого сому.

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65039, Odessa, str. Kanatnaya 104, r. A 224.



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A.V. MAKARYNSKA, PhD. Sc., Associate Professor,  
N.V. VORONA, PhD. Sc., Associate Professor,  
Department of Feed and Biofuel Technologies  
Odessa National Academy of Food Technologies, Odessa, Ukraine

## USING OF BIOTESTING IN SAFTY ASSESMENT OF THE EXTRUDED FEED ADDITIVE WITH ALGAE

### Abstract

The article is devoted to the problems of determining quality and safety of extruded feed additive (EFA) with algae. It is used in the production of mixed feed and premixes.

It is proved that the safety of finished food products depends on the safety of feed and feed raw materials. The list of conditions for obtaining safe finished products is given. Today traditional methods of analytical chemistry, express and toxicological methods (marking, biotesting) are used for the analysis of feed safety.

The expediency of use of brown algae in the composition of feed products is substantiated. The brightest representative of brown algae is *Laminaria*. The technology of using *Laminaria* algae in the composition of feed products in the form of extruded feed additive is proposed.

The method of determination of organicity by methods of biotesting is given: biocrystallization method, determination of the oxidation-reduction potential index (ORP), organicity using *Colpoda steinii* culture. Indicators of organicity are given.

An analysis of experimental samples biocrystalograms suggests that EFA is environmentally safe and do not endanger the environment or the health and life of animals and humans. When determining the ORP of the EFA with algae it was established that the product is easily digestible, since it has a biological compatibility with the animal organism.