

# Directions for the Use of *Palaemon adspersus* Shrimp in Food Technology

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**Abstract:** *Palaemon adspersus* shrimp is a type of raw material that is affordable in terms of value and resources in the domestic market due to the industrial production in the Azov-Black Sea basin. The chemical composition of *Palaemon adspersus* shrimp characterizes it as a valuable source of high-protein and dietary products, which determines the feasibility of substantiating the directions of use in food technology and complex processing. Analytical and patent monitoring of the domestic fish market indicates a limited range of *Palaemon adspersus* shrimp food and biological additives. The production of food and biological additives from domestic raw materials requires systematic research, which is currently absent in Ukraine. That is why the production of *Palaemon adspersus* shrimp food and biological additives, common in the Azov-Black Sea basin, is one of the most promising areas for raw material use. Based on the evaluation of the conducted research, recommendations on the technologies of production of fishery food based on shrimp *Palaemon adspersus* are offered. This will make it possible to realize more fully the nutritional potential of valuable protein-containing raw materials, to rationally use the domestic raw material base of hydrobionts, as well as to expand the range of fishery products with a rationalized amino acid and mineral composition.

**Keywords:** *Palaemon Adspersus* Shrimp, Fish Semi-finished Products, Quality Forming, Technology

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## 1. Introduction

The production of *Palaemon adspersus* shrimp food and biological additives, common in the Azov-Black Sea basin, is one of the most promising areas for the integrated use of small-scale raw materials. Analytical and patent monitoring of the domestic market for fishery products indicates a limited range of food and biologically valuable additives from shrimp *Palaemon adspersus*, while, according to the Institute of Fisheries and Ecology of the Sea, shrimp stocks in the Black Sea are 370 thousand, in Azov - 250 thousand tons [1].

It should be noted that shrimps *Palaemon adspersus* of the Azov-Black Sea region are small, their size and mass characteristics fluctuate within 41-63 mm and 0.5 - 2.1 g [2].

For the production of foodstuffs and biologically valuable additives from domestic raw materials, systematic scientific research is needed, which is currently absent in Ukraine or dates back to the 1960s and 1970s [3].

At the same time, *Palaemon adspersus* shrimps are a type of

raw material that is affordable in terms of value and resources in the domestic market due to the industrial production in the Azov-Black Sea basin. The chemical composition of *Palaemon adspersus* shrimp characterizes it as a valuable source of high-protein and dietary product, which determines the feasibility of substantiation of the directions of use in food technology and complex processing and is one of the primary factors of forming the quality of the finished product, characterized by the content of complete proteins, essential vitamins, fatty acids [4].

As the main fishery raw materials for the production of fish semi-finished products (dumplings) and finished products (fish sticks), the Azov-Black Sea goby, characterized by low content of lipids - 1-2.5%, high content of high-grade proteins - 16-18% and mineral elements - calcium, Phosphorus. The above indicators characterize the goby as a valuable source of high-protein, low-fat and dietary product and determine the feasibility of its processing for use as a protein-mineral enrichment, flavoring ingredient in the production of fishery products, in particular in the mass and social nutrition segment.

It will allow to expand the directions of rational use of domestic small fish raw materials and biologically valuable non-fish seafood [5-6].

Thus, the purpose of the study is to substantiate the directions of use in the food technology of the Azov-Black Sea

species of shrimp *Palaemon adspersus* for the development of food and biological value-optimized combination of fish semi-finished products (ravioli) and finished products (fish sticks).

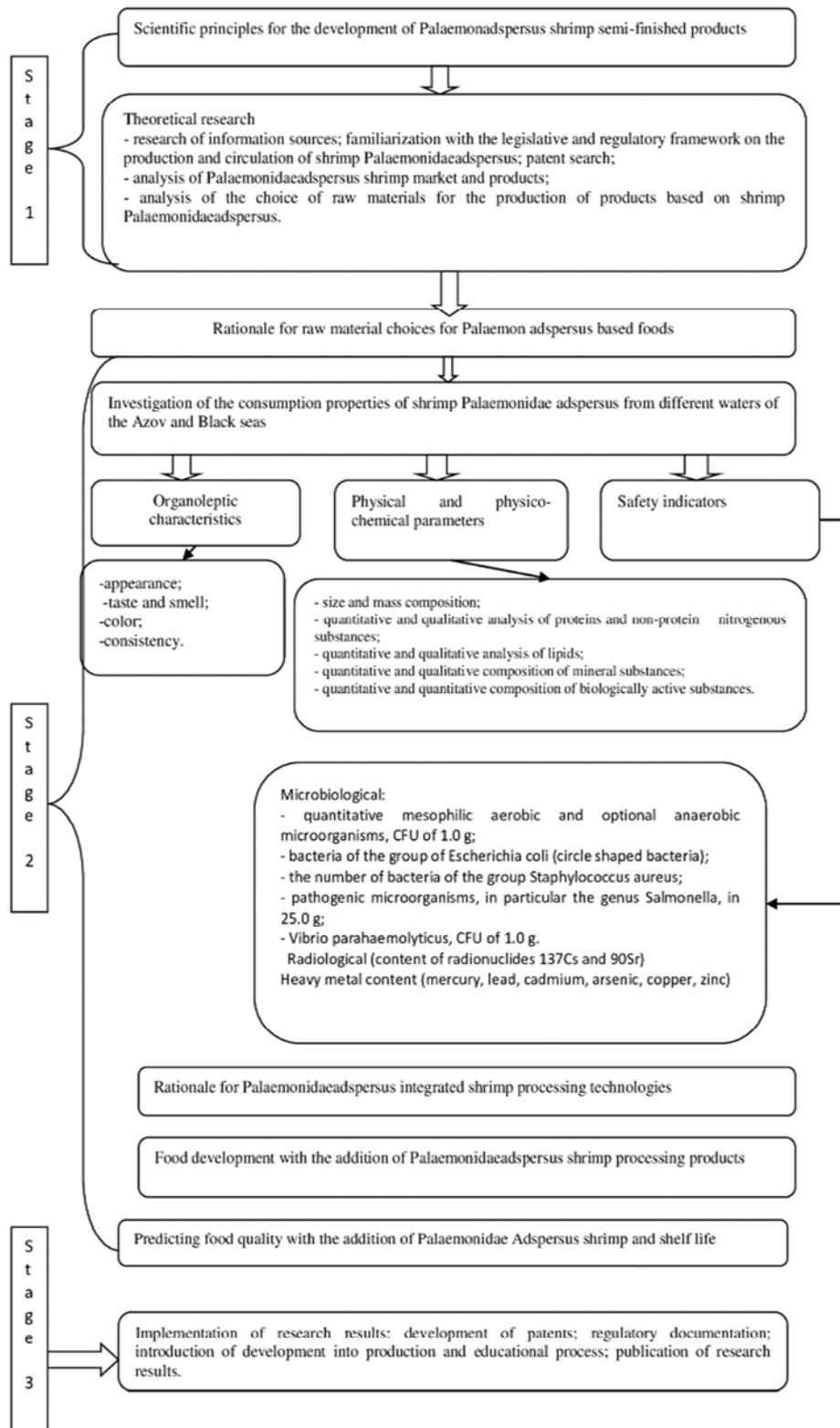


Figure 1. Scheme of research.

## 2. Material and Methods

Object of the study - Foods with the addition of *Palaemonadspersus* shrimp (coastal catch during September - October 2019, Lazurne village of Kherson region), containing:

1. frozen fish food stuffing (composition: stew of Azov-Black Sea, nutritional value: protein - 18%, fats - 1% (SOU 15.2-37-37472282-787: 2011), produced by LLC BARK (Berdyansk, Zaporizhzhya region.);
2. dough - drinking water, table salt, wheat flour of the highest grade;
3. egg powder - plays the role of plasticizer in the formation of minced meat;
4. Swan's salt (main ingredients: salt, blueberry (Ucho-suneli), garlic, fennel seeds, coriander seeds, hot red pepper, wild or mountain caraway seeds, Seteron saffron (cloves, saffron, cauliflower, honeysuckle) seasoning for fish dishes and salting.

The studies were carried out in several stages, taking into account the factors of formation of the quality of the finished product (Figure 1):

Organoleptic studies of frozen fish food forcemeat were carried out according to the complex characteristics of the raw material under study and the feasibility of using *Palaemonadspersus* shrimp to improve the sensory characteristics and functional properties of *Palaemonadspersus* shrimp processing products was proved [7].

In accordance with the scientific concept, the formation of consumption properties of new fishery products was carried out on the basis of the principles of food combinatorics, the requirements of the science of nutrition, and provided for the determination of the optimal ratio of minced goby of the Azov-Black Sea and shrimp *Palaemonadspersus*, the selection of structure-forming components, and the selection of their influence on the product, optimal processing modes.

Statistical and mathematical models are constructed by the methods of multivariate experiment. Variable factors - components of the recipe for semi-finished products (dumplings) and finished product (fish sticks) have been identified. Variational components varied depending on the type of predicted formulation [8].

The statistical processing of the semi-finished studies was performed according to the procedure in Excel.

## 3. Results and Discussion

The first stage of experimental studies involved the determination of structural-mechanical (boundary strength, ultimate stress, density) and sensory quality indicators of *Palaemon adspersus* shrimp to substantiate the technological functionality of food production.

The sensory analysis of shrimps made it possible to conclude that shrimps caught by the method of coastal fishing - whole, pure, one size group, in color - white with pink-orange hue, have a dense and juicy consistency,

characteristic, pronounced smell and pleasant, characteristic boiled shrimp taste [3].

Based on a set of previous studies, we determined that the average value of the *Palaemonadspersus* shrimp meat density was 1.03 g / cm<sup>3</sup>. It should be noted that in accordance with the recommended data of FAO, the density of whole-cooked shrimp with a shell is 0.58 g / cm<sup>3</sup>, whole-cooked shrimp without a shell - 0.77 g / cm<sup>3</sup> [9].

Thus, the resulting *Palaemon adspersus* meat density exceeds the recommended FAO [10]. This indicates changes in the consistency of the meat and the concentration of solids due to freezing and storage for 1 month. Therefore, the density of the *Palaemonadspersus* shrimp meat is an important quality indicator that must be taken into account when optimizing storage and transport modes, and the shelf life of seafood.

According to the results of the research, data were obtained regarding the tensile strength in the range  $3541.2 * 10^{-3} - 6420.9 * 10^{-3} \text{ H} / \text{m}^2$ . This is a proof that the smaller the size of the shrimp meat, the lower its consistency. Thus, shrimps <30 mm in size are characterized by less ductile, deformable strength, which must be taken into account in food technology.

As a result of the study of the adhesive properties (PA) and the modulus of elasticity (n / mm<sup>2</sup>) of shrimp meat with different size and mass characteristics, it was found that small size shrimp are susceptible to less sticking (adhesion  $\approx 4000 - 12000 \text{ PA}$ ) and resistance at deformations (modulus of elasticity  $\approx 2.0 - 3.5 \text{ n} / \text{mm}^2$ ), that is, they are characterized by lower elastic properties. Accordingly, it can be concluded that small shrimp is advisable to be used in combination for the production of biologically valuable nutritional supplements.

At the same time, to create high quality food and biologically valuable additives from *Palaemon adspersus* shrimp, it is necessary to deliberately influence their sensory properties in the uncertainty of the experiment. In this regard, the consistency of the cleaned shrimp meat was estimated by determining the shear stress, which indicates the strength of the meat structure when assessing its resistance to external forces leading to the destruction of the product under study.

According to the results of studies, the highest value of the shear stress modulus ( $1764 * 10^4 \text{ Pa}$ ) has the meat of large-sized cooked-frozen shrimps, which is characterized by a higher strength of the structure. At the same time, analysis of the results of the study of the shear stress indicates a low value of the indicator, which is explained by the heat treatment, freezing and moisture content of the product after thawing. Increasing the shear stress of the shrimp meat can be achieved by the method of drying the powder, which will make it possible to expand the range of production technologies for a wide range of products and food additives [9, 11].

It should be borne in mind that the chemical composition of *Palaemon adspersus* shrimp is one of the primary factors in the formation of the quality of the finished product, characterized by the content of high-grade proteins, essential fatty acids, vitamins and trace elements [12, 13].

It should be noted that the shrimp shell of *Palaemon adspersus* contains very valuable substances (protein - 70%,

chitin - 25%, calcium - 5%), which can be used in complex technologies to produce chitosan, glucosamine and protein hydrolysates [14, 15].

The next stage of experimental research is the formation of the consumption properties of fish semi-finished products with the addition of products of processing of shrimp

*Palaemon adspersus*. To this end, we identified promising areas for processing *Palaemon adspersus* shrimp - food uses: production of fish semi-finished products (dumplings) and finished products (fish sticks) with the addition of *Palaemon adspersus* shrimp processing products with an optimized ratio of ingredients (Table 2).

**Table 1.** Chemical composition of shrimp *Palaemon adspersus*.

Nutrient	Unit	Measure Content (on dry matter)
Proteins	%	17-20
Fat	%	0.1
Carbohydrates	%	4.5
Mineral elements, in particular:	%	1.7-1.8
- Fe (Fe)		19
- Copprum (Cu)		11
- magnesium (Mg), zinc (Zn)	mg /100 g	11
- phosphorus (P)		17
- Selenium (Se)		64
Vitamins:		
niacin (PP)		2.00
tocopherol (E)		2.30
thiamine (B1)	mg /100 g	0.06
riboflavin (B2)		0.07
Pantothenic acid (B5)		0.35
pyridoxine (B6)		0.10
retinol (A)		16.01
folic acid (B9)	mcg/100g	13.0
cyanocobalamin (B12)		0.85

**Table 2.** Factors of quality formation of fish semi-finished products with the addition of *Palaemon adspersus* shrimp.

Semi-finished products	Dumplings	Fish sticks
Model compositions	Proportions, shrimp / stuffing of Azov-Black Sea goby Energy value, kcal / 100 g 1:2 / 0,5	Proportions, shrimp / stuffing of Azov-Black Sea goby Energy value, kcal / 100 g 1:1,4 / 0,7
Option 1	216,5	23,4
Option 2	3:10 / 0,3 216,13	1:5 / 0,2 20,3
Option 3	1:5 / 0,2 216,5	1:6 / 0,17 23,4

Thus, in order to determine the dependence of the consumption properties and energy value of the semi-finished product and the finished product on the mass fraction of shrimp *Palaemon adspersus* in the recipe, they analyzed the nomenclature and characteristics of organoleptic samples.

Note that the taste and smell of dumplings after cooking in the hot state are pleasant, characteristic; minced must be juicy, can be moderately salty, with the aroma of spices, without foreign taste and odor, any foreign impurities.

At the same time, in order to substantiate the directions of use in the food technology of the Azov-Black Sea species of

shrimp *Palaemon adspersus* for the development of food and biological value-optimized combined fish semi-finished products (dumplings) and finished products (fish sticks), refining products were determined. of the studied samples and the rational ratio in the recipe for shrimp *Palaemon adspersus* and the Azov-Black Sea goby [4].

The solution to this problem involved determining the correlation coefficient between the energy value and the content of shrimp *Palaemon adspersus* and the steppe of the Azov-Black Sea for the investigated products of processing. For dumplings, the correlation coefficient is 0.97, which is positive and, according to the Cheddock table, with a strong

direct link, and therefore, with increasing the ratio of the studied components, the energy value of the processed products increases [5].

The correlation coefficient of the dry finished product (fish sticks) is a positive value (0.97) and is characterized by a direct correlation with a strong relationship between the ratio of the shrimp *Palaemon adspersus* and the bullhead of the Black Sea and the energy value of the product.

Thus, the *Palaemon adspersus* shrimp meat content of 5.75

- 8.38 g / 100 g of product is optimal for forming the best organoleptic characteristics of dumplings. For fish sticks, the optimal content of *Palaemon adspersus* shrimp meat is 12.12 - 33.33 / 100 g of product.

Based on the obtained data, a mathematical and statistical processing of the results was performed and the energy value of the dumplings was correlated with the ratio of *Palaemon adspersus* shrimp meat to that of the Azov-Black Sea bull.

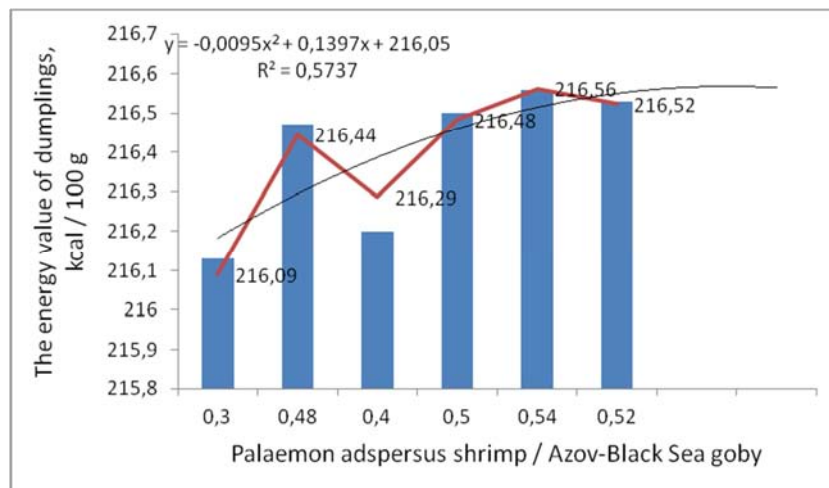


Figure 2. Dependence of energy value on the ratio of *Palaemon adspersus* / shrimp meat of Azov-Black Sea dumplings in dumplings.

From the graph it follows that the ratio of values in the range 0.48-0.52 is optimal for fish dumplings with the addition of shrimp *Palaemonadspersus* with high energy value.

Mathematical and statistical analysis of the results of the tested samples of dry fish finished product (fish sticks) determines the dependence of energy value on the ratio of *Palaemonadspersus* shrimp meat to that of the Azov-Black

Sea goby (Figure 3).

Therefore, the ratio of values in the range of 0.71 to 0.76 is optimal for fish sticks with the addition of shrimp *Palaemon adspersus* with high organoleptic characteristics.

The obtained regression equations can be used to predict the quality of fish processing products with the addition of *Palaemon adspersus* shrimp (respectively, dumplings, fish sticks).

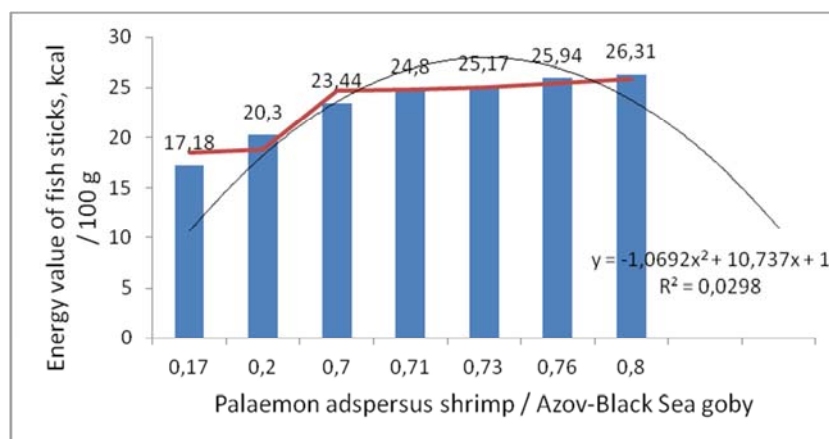


Figure 3. Dependence of energy value on the ratio of *Palaemon adspersus* / shrimp meat of Azov-Black Sea go by in fish sticks.

## 4. Conclusion

The article analyzed *Palaemon adspersus* shrimps as a promising raw material of the Azov-Black Sea basin and their impact on the quality of fish products.

Formed the consumption properties of fish semi-finished

products and finished food products with the addition of shrimp *Palaemon adspersus*. Determined promising directions of processing of shrimp *Palaemon adspersus* - directions of food use: production of fish semi-finished products (dumplings) and finished products (fish shrimp spices)

Recommendations are made on the technologies for the production of fishery products based on shrimp *Palaemon adspersus*. This makes it possible to fully realize the nutritional potential of valuable protein-containing raw materials, to rationally use the domestic raw material base of hydrobionts, as well as to expand the range of fishery products with improved amino acid and mineral composition.

It is determined that the optimal combination of ingredients for dumplings is the ratio of shrimp *Palaemon adspersus* and meat of the Azov-Black Sea goby within 0.8-0.42, for fish sticks - 12.12 - 33.33.

Combinations containing more than 30% of *Palaemon adspersus* shrimp meat for dumplings and more than 12% for fish sticks have been proven to have the highest quality.

The mathematical and statistical processing of the results of the study of the rods proves that the correlation coefficient and the regression dependence between the energy value and the content of the shrimp *Palaemon adspersus* and the steppe of the Azov-Black Sea for the investigated products of processing are positive.

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