

# STUDY ABOUT SUPERIOR VALORIFICATION OF FISH BY CONSERVATION

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## Abstract

The study refers to fish breeds raised in freshwater polyculture that have a low value and can be capitalized by processing. The activity of processing the *Hypophthalmichthys nobilis* specimens from Bârca acumulation (Iasi) was studied during a period of 3 years and revealed the fact that by processing the less valuable fish breed, there is registered a consistent profit. The fish paste, practically, increased the fish farm productivity by over 20% reaching 58.9% and it had a contribution of 28.9% to 49.5% to the total profit. By creating a brand for the farm's products, a new niche market has been reached and an unexpected profit was obtained during the winter, when the farm recorded only maintenance expenses.

**Key words:** freshwater, paste, polyculture, productivity

## INTRODUCTION

In Romania, fish processing is a traditional activity within the fisheries sector, having an important role in the processing of fish material obtained through fishing and aquaculture in order to make better use of the raw material, to ensure a wide range of fish products for consumers and to achieve added value by processors (Wheaton, 1985).

Each year, the fish varieties obtained from processing are more diversified and the presentation form is substantially improved.

The fish is processed in the form of decapitated fish, eviscerated, ported, threaded, salty, smoked, marinated and salads. The largest quantities of products are represented by salads, smoked products, marinated products, followed by primary processed fish (beheaded, eviscerated, ported, threaded) (A.I.B., 2017).

Fish, like other aquatic animals, is one of the most perishable products, the unpleasant smell of altered fish being nothing more than a sign that the proteins have decomposed, generating amines and ammonia (Nicolae, 2002).

Processing fish in fish farm units is like big release because it brings a plus value to

farms for breeding material. In addition to a minimal profit by selling fish, both freight and population, there is also an additional income by processing the fishery material in the form of canned or semi-preserved (smoked, marinated, paste, tab, salty, frozen, etc.) (Döring, 2012)

## MATERIAL AND METHOD

The biological material used for recovery in this study is head carp, *Hypophthalmichthys nobilis*. *Hypophthalmichthys* is a genus of fish that is part of the Cyprinid family and comprises 3 species: *Hypophthalmichthys nobilis* - head carp, *Hypophthalmichthys molitrix* - silver carp and *Hypophthalmichthys harmandi* – a species that does not exist in our country.

The head carp has a high growth rate, making it one of the most exploitable fish in aquaculture, along with silver carp. Unlike common carp, these species of fish are feeding by filtering water, consuming both zooplankton and phytoplankton. Their commercially available value for consumption causing their export from China, native country in over 70 countries. Today, head carp and silver carp can be found in wild waters in Europe, South and North America, India and other regions. Both species are considered in many areas invasive species (Döring, 2012, Haye, 2014).

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The *Hypophthalmichthys nobilis*, besides other species in polyculture were grown in Bârca accumulation, that has 18 acre of water surface, with a volume of 342.000 m<sup>3</sup> of water with an usable volume of 252.000 m<sup>3</sup> (fig. 1).



Fig. 1 Accumulations of Mînjești and Bârca (google.maps)

Bârca fish farm is located at 12 km from the center of Iasi, being on the map of two communes, Miroslava and Mogosesti Iasi. The farm was established in 2009, the first year in which it was populated with *Ctenopharingodon idella*, Romanian carp, *Hypophthalmichthys molitrix* and *Hypophthalmichthys nobilis* being 2010.

For the period that was studied, 2017-2019, at the surface of 18 ha of water, there is an increase in cargo production of 10%, registered in 2018-2019 (tab. 1), which was recorded due to the environmental conditions, independent by farm fishery activities. The only species used for processing where the

*Hypophthalmichthys nobilis* (head carp) and the *Hypophthalmichthys molitrix* (silver carp), trying to capitalize on the cheapest material.

Table 1 Evolution of cargo fish production over 3 years

Specification	Years to study		
	2017	2018	2019
Production area (ha)	18	18	18
Recorded production (kg/ha)	1,450	1,500	1,650
Total (kg)	26,100	27,000	29,700

The highest yields were obtained from carp (62-68% of cargo fish species), followed by head carp (22-27% of total cargo fish species) (tab. 2).

In 2017 and 2018, head carp was harvested intensively to be used in processing for sale in the form of fish paste, smoked and fillets and, as a result, in 2019 there was an increase in the population of silver carp, compared to the total fish population.

For the actual sale of the commodity fish, only the species head carp, silver carp and pikeperch were sorted, the carp being capitalized as a commodity in a percentage of 25%, and the difference was released in the accumulation intended for sport fishing.

Table 2 Dynamics of fish production by species, for the years of study

Specif.	Years of study					
	2017		2018		2019	
	kg	%	kg	%	kg	%
Carp	16,182	62	18,360	68	20,196	68
Head carp	7,047	27	5,940	22	7,128	24
Silver carp	2,088	8	2,430	9	6,831	23
Perch	783	3	270	1	297	1
Total	26,100	100	27,000	100	29,700	100

Table 3 Species harvested and capitalized, for 3 years

Specification	Studied Years					
	2017		2018		2019	
	Price/kg	Income	Price/kg	Income	Price/kg	Income
Carp	2	94,184	2	20,320	4	57,040
Head Carp	8	6,376	9	3,460	10	9,400
Silver Carp	8	6,704	9	1,870	0	4,300
Perch	5	1,745	20	400	2	940
Total Income	-	279,009	-	301,050	-	46,680

### Working method

In 2017, it was produced and launched on the market "Head carp paste", a traditional

product. The technological flow took place within the farm. In addition to the head carp paste, on our existing customers request, the

fish material was also processed into two products: smoked fish and fish fillets. The existing customers were the fishermen from summer time (sport fishing).

The finished product, "Head Carp Paste", was adapted as an image, but also in terms of content to meet market demand for the appearance of the product, but also the need for preservation for as long as possible.

The raw material used to produce the paste consisted of head carp specimens from Bârca fish farm with body weights ranging from 4-10 kg per specimen.

Thus, when harvesting the fish material, which took place in September-October, depending on atmospheric conditions, were chosen the specimens that will go through the entire technological flow in order to manufacture the head carp paste.

In order to harvest large and very large specimens, in Bârca fish farm, the harvest is done with a net with the following characteristics: length of 150 m and width of 2 m, made of polyamide mesh with a wire thickness of 1.2 mm and the size of the side of the mesh of 100 mm.

After harvesting, only the specimens exceeding the length of 50 cm were chosen, somatoscopically, to follow the technological procedures, appreciating, by following the experience in the fishing field, the fact that they will exceed the body weight of 4 kg (Nicolae, 2012). Sorting is performed by specialists who harvested, manually, in the accumulation bed, the selected specimens being transported to the processing line in

special tubs, made of aluminum, with a capacity of 150 l and with perforations of 2 cm in diameter over the entire surface that allowed the handling of biological matter in optimal conditions. (Nathan, 2000)

The cleaning and evisceration procedures take place within the farm, outside, at a maximum temperature of 12-13 °C. The fish, being a poikilothermic animal, has a body temperature determined by the ambient temperature, and in order to preserve its morphological qualities and to postpone some physico-chemical and microbiological changes, such as muscle rigidity which is installed within 2 hours of capture, following that, in 24 hours, to install the autolysis state, these procedures, always, take place outdoors (Radu, 2013).

Scaling is the next procedure applied to the biological material, which takes place inside the farm, the processing line being installed outside and having a stainless steel table with a thickness of 1 mm, with drain grate, outlet and flange of 10 cm, having a length of 1.8 m and a width of 0.7 m. (fig. 2).

Scaling is the operation performed by a single person, who will carry out all the following procedures, until the finished product (Stroia, 2002). The cleaning process is done with a cleaner for fish scales, made of stainless steel with a length of 22.2 cm (fig. 3). The removing of scales is done by fixing the fish on the polyethylene table top and performing firm and repeated movements, in the opposite direction of scales position, from tail to head.



Fig. 2 Stainless steel fish preparation table



Fig. 3 Scale cleaner

The fish is rinsed with a jet of water, removing any traces of residue and scales, in order to be eviscerated (guttet).

For evisceration is used a special knife (fig. 4) for threading fish, with a blade of at least 21 cm in order to be able to complete the threading process, considering the dimensions of the fish material. Thus, the actual

evisceration begins by sectioning the abdomen of the fish. The fish is layed with the head targeted to the left hand and the abdomen toward the operator, the tip of the threading knife is inserted into the anal orifice and the abdomen is sectioned to the heart. The operator is taking care that the incision is not too deep in order to avoid damaging the

bowels. After sectioning, the hand is inserted inside the abdominal cavity, immediately above the heart, walking with your fingertips on the contour of the ribs, behind the bowels, you hold the contents firmly in your hand, and press with your thumbs to detach the heart while squeezing in the palm and pulling in the opposite direction, to the tail, to carefully remove the bowels (Bykowski, 1996). This is followed by cold water rinsing of the fish carcass. Specimens thus eviscerated are placed in transparent plastic boxes with lids, 0.8 m long, 0.5 m wide and 0.5 m deep, and transported 6 km to continue the manufacturing processes of head carp paste.



Fig. 4 Threading knife

The portioning process takes place at an ambient temperature of 22-23°C, using as working materials the eviscerated and washed head carp, a shredder and the threading knife (Stroia, 2002). Threading begins by removing the head: with the left hand hold the specimen firmly, and with the knife blade go on the contour of the opercular apparatus starting between the first two vertebrae of the spine, including the pectoral fins. (fig. 5).

After removing the head, cut the caudal part perpendicular on the direction of the anus so that it passes through the vertebrae. The caudal fin is removed by cutting the tissue in a straight line around the spine and then twisting it without crushing the bones (fig. 6).



Fig. 5 Head removal



Fig. 6 Removal of the caudal fin

Then the dorsal, ventral and anal fins are removed, then the trunk is divided once more into two equal parts (Jiang, 2018). The aim is for the fillets to be large (fig. 7), using to the maximum the capacity of the container for boiling, so that the deboning process can be performed as quickly, easily and correctly as possible.

From the trunk thus portioned, the spine is removed, following with the knife blade the straight line of the spine, detaching the ribs from it on both sides (fig. 8). The same procedure is applied to both sides of the trunk, but also to the caudal, passing here with the blade of the knife parallel to the spine (fig. 9).



Fig. 7 Final portioning



Fig. 8 Spine removal



Fig. 9 Spine removal - caudal area

The fillets thus obtained are passed through a stream of cold water and then weighed with a kitchen scale which has an accuracy of 0.001 g (fig. 10).

The capacity of the pot in where the boiling process took place is 6 liters, being operational with 3 kg fillets, that were positioned on a cooking device with a diameter of 20 cm (fig. 11) inside the pressure cooker. The device has the role of keeping the fish on the surface of the water, carrying out a steaming, without damaging the organoleptic



Fig. 10 Electronic precision balance 0.001g

qualities of the finite product. The water used is still water bottled in an amount of 0.5 l, without other additions. It was used bottled still water because it has a known content of chemical composition. Mains water may be contaminated, within the limits of references, but that were not accepted in the processing of fish, being possible on presenting nitrites, nitrates and other elements that describe its hardness and can influence the quality of fish meat that boils long before these elements are removed by boiling (Jiang, 2014).

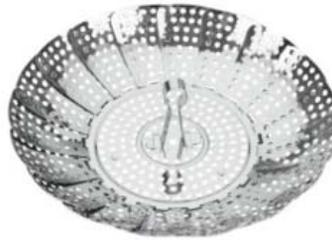


Fig. 11 Cooking device

The pot used has a capacity of 6 l, it is set following a boiling at 120°C, 2 bars pressure, 5 minutes heating, 20 minutes boiling and 5 minutes slow depressurization (program 11) (fig. 12).



Fig. 12 Pressure cooker

its color, about 20 minutes, depending on the variety of the onion.

By the end of the onion cooking process, the pot in which the fish was boiled has been depressurized, and the fish has cooled and can be deboned. If the fish is cooling to room temperature after it was boiled, it will dry and will be hard to sort and debone. Thus, before getting to room temperature, using a pair of anti-cutting gloves (fig. 13) and bone tweezers (fig. 14), the fish will be easily deboned.

Meanwhile, weigh 2 kg of onions, with the same scale used to weigh the fish. It is cleaned, washed and then cut, by hand, into cubes of the right size and as equal as possible, a very important aspect when cooking the onion. All these actions need a close look in order to obtain a perfect consistency and an uniform appearance, without color differences that affect the taste of the finite product.

Tempering the chopped onion is done in a liter of good quality oil and it takes until the onion becomes just glassy, without changing



Fig. 13 Anti-cutting gloves



Fig. 14 Bone tweezers

After boning, the fish is minced once with an electric shredder (fig. 15), with a power of 2200 w, maximum chopping capacity of 4.3 kg/minute, through a sieve with 3 mm holes. Immediately after chopping, the fish is incorporated with cooked onions and 400 g of broth. Spices, salt and bay leaves are added to taste. The composition is mixed until it becomes homogeneous, has a bright color, a pleasant smell and a dense consistency, without being sticky. The composition is left on low heat until the oil rises on its surface.

The jars were placed, for initial sterilization, in the oven at a temperature of 120°C at least 2 hours before the process of filling them with paste. Basically, the oven was loaded with jars, positioned horizontally, with the mouth open, before initiating the process of threading the biological material (A.I.B. 2017).



Fig. 15 Electric shredder

After the oil rose above the composition, the jars were filled and closed. This operation took place in these conditions: the composition was boiling, and in the oven the temperature did not decrease by more than 1°C and only when one container (jar) was removed. To maintain these conditions, the operator removed a container from the oven and closed its door each time, and the composition was mixed before each action of filling the jars to keep the same temperature throughout the paste.

After being sealed, the jars filled with paste are placed in the sterilizer, that has a capacity of 34 pieces, the temperature is set at 100°C and time is set at 60 minutes (fig. 16). The sterilizer is switching off automatically, and the next day, after the jars have cooled down, they are labeled.



Fig. 16 Sterilizer

The jars were sealed at the time that the lids were closed because of the high temperature they were operated. In other words: both, the jars and the composition had a packaging temperature that did not fall below 90-100°C. This being confirmed when closing the jars and the lids being pulled inwards, with the corresponding noise, and the composition still boiling inside the containers.

The label form chosen was the one with the label attached on a hemp thread around the lid, thus leaving the jar exposed for high visibility on the product. On the label were written the ingredients, the date of packaging, that coincides with the date of manufacture, the expiration date, the storage conditions, before and after opening, and the contact details of the manufacturer (fig. 18).



Fig. 18 Label – front view



Fig. 19 Label – back view

In the attempt of preserving the quality of the product, "Head Carp paste", its large-scale production was not considered an option, remaining on a level of production that only balances the income to expense ratio during the winter. There was calculated that the profit from processing the head carp to cover the expenses with the farm maintenance in the cold season, and the profit exceeded the expectations and the estimation. Performing a simple evaluation, it was found that 0.188 kg of head carp, prepared with 0.11 kg of onion, 0.04 kg of sun-flower oil and 0.001 kg of broth (tab. 4) bring a considerable increase, both financially and operationally.

Table 4 Quantities of ingredients needed to produce a jar of "Head Carp Paste"

Ingredients (kg)				Quant. of finit product (kg)
Head Carp	Onion	Sun flower oil	Broth	0,314
0,188	0,11	0,04	0,001	

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## RESULTS AND DISCUSSIONS

The three years studied are the years when head carp was processed, so in 2017 there was a profit from "Head Carp Paste" of only 15032.5 because it was produced only 7 weeks, starting in October. The year 2018 has the highest profit because the processing was performed during 18 weeks: 9 in January-March and 9 in October-December,

and in 2019, the profit decreases, the paste being produced only 9 weeks, during January- March (tab. 5).

Table 5 Annual income from merchandise and processed fish – Head carp species

Head carp annual profit			
Year	2017	2018	2019
H.c. production (kg)	7047	5940	7128
Price H.c./kg (Lei)	8	9	10
H. c. income (Lei)	56376	53460	59400
H.C. costs (Lei)	22551	21384	23760
Profit H.c. (Lei)	33825	32076	35640
Profit H.c. Paste (Lei)	15032,5	31500	14515
<b>TOTAL PROFIT</b>	<b>48857,5</b>	<b>63576</b>	<b>50155</b>

The processing of fish took place only in the cold season, in the hot season there were sport fishing activities. In 2017, were packed 1195 jars of paste. Knowing the quantity of head carp used to produce a jar of paste (tab. 4), the total quantity of head carp used to produce 1195 jars is calculated, resulting a total of 224.66 kg.

The same calculation was applied for 2018, resulting a quantity of 423 kg head carp, and 2019 with 197.4 kg of head carp.

Table 6 Annual profit from Head Carp Paste

Annual receipts for H.c. Paste			
Year	2017	2018	2019
Receipts (Lei)	19218	39600	18400
Production costs (Lei)	4182,5	8100	3885
Profit (Lei)	<b>15032,5</b>	<b>31500</b>	<b>14515</b>

Table 7 The amount of fish used to produce "Head Carp Paste" during the studied years

Year	2017	2018	2019
Number of packed jars	1,195	2,250	1,050
Amount of fish used	224.66	423	197.4

The costs of processing head carp in paste are represented by the investment in raw materials, wages, electricity, ingredients, packaging and distribution of the finite product. Considering these variables, the cost values per kg of paste produced and packaged, as well as per jar, were established.

There was registered an increase in costs from year to year, but one explanation in this regard is that in 2017, being the first year when it was tried to capitalize on fish material by processing it, managing a completely new sector of activity and start processing in October, only 1195 jars were produced for sale. However, a profit of 5.8 lei/jar was recorded

The following year, comprising both 9 weeks in spring and 9 weeks in autumn when the product "Head Carp Paste" was marketed, the receipts are commensurate and the costs are relevant. During the autumn was invested more in packaging, changing the model of the jars and the way of presentation (thematic packaging for different holidays).

Table 8 Costs structure for head carp production

Costs	Fix	Wages	Electricity	Fuel	Harvest	Obs.
(%)	20%	30%	23%	15%	32%	Costs/kg
2017	0.64	0.96	0.74	0.48	1.03	3.22
2018	0.72	1.08	0.82	0.54	1.15	3.6
2019	1	1.5	1.15	0.75	1.6	5

Regarding the costs for 2019, the high level of investment in packaging was maintained and it occurred only in the spring (9 weeks) explaining the high level of the costs value.

The profit per fish kg recorded for the new commodity, during the studied period, presents a typical situation: when the production is lower, the price tends to

increase and the profit as well. The situation arose as a result of entering the market in the previous year, with products that met consumer requirements and increased demand. Wholesale, in 2018, were minimized, this being practiced with additional transportation costs and low prices, and retail sales, directly from the farm, dictated the level of profit.

Table 9 Costs structure for head carp production

	Raw material	Wages	Electricity	Ingredients	Package	Distribution	Costs	
(%)	18	30	28	5	8	11	Per kg	Per jar
2017	3,14	5,23	4,88	0,87	1,39	1,92	17,42	5.80
2018	3,60	6,00	5,60	1,00	1,60	2,20	20,00	6.60
2019	4,99	8,31	7,76	1,39	2,22	3,05	27,70	9.25

Table 10 Profit per fish cargo kg

Year	2017	2018	2019
Cargo Head carp profit	33,825	32,076	35,640
Quantity of head carp capitalized	7,047	5,940	7,128
Profit per fish kg	4.79	5.4	5

The profit per kg of processed fish of 66.91 lei, in 2017, brought us in front of a clear evolution of incomes compared to the profit per kg of cargo fish of only 4.79 lei. Thus, out of 224.66 kg of head carp, with the selling price of 8 lei, by processing there was registered a profit of 66.91 lei per fish kg,

even if the head carp was processed only in autumn.

The year 2018 has the highest profit, but it is due to the same cause: the processing took place only in the spring of 2019, in autumn, the head carp sales remaining the only way to capitalize on the fish material.

Table 11 Profit per processed fish kg in studied years

Year	2017	2018	2019
„Head carp paste”profit	15,032.5	31,500	14,515
Amount of h.c. used in processing	224.66	423	197.4
Profit per fish kg	66.91	74.46	73.53

The profit per fish kg recorded for the new commodity, during the studied period, presents a typical situation: when the production is lower, the price tends to increase and the profit as well. The situation arose as a result of entering the market in the previous year, with products that met

consumer requirements and increased demand. Wholesale, in 2018, were minimized, this being practiced with additional transportation costs and low prices, and retail sales, directly from the farm, dictated the level of profit.

Table 12 Profit (%) over the 3 studied years

Year	2017	2018	2019
Head carp Profit (Lei)	33,825	32,076	35,640
„Head Carp Paste” Profit (Lei)	15,032.5	31,500	14,515
Total Profit (Lei)	48,857.5	63,576	50,155
% profit head carp	69.24	50.5	71.1
% „Head Carp Paste”	30.76%	49.50%	28.9%

In 2018, a full year in terms of farm fishing integration with the activity of processing head carp in paste, the percentage of profit from the sale of the finite product is only one percent different from the profit of head carp cargo.

## CONCLUSIONS

The conclusion of the activity carried out during the three years is that it added value to a cheap fish species and there were receipts during the "dead" period of the fish farm. In cold months of the year the fishing season is closed and the farmers record only costs with the maintenance of the farm.

The head carp specimens were used for processing as paste and smoked fish, but for fresh fish fillets were also used silver carps, in order to capitalize on the cheapest material.

There was created a brand for paste and the other products and it was named „Fisherman's airs and graces” („Fițe de pescar”). At first, there were accepted changes to the recipe from the loyal customers, represented by pond fishermen. These changes regarded only the seasoning intensity of the product. During the 6 months

that the paste was produced and sold, "airs and graces" were also accepted from customers who got in contact with the product at the fairs where it was presented.

The fish paste, practically, increased the fish farm productivity by over 20% reaching 58.9%

The fish paste had a contribution of 28.9% to 49.5% to the total profit.

The entire amount of head carp would be suitable for the preparation of fish paste and a profit of over 200% would be obtained.

In order to increase the profit, it would be possible to switch to a small-capacity production line and buy raw materials from other producers.

The resulting waste from the evisceration of head carp was mixed with fish fodder, by own recipe, and was successfully reused, thus reducing the impact on the environment.

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