

FISH FEED MICROBIOLOGICAL STATUS

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Abstract

Lack of domestic fish feed products results with the need of import. However, fish feed may trigger changes in the fish metabolism. Namely, the feed may be responsible for the decrease in fish accretion and/or the reason for the fish diseases occurrence. All these problems commonly are connected with feed and/or water quality.

Therefore, we decided to investigate the microbiological status of various feeds used in fish diet. In this research we investigated following groups of microorganisms in fish feed: Total number of bacteria, sporogenous bacteria, yeasts and molds, coliforms, *Escherichia coli* and *Proteus* species, as well as fecal streptococci and staphylococci and sulfitoreductiv clostridia.

The results showed that the feed used in the fish diet, nevertheless is domestic or imported, largely differs in their microbiological status, regardless we are speaking for quality or safety. Fish feed from domestic origin showed high contamination rates, and this directly resulted in fish growth rate decrease, and demonstrated toxic effects, because one of the finds was presence of aflatoxin producers.

Key words: *Fish feed quality and safety, Microbiological status, Contaminants.*

1. Introduction

Nowadays a big problem facing the humankind is food production because food is one of the preconditions for survival. From the aspect of food security, fishing sector is very important economic part of the food industry. Republic of Macedonia has all preconditions for fish farming, mostly because of the quality of the water resources. Until now these preconditions are not exploited enough. This situation is due to many reasons but one of the most important is that there is not

enough fish feed and the quality of the this feed is low, so we can not expect high productive results. Fish feed low quality is a direct result of non-balanced composition of the ingredients and poor microbiological status. For example, on the quality of fish meat influences have: feed chemical composition [1 and 2] and different percentage of proteins [10].

From the other hand, microbiological composition of the fish feed has a big influence on the weight gain and fish health condition. Especially if there are harmful microorganisms present in the feed that destroy the health condition of the fish which results in the disorder in the digestive metabolism leading to the decrease of the new born fishes or total death. Microbiological status has a cosmopolitan character also because the fast reproduction of the microorganisms can lead to over reaching the upper boundary of tolerance for maintaining the health condition and can cause the decrease of the fish production or death, which is a total disaster for the fish farm. That is why it is very important to examine the microbiological status on the fish farm [4, 5, 6 and 8].

A guidelines for drinking water quality [3] indicates that coliform bacteria in the fish digestive system can cause metabolic changes which leads to the health disorders and production decrease.

Ziberoski *et al.* [6], analyzing the microbiological quality of the water concluded that the biggest percentage of the microorganisms can be found at the exit of the water system which led to the conclusion that the fish feed strongly influenced to the contamination of the water in the pools.

Some authors are using *Escherichia coli* as a contamination indicator for the water from fish pools used for carp and trout production [9].

Table 1. Microbiological state of the fish feed used for feeding the Californian trout in the “Tajmiste” complex (2 years of average)

| Type of microorganism | First year | | | Second year | | |
|--------------------------------------|---------------------|------------------|-----------------|---------------------|------------------|-----------------|
| | Feed from Macedonia | Feed from Greece | Feed from Italy | Feed from Macedonia | Feed from Greece | Feed from Italy |
| Total number of bacteria | 2.230.000 | 2.180.000 | 1.060.000 | 2.580.000 | 2.320.000 | 990.000 |
| Sporogenous bacteria | 1.310.000 | 1.020.000 | 1.110.000 | 1.440.000 | 1.090.000 | 760.000 |
| Yeasts | 24.000 | 12.000 | 10.000 | 29.000 | 11.000 | 9.000 |
| Molds | 6.000 | 5.000 | 3.000 | 7.000 | 6.000 | 4.000 |
| <i>Escherichia coli</i> | 2.450 | 1.120 | 14 | 2.130 | 1.270 | 10 |
| <i>Proteus sp.</i> | 22 | 13 | - | 14 | 4 | - |
| <i>Pseudomonas aeruginosa</i> | - | - | - | - | - | - |
| <i>Salmonella sp.</i> | - | - | - | - | - | - |
| <i>Shigella sp.</i> | - | - | - | - | - | - |

According to some authors, if putrid bacteria are found in the fish pools water and in their feed, than the producers are faced with big problem, because these bacteria are very persistent, so the only way of their elimination is total cleaning of the pools [6 and 7].

First written information about fish farming is dating from 457 B.C. from Fan Lia, who wrote a book for organisms living in water. Later, aquaculture spreads in Europe. Aristotle in his book “Historia naturalis” described 116 fish species, their development, the way of breeding, the way of eating, reproduction etc.

Republic of Macedonia is rich with water resources which depending on the water quality, can be used for breeding different fish species. Main factors in fish production are water quality and fish feed. Huge amount of the microorganisms present in the fish, especially pathogenic microorganisms can influence fish health and fish production which can result with the decrease of the production.

It is evident that the most expensive part of the expenditures for the fish meat production is fish feed. In 1950's, that was the main reason for introducing the legislation which was banning use of fish feed which previously wasn't microbiologically and chemically examined and approved for use as a fish feed.

2. Materials and Methods

As material we used fish feed produced in the Republic of Macedonia and feed imported from Greece and Italy. The experiment was conducted in the “Tajmiste” complex, in the pools for Californian trout production. We followed the microbiological state of the fish feed for with Californian trout weighting 200 - 500 g. Also we examined different groups of microorganisms in the

water at the different points in the pool, or more precisely: at the pool entrance, in the middle of the pool, and at the pool exit. The state of the microorganisms in the water was followed in the pools with Californian trout weighting 200 - 500 g.

In the water and in the fish feed we were examining following groups of microorganisms: Total number of bacteria, sporogenous bacteria yeasts, molds, *Escherichia coli*, *Proteus sp.*, *Pseudomonas aeruginosa*, *Salmonella* and *Shigella*. Results are expressed as number of microorganisms / 1g feed / 1ml of water.

3. Results and Discussion

In the Table 1 it can be seen that there is a big difference in the number of the examined groups of microorganisms in the fish feed according to their origin. Most contaminated feed is the feed from Republic of Macedonia. Feed from Macedonian origin is also contaminated with *Escherichia coli* and *Proteus sp.* which indicates that that either:

1. The raw material used for feed preparation is contaminated,
2. Feed is prepared in the environment with low hygienic conditions or with the contaminated equipment or
3. Feed storage unit (air, floor, etc) is contaminated.

Second most contaminated feed is the feed imported from Greece (Table 1). In the fish feed originated from Greece we also found *Escherichia coli* and *Proteus sp.* but their number is twice as smaller compared with the feed from Republic of Macedonia. Generally speaking, feed originated from Republic of Macedonia and Greece does not fulfill the feed safety and quality criteria to be used as fish feed.

Table 2. Microbiological status of the water in the water pools for raising Californian trout in the “Tajmiste” complex (2 years of average)

| Type of microorganism | First year | | | Second year | | |
|-------------------------------|----------------------|--------------------|------------------|----------------------|--------------------|------------------|
| | Entrance in the pool | Middle of the pool | Exit of the pool | Entrance in the pool | Middle of the pool | Exit of the pool |
| Total number of bacteria | 12 | 1.300 | 2.450 | 10 | 1.420 | 2.780 |
| Sporogenous bacteria | 3 | 240 | 780 | 2 | 270 | 910 |
| Yeasts | 2 | 32 | 146 | 1 | 44 | 166 |
| Molds | - | 8 | 12 | - | 7 | 10 |
| <i>Escherichia coli</i> | - | 166 | 442 | - | 158 | 465 |
| <i>Proteus sp.</i> | - | 2 | 8 | - | 1 | 7 |
| <i>Pseudomonas aeruginosa</i> | - | - | - | - | - | - |
| <i>Salmonella sp.</i> | - | - | - | - | - | - |
| <i>Shigella sp.</i> | - | - | - | - | - | - |

Fish feed imported from Italy is the least contaminated and all the examined groups of microorganisms are in the range of the legally allowed amounts with very small deviations. In the feed from Italy harmful microorganisms of the type *Escherichia coli* are also identified, but their numbers are insignificant, which leads to the conclusion that the raw material was clean as well as the environment and the equipment for feed preparation. Bacteria from the *Proteus sp.* were not identified in the fish feed from Italy.

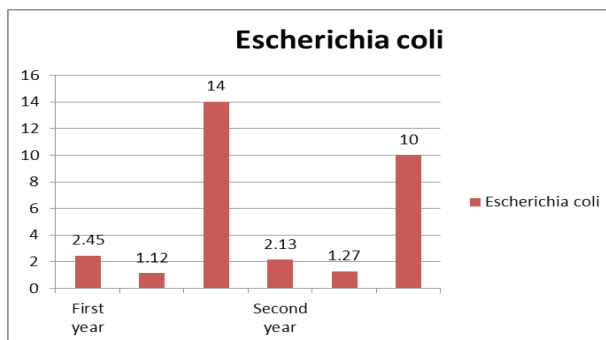


Figure 1. Fish feed contamination with *Escherichia coli* species

On the Figure 1 it can be seen that the fish feed from Republic of Macedonia and from Greece is out of the range of tolerance concerning the contamination with *Escherichia coli* compared with the fish feed from Italy which we can say is relatively clean.

Harmful and dangerous microorganisms such as *Pseudomonas aeruginosa*, *Salmonella sp.* and *Shigella sp.* were not identified in the examined fish feed which is a good fact because these bacteria are very dangerous for fish health.

From the results in the Table 2 we can conclude that in the entrance of the water in the pool the water is with

a quality of drinking water, which indicates that water quality used for raising Californian trout is good. Problem arises with the number and types of microorganisms found in the middle of the pool where the water is very contaminated which leads to the conclusion that the water is contaminated from the fish feed and from the waste material from the fishes. These conclusions are supported with the values for the examined microorganisms at the pools exit, where the number of the examined microorganisms is biggest. These values correspond with the examinations conducted by Ziberoski *et al.* [6].

4. Conclusions

1. On the basis of gained results we can conclude following:
2. According to the Total number of bacteria, the most contaminated fish feed is the feed originating from Republic of Macedonia, and the feed originating from Greece shows lower, but similar results. The least contaminated is the fish feed imported from Italy.
3. The most contaminated fish feed with sporogenous bacteria is the feed originating from Republic of Macedonia and Greece, which can easily leads to negative health effects to fish. That's why our recommendation to fish farmers is that if they use feed from both countries, than they have to have very strict control on its quality and safety.
4. Yeasts present in the feed are within the range of normal values and do not have negative health effects on Californian trout.
5. Molds present in the feed from Republic of Macedonia and Greece can cause metabolic disorders in

the fish, especially because there is possibility that there can be present molds which are producing toxins, and which can also result with high fish mortality rate, or with destruction of whole production.

6. The presence of the *Escherichia coli* and *Proteus sp.* in the fish feed produced in the Republic of Macedonia and Greece represents microbiological hazard which can have a catastrophic consequences in the Californian trout production. 6. In the water used for Californian trout production microorganisms found in the middle of the pools and especially at their exit which leads to the conclusion that the water is contaminated from the fish feed and from the waste material from the fishes.

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