# MARINE EPIBIOTA - PRODUCING AND USING TECHNOLOGIES

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**ABSTRACT**

The spontaneously developing epibiota in the Black Sea consists of organisms crowds (uni/pluricellular algae, protosoa, briosoa, molluscs, crustaceans etc.), which during their juvenile stages get fixed on the rigid surfaces in the water (natural or artificial), where their whole life cycle will unfold. The qualitative and quantitative structure of this epibiota differs depending on the existent environment conditions, but generally the bivalve molluscs prevail, with over 80% from the total biomass.

A modern and efficient technology for obtaining the marine epibiota in the Romanian costal area of the Black Sea is by arranging in the littoral sector, between the 10 – 15 m isobaths, of marine equipments – floating installations – capable to maintain in the water masses some suitable artificial supports, destined for the epibiont organisms to fix and grow.

In the Romanian Black Sea coast specific environment conditions, the marine epibiont organisms have an explosive development so they realise average biomasses of 6 – 8 kg of living biological material / m² on the support and ensure the obtain of a total biomass of approx. 3t / installation / culture cycle.

Due to the biodiversity of the organisms in the marine epibiota (approx. 30 species) it has a complex biochemical composition, comparable with the products of animal origin and a superior composition concerning essential bioactive compounds, amino acids, vitamins, enzymes and hormones, which can be valued in breeding animals, both in fresh and processed state.

The processing of the fresh marine epibiota in fodder flour has the advantage of conserving some nutritive qualities and of easy dealing with, but some restrictive parameters have to be taking care of – humidity, temperature, which can affect the quality of the product.

By administering 10% epibiotic fodder flour in the daily ration, the growing is influenced for chicken with +25,2 1%. The

supplementary feed hens with 5 and 10% epibiotic flour achieved growths with 9 and 1,2% higher.
The fats quantity in the yolk of the egg produced by the hens that were supplementary feed with 10% marine epibiotic flour, proved to have a low level. The cholesterol value dropped by 29%, the total fat acids reduced by 5,6 % and the triglycerides recorded lower levels by 13,4% compared to normal feed conditions.
The marine epibiota producing technology offers the possibility to obtain some substantially profits by using the so far unexploited marine surfaces and constitutes an ecological method, destined to improve the quality of the marine waters in the touristy areas by increasing the quantity of the epibiont biofilters.

**KEY WORDS:** marine epibiota, uni/pluricellular algae, protosoa, briosoa, molluscs, crustaceans, bivalve mollusks, floating installations, fodder flour

## INTRODUCTION

The notion of *marine epibiota* defines the total vegetal and animal organisms that in the juvenile stages fix on existent rigid surfaces in the water mass (naturals or artificial) where they develop their entire life cycle.

The marine epibiota that develops in the Black Sea is made of an agglomeration of organisms that belong to various systematic groups: uni- and pluricellular algae and invertebrates (protozoars, coelenterates, mollusks, crustaceans etc.). The qualitative and quantitative structure of this epibiota differs, according to the environmental conditions, but generally the bivalves are dominant, with over 80% biomass.

Due to the biodiversity of the organisms in the epibiota's structure (approx. 30 species) it has a complex biochemical composition, comparable with animal products and a superior content of bioactive essential compounds: aminic acids, vitamins, enzymes and hormones that can be used in zoo technologies and pharmaceutical industry.

From the basic biochemical compounds of the marine epibiota the proteins that can be assimilated over 80% are in the biggest quantities: 52 g digestible protein/fresh epibiota kg and 115 g digestible protein/dry at $65^0$C material.

Because of the known biotechnical qualities of the marine epibiota, in many countries around the Black Sea were made researches in order to use this bioresource as food additive for birds and animals.

The present paper presents the results of the research on the possibility to introduce and use in zoo technology of a new food additive, obtained by processing a natural marine bioresource – marine epibiota – that may cover the nutritional lacks of microelements and other bioactive compounds.

## MATERIAL AND METHOD

The marine epibiota that develops spontaneously develop on the rocky facies in the littoral zone represents an important component of the Black Sea's ecosystem and cannot be exploited because of the major role of natural biofilter of the coastal areas and the big exploitation costs.

Big quantities of marine epibiota can be obtained by applying some culture biotechnologies for bivalves, by this way ensuring a qualitative and quantitative stabile production, sure in time and with estimated costs, by using of an important marine resource – phytoplankton – in the coastal areas that are improper to other uses, by using marine equipments adapted to the hydro – meteorological conditions specific for the Romanian coastal zone of the Black Sea (URSACHE, 1993).

The producing of the marine epibiota imposes the realizing and installing in the water of some marine equipments specific for the major phases of the technological process, in thigh correlation with the biologic situation of the natural populations of organisms and the evolution of the hydroclimatc conditions in the area.

An efficient biotechnology for obtaining the marine epibiota in the Romanian costal zone of the Black Sea is the installation in the littoral sector, between the 10 – 15 m isobaths of some floating marine equipments capable to maintain suspended in the water mass the adequate artificial supports, destined for the fixation and grow of the epibiotic organisms.

The population with filtrating epibiont organisms of the artificial surfaces installed in the water is made naturally with larva from the reproducing of the mussels in the area. The high densities of the epibiont organisms that fix on artificial surfaces and their explosive grow ensure the obtaining of a biomass of 3t/instalation/culture cycle.

The marine epibiota producing technology on floating installations is also an ecological method for improving the quality of the marine waters in the sectors of big touristic importance, by using the epibiont biofiltrators.

When establishing the areas for installing the floating structures must be taken into consideration the possible alterations of the environment by pollution. The pollution destroys the equilibrium of the biotope, having effects on the exploitation of the biologic resources and endangering human health by contaminating the marine products.

The applying of this method will lead besides obtaining of a big quantity of marine epibiota, to the improvement of the marine water's quality in the area by increasing the quantity of epibiotic biofiltrators.

## RESULTS AND DISCUSSIONS

### Technical aspects of producing marine epibiota

The lack of natural shelters that could diminish the destructive force of the waves and the small amplitude of the tide in the Black Sea (about 11 cm, with an average period of 12 hours and 25 minutes) does not allow the placement directly on the substrate of some artificial collectors because during the violent storms the growing platforms can be destroyed or covered with sand and algae fragments.

The only accessible way to grow epibiont bivalves at the Romanian coastal zone of the Black Sea is the suspended breeding in the water masses on floating installations (URSACHE, 1993).

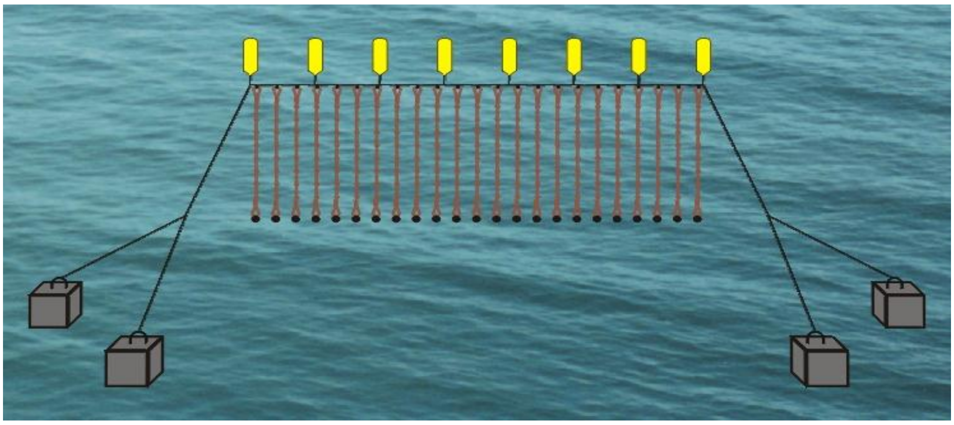


Fig. 1 - Floating installation equipped with artificial collectors

The breeding of the bivalves suspended in the water mass, where the phytoplankton food is more abundant imposes the realizing of some floating marine equipments which to maintain the populating material in immersion, at depths between 1 - 5 m.

In the hydrological conditions of the Romanian littoral of the Black Sea, floating installations were designated, for suspending in the water mass the artificial supports for breeding the epibiont bivalves. They were made of polyamide materials (PA relon ropes), and they were composed by two distinct parts:

- the anchored floating suprastructure;
- artificial supports suspended in the water mass.

When designing the marine equipments we take care to cancel the destructive force of the hydro meteorological factors – wind, marine currents, waves, substrate nature, through marine engineering elements: material resistance in the marine environment, floatability needs, anchoring system that will allow making a model of floating installation capable to resist to the environmental conditions (ADAM *et al.*, 1981; ANTON *et al.*, 1989; VOINIKANIS, 1954).

## The productivity of the floating installations in the pilot station

In the Romanian coastal area of the Black Sea the epibiont bivalves reproduce with variable intensities during the entire year. This is proven by the constant existence in the water masses, during the entire year, of a variable quantity of mussel larva.

Generally three moments of maximum abundance of mussel larva were observed, and these are: in May 2720 larva/$m^3$ in south and respectively 1361 larva/$m^3$ in north, in July 16444 larva/$m^3$ in south and respectively 3468 larva/$m^3$ in north and in September 4972 larva/$m^3$ in south and respectively 3035 larva/$m^3$ in north (MÜLLER, GOMOIU, 1987).

Under the aspect of larval stages structure, the mussel larva populations are represented through four main types: trocofore, veligere, veliconce and pediveliconce (having an asymmetrical shell and well developed foot), capable of fixation.

Starting from April, when the water temperature riches $8 \div 10^0$ C, an intensification of the reproduction occurs, marked through the presence of a big quantity of larva per cubic meter, compared to the previous months. More than 99% belong to the first developing stages.

Early in the spring, the trocofore larvas are dominant in plankton. Starting from May and until October, the first two categories have a big abundance, and this shows that the reproduction of the adults takes place continuously, though, the majority of the populations are formed by larva in advanced stages of development – veliconca and pedveliconca.

It results that during the cold season, the developing period from egg to pedveliconca including, lasts for about 45 – 60 days, while during summer it is not bigger than 30 days.

The analyze of the mussel larva distribution shows that the water masses situated at the 10 – 30 m isobaths are always best populated. Regardless the distance to the shore, the 0 – 10 m layer and to some extent the 10 – 25 m one maintained permanently densely populated with mussel larva. This proves that the development from egg to larva capable of fixation takes place in the upper water masses, close to the surface, and not at the bottom, where the mussel populations that generates larva are found.

Because of the lower temperatures recorded in the past five years at the Romanian coastal zone of the Black Sea (t water = 12 – 14 $^{0}$C) the fixation of the epibiont organisms larva took place between 15 of April and 15 of May.

In the first decade of June, the bivalve fixed naturally on the collectors – after the spring reproduction – had an average length of about 3 – 5 mm.

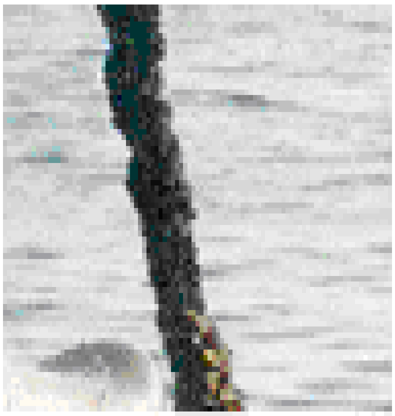


Fig. 2 - Artificial collector after two months from launching

The structure of the deposed organisms on the artificial collectors is dominated by *Mytilus galloprovincialis* with 80%, cirripeds 12%, other invertebrates 5% and unicell algae 3%. We noticed the presence of the coelenterate *Obelia* sp. that fixed with abundance both on the artificial collectors and the submerged part of the floaters.

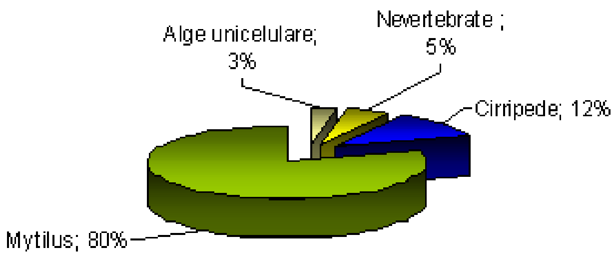



Fig. 3 - The structure of the marine epibiota after two months from launching

In the warm season, the larva fixed on the artificial collectors developed uniformly, forming compact agglomerations on the artificial supports. We noticed the preference of the mussel juveniles for the areas closer to the surface, and an agglomeration of the individuals by the individual length, the bigger ones being localized upper and the smaller ones lower on the collector.

Fig. 4 - Artificial collector after three months from launching

In normal hydro biological conditions specific for the reference areas, the total quantity of organisms found on a meter of collector by natural fixations – after spring reproduction – in June is presented in figure 5.

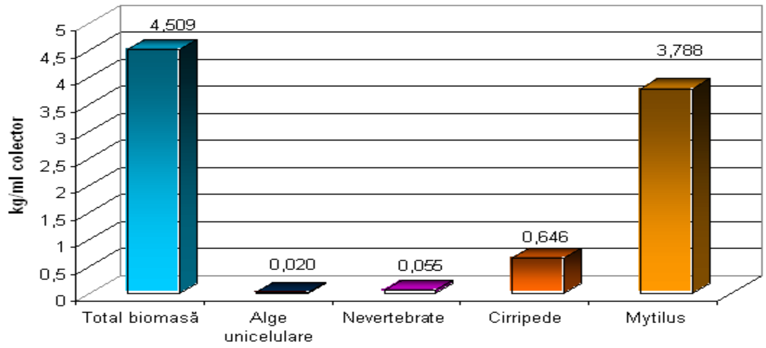



Fig. 5 - Total and by groups fixations of living organisms (in biomasses) on the artificial collectors after three months from launching (June)

After three months from launching the installations in the water, the biomass of the existing epibiont organisms on the artificial collectors is of 4.509 kg/m.l. of collector.

From the existing organisms on the collectors, the mussels are dominant, with 84% of biomass, followed by cirripeds with 4.94%. The rest of 10% biomass is represented by macro algae and other epibiont invertebrates.

From the analyze of the data about the organisms deposals we noticed that at the end of May 2006, on the artificial collectors launched in March, the mussel small juveniles are dominant, fixed after the massive reproduction that took place in this year’s spring. Beside this population, on the collector new bivalve generations fixed from the summer reproductions.

Fig. 6 - Artificial collectors after five months from launching

By multiplying the average biomass on the collector unit with the total length of the collectors attached on the floating structure of an installation ($L_{total} \approx$ 330ml) it results that the total biomass of epibiont organisms found on an installation after three months after their launching is of about 1487.97 kg. The existing organisms on the floating suprastructure and on the anchoring ropes were not taken into account.

Fig. 7 - Artificial collector after five months from launching (in detail)

After five months from launching the aquaculture installation in normal hydro-biological conditions specific for the reference areas, recorded during the experimentations March – August 2006, the average biomass of epibiont organisms on a meter of collector is of 7.23 kg/m.l.

From the existing organisms on the collectors, the mussels are dominant, with 90% of biomass, followed by cirripeds with 8%. The seasonal algae represent about 1.5% and the rest of 0.5% constitutes of epibiont invertebrates.

Because the mussels fixed on the artificial collectors represent quantitatively speaking in August 2006 about 90% of the total biomass, in figure 10 is shown the mussel juveniles fixation depending on the submerged horizon, after seven months of immersion.

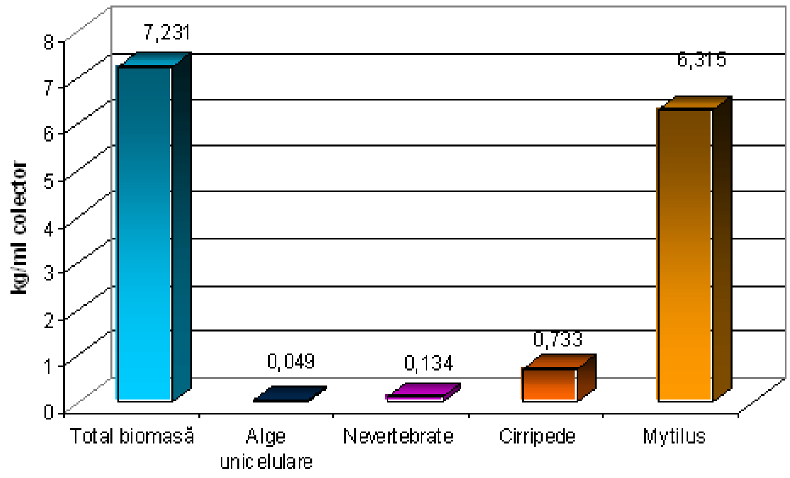



Fig. 8 - Total and by groups fixations of living organisms (in biomasses) on the artificial collectors after five months from launching

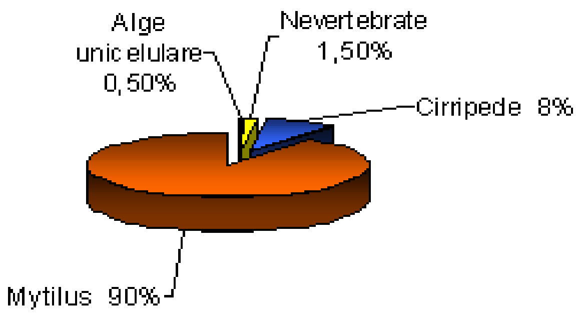



Fig. 9 - The structure of the marine epibiota after five months from launching

The following aspects are evinced:

- a big number of mussels exist on the collector unit (about 68500 individuals/m.l.);
- about 87.2% of the total mussels on the collector represents the small juveniles belonging to the intense reproductions in that year's spring. The percent grows with the reference isobaths;
- about 11.7% of the total mussels fixed on the collector is formed of juveniles coming from post larva fixations from the 2005's autumn;
- the adults that should came from the reproductions in 2004 are insignificant.

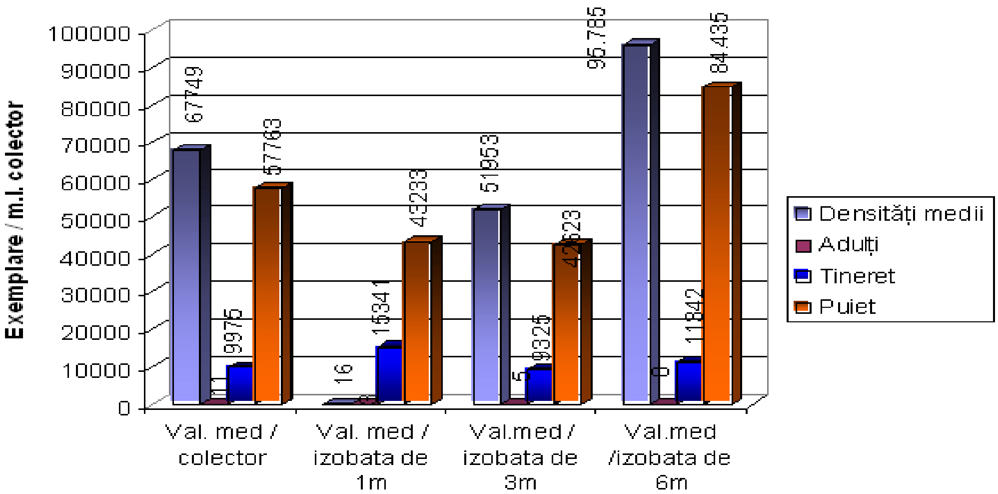



Fig. 10 - The situation of mussel fixations, in average densities, on artificial collectors attached on floating installations after seven months of immersion

On the basis of the presented data regarding the evolution of the biomass until the end of August, it results that on the experimental model's collectors the mussel juveniles are predominant, small size, fixed after the intense reproduction that spring, and the average bioproductivity of a floating installation is of about 1.8 – 2.0 tons.

The positioning and maintaining of the growing elements in the upper waters, in the 1 – 5 m horizon, where the light and food quantity is superior allows the mollusks to feed continuously. This allows a linear faster growing rate that is not available in natural conditions. Because of the fast growing, the hells often remain friable, but the superior quality of the flesh ensured by the food richness overcomes the complete maturation necessity.

Depending on the hydro climatic conditions in 2006, until November, the epibiont organisms' biomass may attend about 9.0 – 9.5 kg/m.l.

The bioproductivity of the floating installations made within the pilot station was almost equal, though a higher rhythm was noticed for the offing installation, where the length and weight of the mussels were bigger.

The marine epibiota fixed on the artificial collectors was uniformly distributed on the installations surface, though, at the shallow water installation, due to the existence of the natural mussel populations on the dykes, the deposed biological material was formed only of mussel juveniles and the densities were superior compared to the other installations.

In the biotic and a biotic environmental conditions recorded during the effected tests, average yearly biomasses of about 2.0 – 2.2 tons of epibiont organisms fixed / floating installation, composed of 90% mussel juveniles, 8% cirripeds, 1.5% seasonal macro – algae, 0.5% other invertebrates. On the basis of the obtained results in the experiments concerning the epibiont organisms capacity of bio purging the marine water, one kg of bio – filtrators can purge in 24 hours and in a 85 – 90% proportion a volume of about 73 $m^3$ marine water, having a phytoplankton load of about 18 mil. cells/liter.

Taking into consideration the average efficiency of purging and the total biomass o the collectors of one installation, it results that the fixed organisms can purge a volume of about 182 500 $m^3$ marine water in 24 hours.

The presented technology of producing the marine epibiota on floating installations constitutes an ecological method of improving the quality of marine water in the littoral sectors with touristic importance by using epibiont bio - filters.

The applying of this method will lead beside the obtaining of a big quantity of marine epibiota to the improving of the quality of the marine water in the area by increasing the quantity of the epibiont bio – filters.

**The technology of processing the marine epibiota as forage additive**

The lack of data in the literature on the using of the marine epibiota contended the introducing of this prime material in a complex of processing and bio – technological analyses (POPESCU *et al.*,2003).

At this we have to add the necessity to complete the animal nutrition by adding natural products that to ensure the mineral substances support – proteins, glucoses, lipids but also biochemical compounds that stimulates the metabolic activity (GANCHOROW *et al.,* 1990).

The analytic methodology was taken from the literature, referring to the analyze of the marine organisms and food quality control (CRASMARU *et al.,* 1999).

For obtaining some efficient results in zoo technology it is recommendable that the fresh epibiota to be dried at the maximum temperature of $65^0$ C (that does not affect the natural bioactive components), minced and conserved as long as possible.

The processing of the fresh marine epibiota constitutes of the following technological phases:

- drying in rotating ovens, hot air alimented, until they rich the maximum temperature of $65^0$C;
- mincing until obtaining an homogenous powder with granulation between 0.20 - 0.80 mm, or bigger, depending on the consumers.

The comparative characterization of the product versus the prime material that follows the evincing of the physical, chemical, bio-chemical and sanitary modifications are presented in the Analyze given in Table 1.

Table 1

Comparative characterization of the marine epibiota and the product-dry powder obtained from marine epibiota

| No. | Characteristics | Epibiota | Powder |
|---|---|---|---|
| **I** | **Organoleptic characteristics** | | |
| 1 | aspect | mollusks, crustaceans and algae mixture | Powder with granulation under 1 mm: 0.2 - 0.8 |
| 2 | color | green with red – brown aspects | brown – gray |
| 3 | | specific marine | specific marine |
| 4 | taste | - | specific marine |
| **II** | **Physical and chemical characteristics** | | |
| 1 | solubility in water at $20^0$ C mg/ml | - | 7.8 - 8.0 |
| 2 | dry substance% din care | 40.0 ± 2.0 | 98.2 ± 0.05 |
| 2.1 | ash% | 20.2 ± 2.0 | 50.47 ± 2.2 |
| 2.1.1 | mineral components in ash mg/g | | |
| | Na | - | - |
| | K | - | - |
| | CaO | 50.5 ± 0.5 | 52.5 ± 0.5 |
| | MgO | 32.0 ± 0.5 | 34.0 ± 0.5 |
| | MnO | 1.25 ± 0.05 | 1.75 ± 0.05 |
| | Fe | 35.0 ± 0.5 | 38.5 ± 0.5 |
| | Co | 1.5 ± 0.1 | 1.7 ± 0.05 |
| | Ni | 1.2 ± 0.1 | - |
| | Zn | 2.8 ± 0.1 | - |
| | Pb | 0.2 ± 0.3 | 2.0 ± 0.5 |
| | Cd | 1.0 ± 1.0 | 1.2 ± 0.5 |
| | Hg | - | 0.2 ± 0.05 |
| 2.2 | organic substance% compared to SU of which | 20.0 ± 0.2 | 49.53 ± 2.2 |
| 2.2.1 | total protein | 40.0 ± 5.0 | 18.5 ± 0.5 |
| 2.2.2 | total glucose | 30.0 ± 5.0 | 17.0 ± 0.5 |
| 2.2.3 | total fats | 8.0 ± 2.0 | 12.0 ± 0.5 |
| 2.2.4 | biologic active components | | |
| | vitamins μg/g SU | | |
| | riboflavin | 2.9 ± 4.6 | 0.5 ± 0.7 |
| | niacin | 10.2 - 10.8 | - |
| | ascorbic acid | 1.5 - 1.8 | - |
| | carotenes mg/g | 30.0 - 39.0 | 10.0 - 12.0 |

| No. | Characteristics | Epibiota | Powder |
|---|---|---|---|
| 2.2.4.2 | enzymatic activity | | |
| | amylases U/mg | 39.0 ± 5 | 20 ± 5 |
| | proteases U Anson | 44.0 ± 0.05 | 30.0 ± 9.0 |
| | SOD / Umg prot. | 0.420 ± 0.05 | 0.150 ± 0.005 |
| | catalase μ mol $H_2O_2$ min x mg prot | 10.2 ± 0.05 | 7.20 ± 0.05 |
| **III** | **Microbiological characterization no./ g** | | |
| 1. | NTG | $10^5$ | 5 X $10^3$ |
| 2. | vibrio para haemoliticus | absent | absent |
| 3. | total coli forms | 100 | 30 |
| 4. | streptococci | 50 | absent |
| 5. | E. coli | absent | absent |
| 6. | Salmonella | absent | absent |
| 7. | Staphylococci coaculozo positive | absent | absent |
| **IV** | **Toxicological characterization** | | |
| | Limits of variation of the heavy metals with toxic potential (in ash) | | |
| 1. | Cu | 0.20 - 0.45 | 4.7 ± 0.05 |
| 2. | Cd | 0.9 - 1.1 | 2.1 ± 0.05 |
| 3. | Pb | 0.15 - 0.40 | 2.5 ± 0.05 |
| 4. | Hg | - | 0.03 - 0.04 |

The modifications are obvious, and are presented here:

- from the inhomogeneous mixture of marine organisms (mollusks, crustaceans, algae), an homogenous powder with granulation of 0.20 – 0.80 mm was obtained;
- the powder maintained the specific marine odor;
- about the physical and chemical composition recorded a concentration in the dry substance, ash and its components;
- the concentration in useful minerals as Ca, Mg, Mn, Fe, Co will contribute to the mineralizing effects of adding the powder in animal food;
- the concentration of heavy metals does not affect the sanitary attributes of the product, and we mention here the drastic diminishing of the microorganisms populations in the product comparing to the prime material;
- the organic compounds should follow the ascending trend line of accumulating, though, in the case of the proteins and glucoses, we noticed a quantitative diminishing probably due to some uncontrollable mineralization processes;
- some of the bioactive compounds – vitamins, riboflavin and pigments are diminishing their concentration in powder compared

to the prime material and the enzymatic activity is lower, these diminishes might be the result of termic treatments.

The marine epibiota powder conserves some bioactive characteristics that, added to the nutritive support justify the using in feeding animals. These aspects are complementary to a digestion capacity (determined in vitro) of 19 – 20% of powder. Compared to other additives used in feeding animals we noticed that the marine epibiota powder maintains in good limits the enzymatic activity of SUPEROXIDDISMUTASE and CATALASE that might regulate the animal metabolism.

## Using the marine epibiota powder in egg - production specialized birds alimentation

The technology of using the marine epibiota powder in feeding the egg – production specialized birds and its influence on body weight, egg production and specific forage consumption was made for **Hisex Brown hybrids** raised at Lumina – Constantza complex (BLOKHUIS, 1989; BROOM, 1969).

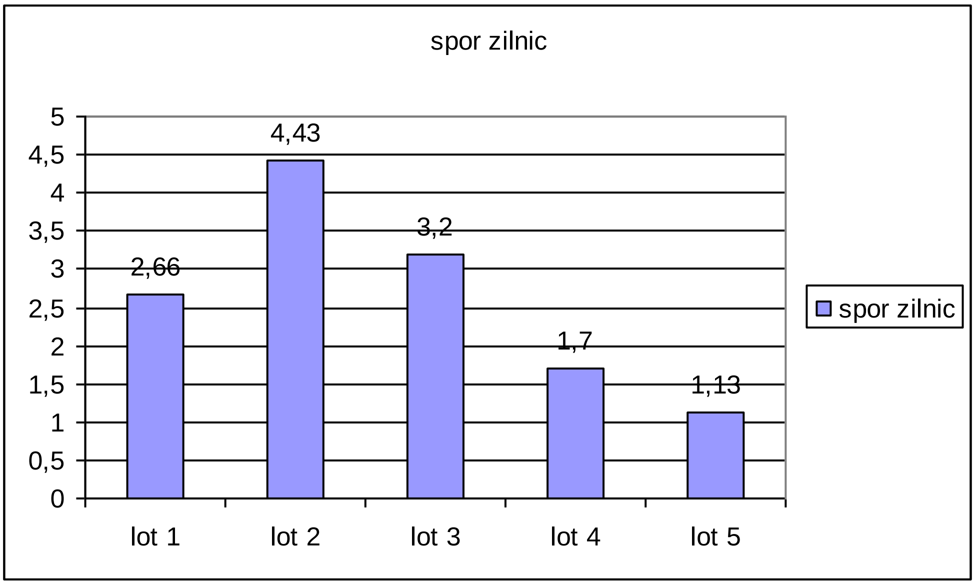
The experiment took place in a production hall, where five boxes were installed, in which were randomized distributed 10 adult birds per box. The special forage prepared for egg – production birds was mixed with epibiota powder in proportions of 0% (witness plot) and 5%, 10%, 15% and 20% (experimental plots). The hens were feed twice a day – in the morning and at 13.00 h with a daily ratio of about 130 – 141 g.

The evaluation of the results took care of the realized growth during the exploitation, mortality, laying eggs performances and egg quality. Also, the average forage consumption, epibiota supplement and supplementary costs were determined.

Table 2

The influence of the dried and grinded epibiota on body weight and losses at egg – producing hens HISEX BROWN rose at Lumina - Constantza Complex

| **Plot / epibiota %** | **N** | **Initial weight (g)** | **Final weight (g)** | **Growth (g) Day / total** | **Mortality N / %** |
|---|---|---|---|---|---|
| **July – August 2006** | | | | | |
| 1 - Witness | 10 | 1952+/- 145 | 2112+/- 125 | 2.66/160 | - |
| 2 - 5% | 10 | 1987+/- 122 | 2233+/- 85 | 4.43/246 | - |
| 3 - 10% | 10 | 2001+/- 149 | 2193+/- 127 | 3.20/192 | - |
| 4 - 15% | 8 | 2000+/- 166 | 2102+/- 121 | 1.70/102 | 2/25 |
| 5 - 20% | 8 | 1943+/- 138 | 2011+/- 143 | 1.13/68 | 2/25 |




Plot 1- Witness; Plot 2 - 5%; Plot 3 - 10%; Plot 4 - 15%; Plot 5 - 20%
Fig. 11 - The average daily growth at hybrid Hisex hens in the 69 - 77 weeks exploitation interval

The administration of a 5 – 10% concentration of dried epibiota in the daily forage ratio at egg – laying hens leads to the obtaining of a variable response of the morph productive indicators, depending on the quantity of administrated epibiota.

The 5 – 10% concentration of epibiota positively influenced the Hisex hens weight, so at the age of 77 week they had a body mass of 2 193 – 2 233g, with 5% bigger than the witness plot and with 11% bigger than the plot supplementary foraged with 20% epibiota.

In all the cases, from the morphopatologic point of view, hexia was evinced, undigested forage rests, hepatic congestion and hepatic vesicle hypertrophy. At 77 weeks of age all the living hens had a specific weight, with body masses bigger than 2 kg.

The most reduced specific forage/egg consumption was of about 131.5 g, for plot 2, with 5% marine epibiota. The witness plot had a specific forage/egg consumption of 133 g/egg and the supplementary foraged plots with over 15% epibiota had a specific consumption bigger with 6.5 g and 11.5 g/egg respectively.

Table 3

Forage and epibiota consumption at experimental and witness plots for egg - laying HISEX BROWN hens

| **Plot / epibiota % July - August 2006** | **n** | **Mixed forage consumption (g/day/head)** | **E consumption (g/day/head)** | **PBD (g/day)** | **Calcium ( g/day)** |
|---|---|---|---|---|---|
| 1 - Witness | 10 | 141 | - | 24.52 | 3.28 |
| 2 - 5% | 10 | 144 | 7.05 | 25.04 | 3.35 |
| 3 - 10% | 10 | 155.10 | 14.1 | 23.99 | 3.21 |
| 4 - 15% | 8 | 162.15 | 21.15 | 25.38 | 3.39 |
| 5 - 20% | 8 | 169.2 | 28.2 | 24.34 | 3.26 |

## Using the marine epibiota powder in meat chicken ratio structure

The administration of a 10 – 20% concentration of dried epibiota in the forage ratios of the meat chicken lead to a variable response of the morphoproductive indicators, depending on concentration and chicken age:

- the 10% concentration of dried epibiota significantly influences the growing rate, about 34, 46.5 and 50.8 g at the age of 22 – 38, 38 – 46 and 47 – 54 days/untreated chicken of about 22 – 54 days of age normally obtain a growth of 40.61 g, with 25.21% less than the meat chickens supplementary foraged with epibiota powder;
- an obvious chicken vitality is noticed, an excessively alive behavior, with mucous and red crests, determined by the protein excess in the ratio that brings a higher blood flux at the mucous;
- the growing of the epibiota proportion negatively influenced the growing rate in the 29 – 36 days period, that was of only 15 g/day and the chicken mortality in this phase was of 4%.
- the obtained results suggest that a concentration bigger than 10% may be administrated to the chickens over 36 days of age, and an accommodation of them with growing proportions of epibiota from 5 to 15% between 22 – 36 days of age is strongly recommended;
- the meat chickens older than 38 days obtain an average daily growing of 44.4 g and 59.75% respectively, with 16% bigger than the untreated chickens.

The administration in the ratio of a epibiota concentration of 20% had negative effects on the morphoproductive performances of the meat chickens and produced an increase of the mortality of over 58%. The epibiota excess favors the high calcium supply that produces cellular death due to the destruction of the regulatory mechanisms of the calcium cellular concentration.

The effected research proves that the marine epibiota constitutes an alternative resource of forage in the meat chicken nutrition.

## CONCLUSIONS

- A study was made on the experimentation of some technical methods destined to the producing of the marine epibiota in the hydro biologic conditions specific for the Romanian littoral of the Black Sea;
- On the basis of the technical, functional and biologic characteristics, we projected and realized a model of floating installation equipped with collectors suspended in the water masses;
- The component parts, made of textiles, and their joining were made according to the execution details presented in the technical documentation;
- During the experiments (March – November) the floating installation maintained its initial position, functional geometry and projected dimensions, and the overloads appeared in the installation under the action of exterior forces were uniform distributed on anchors, ensuring the optimal conditions for the maintaining of the collectors in a continuous immersion at the 1 – 5 m horizon;
- The population with filtering epibiotic organisms of the launched technical instruments was made only through natural fixation of larva resulted from the reproduction of the mussel populations in the area;
- After seven months from launching the installations, the average value of the epibiont organisms biomass found on a meter collector is 9.231 kg/m.l. and the bio productivity is of about 2.5 – 3 t, depending on the hydro climatic conditions every season;
- On the collectors of the mariculture installation the mussels are dominant with about 90% of the biomass, followed by cirripedia with 8%. The seasonal algae represent about 1.5% and the rest of 0.5% is formed of epibiont invertebrates;
- The processing as powder has the advantage of conserving some nutritive qualities but we have to take care of some restrictive parameters – humidity, temperature, that might affect the quality of this product;
- The administration of a 3 – 20% concentration of dried epibiota in the forage ratio of the meat chicken lead to a variable response of the

morphoproductive indicators, depending on the concentration and chicken ages;

- The administration of a 10% concentration epibiota powder in the ratio did not significantly influenced the growing rate of the meat chicken. The untreated birds, at the same age (22 – 54 days) realized weights with about 25.21% lower than the ones supplementary foraged with epibiota powder;
- The studied biochemical compounds had the following tendencies the hepatic glycogen grew in normal limits for the chickens feed with medium quantities of epibiota (5 – 10%). The catalaze and sulphoxide dismutaze had bigger values in the case of excessive epibiota ratios, proving the apparition of the oxidative stress;
- For the 15% epibiota supplementary foraged plot, we recorded body biomasses with about 41% lower than for the witness plot. We also recorded the smallest laying percent (51%) and the biggest mortality (27.77%);
- The effected research proves that the marine epibiota constitutes an alternative forage source, that can be used in the alimentation of the meat chickens in percents under 10% of the normal forage ratio;
- The optical and electron microscopic study made on digestive tissue collected from treated chickens showed normal morphostructures for the 5 and 10% concentrations. Higher concentrations produced hemorrhages in the submucoses;
- At cellular level we noticed: many cells with fibroblastic invasion, with the tendency of reduction of the glandular cells of the whole digestive system, degenerated mitochondria;
- The protein malabsorbtion due to the block of the calcium channels and the disturbing of the molecular transport at the intestinal epithelium level and hepatic and renal cell membranes.

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