The Effects of Some Phytoadditives on Growth, Health and Meat Quality on Different Species of Fish

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Abstract
The growing tendency for food safety led to the ban of antibiotics. To replace their effects, the search for natural alternatives has begun. Thus, strong candidates to replace antibiotics are phytoadditives. Phytoadditives are fodder additives obtained from medicinal plants or plants extracts. Through their use it can be hoped to achieve the same results as in the use of antibiotics. Although they have a large spectrum of use, even today their mechanisms of action are not fully understood. Only recent, the study on the possibility of phytoadditives usage in aquaculture has begun. The present study is a review of the use of some plants as phytoadditives (garlic, onion, oregano, etc.) and of the researches made to reveal their effects on fish. The researches conducted in this field have shown the diverse effects of these phytoadditives used in fish as immunomodulators, immunostimulants, bioproductives, antioxidants, antimicrobials, stimulants of the enzymatic equipment, stimulants of nitrogen absorption. A major advantage in the use of phytoadditives is the fact that they are natural substances and do not pose any threat to fish, man or environment.

Keywords: fish, garlic, immunostimulants, onion, oregano, phytoadditives

Introduction

The world trend to improve food security and to use natural products will drive the chemically synthesized antibiotics and growth promoters out of use. The search for alternative, natural solutions has begun in order to substitute their use. In order to replace antibiotics, the attention was focused also on plants known to have benefic effects on human health (aromatic plants, medicinal plants, spices and plants extracts). Although the majority of plants are known for centuries and are used in the traditional medicine, their way of action is not fully understood, the existing data being at most empirical.

Phytoadditives are fodder additives obtained from medicinal plants or plants extract. They are being used on a wide range, by humans as well as by animals, including fish. Recent studies tried to show the effects of phytoadditives usage in all farmed animals. Among the noticed effects there we can mention the immunostimulator effect, bioproductive effect, antioxidant effect and antimicrobial effect, their ability to stimulate the enzymatic equipment and to increase the nitrogen absorption.

The main advantage of using these phytoadditives is that they are natural substances that don't pose any threat to fish health, human health or to the environment. Researches are still in progress to determine their way of action and the possible side effects that can appear as a result of their use, and to determine the possibility of using other plants as phytoadditives.

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Different plants used as phytoadditives

Garlic (*Allium sativum*)

A member of the *Liliaceae* family, garlic is used for centuries as a spice and also in the popular medicine. Garlic is originating in Asia Minor and spontaneously grows in southern Europe, but in cultures can be found all over the word.

It's a rich source of calcium, phosphorus and vitamin B_1; it has a high content of carbohydrates

and as a consequence a high nutritive value. Garlic also contains iodine salts which have a positive effect on the circulatory system and rheumatism, silicates which have a positive effect on the skeletal and circulatory system and sulfur salts with positive effects on the skeletal system, cholesterolemia, and liver diseases. Garlic also contains vitamin complex B, vitamins A, C and F (Simona Drăgan [1]). Another substance with a major role is aliin which has anthelmintic effects.

In short, garlic has the following effects: lower the cholesterol and the triglycerides, ameliorates atherosclerosis, has a hypotensive, coronary dilator, antioxidant and anti cancer effect.

Salah [2] carried out an experiment to determine the effects of garlic on Nile tilapia (*Oreochromis niloticus*). The fish diet was supplemented with garlic in doses of 10 and 20 g/kg feed. During the experiment, an intentionally infestation with *Aeromonas hydrophila* was carried out. Body weight, survival rate, meat quality indices and shelf life where recorded throughout the experiment. In terms of body weight there was no significant difference. Significant differences where observed in the hematocrit values, the meat quality indices and in shelf life. After the induced infection with *Aeromonas* a better survival rate was observed in the garlic treated groups.

Metwally [3] studied the effects of garlic on some antioxidant activities in Nile tilapia. Fish where fed on diets containing different form of garlic: natural garlic, garlic oil capsules (Strongus), and garlic powder tablets. At the end of the experimental period a significant increase had been observed in growth performances and weight gain and also a significant decrease of the mortalities rates. In the experimental groups protein plasma levels where significantly higher while blood sugar, triglycerides and cholesterol levels where significantly.

Shalaby [4] studied and compared the effects of garlic and chloramphenicol used as immunostimulants and growth promoters on some physiological parameters, growth performance, survival rate and bacteriological characteristics of Nile tilapia. Fish where fed diets containing garlic (10, 20, 30 and 40 g/kg feed) and chloramphenicol (15, 30 and 45 g/kg feed). Results obtained showed a significantly increased final weight and specific growth rate directly linked with the inclusion levels of garlic and chloramphenicol. The lowest FCR was observed at the inclusion level of 30g/kg garlic and 30g/kg chloramphenicol. No significant differences where observed in the case of survival rate. At the garlic fed group a rise in brute protein levels of flesh was observed, at the same time the total lipid content levels dropped. The hemoglobin content and the erythrocyte numbers were significantly higher in the experimental groups. The rise of the inclusion level of garlic determined a drop in plasma glucose concentration while the rise of inclusion levels of chloramphenicol determined the rise of plasma glucose concentration. Dietary administration of garlic and chloramphenicol determined a significant drop in total lipid concentration and a rise in total plasma concentration. All inclusion levels of garlic and chloramphenicol decreased total bacteria and coliforms in the water, muscles and intestine compared with the control group.

Ahmed [5] studied and compared the effect of black seed (*Nigela sativa*), garlic and commercial Biogen as immunostimulants in Nile tilapia. The feeds where administered for three months in summer and six months in winter. Supplementary, an infection was made with *Pseudomonas fluorescens* to determine the fish's immune response after the treatments. At the end of the trial period no significant differences where observed in growth performances between experimental groups, here the non-specific mortality rate was smaller. At the end of the summer period there where no significant differences in the growth performance observed between the treatment groups; here the non-specific mortality rate was lower. In the same groups, at the end of the winter period, a significant increase in body weight was observed. Non-specific mortality was reduced in all treatment groups excepting the group that received Biogen.

Nya [6] used garlic to control an *Aeromonas hydrophila* infection in rainbow trout (*Oncorhyncus mykiss*). At an inclusion level of 0.5 and 1.0 mg/g feed a 4% reduction in mortality was observed, compared to the control group. Moreover, there was a significant increase in growth, feed conversion and protein efficiency. Other effects of garlic supplementation where: higher hematocrit, erythrocytes and leucocytes levels enhance of lyzozyme and antiprotease activities as well as stimulation of antioxidant activities.

Onion (*Allium cepa*)

Onion is a member of the *Liliaceae* family and it's used as a medicinal plant, vegetable and spice. Onion has antibiotic, antiseptic and antiinfectious properties. It has a strong hipoglicemiant effect, therefore being recommended in diabetes. Onion contains small quantities of sugar, fats and vitamins A, C and B complex; it hasa high content of magnesium, potassium and copper. Onion has antioxidant and tonic effects being recommended in cases of tiredness and convalescence (Simona Drăgan [1]).

Benkeblia [7] studied the antimicrobial effect of essential oil extracts of three types of onion (green, yellow and red) and garlic in different concentrations (50, 100, 200, 300 and 500 ml/l) against two bacteria (*Staphylococcus aureus, Salmomella enteritidis*) an three fungi (*Aspergillus niger, Penicillium cyclopium şi Fusarium oxysporum*). The strongest antibacterial effect was observed in garlic and the lowest in green onion. All of the garlic extracts presented inhibitory activity, in any concentration used. Among the onion types, red onion had the strongest inhibitory activity, followed by yellow onion, the lowest being observed in green onion.

Al-Salahy [8] administered onion and garlic juices on *Clarias lazera* once a day for 5 days. The physiologic determination where carried out 5 h, 24 h and 5 days after administration. Contents of free amino-acid, total lipids, cholesterol, total protein and urea levels in blood serum, liver and muscles where determined. Onion and garlic administration caused a temporary hypoglycaemia and a rise of the muscle glycogen levels. Onion consumption caused hypolipidemia and hypocholesterolemia in blood serum accompanied by a rise of cholesterol levels in liver and muscles. The garlic fed group presented a drop in free amino-acid levels. Both experimental groups presented a rise in liver free amino-acids. Moreover, the garlic fed group presented a rise in muscle free amino-acid levels, an enhanced muscle uptake of free amino-acids may enhance protein syntesis.

Other plants as phytoadditives

Oregano (*Origanum vulgare L*)

A member of the *Lamiaceae* family, oregano is well known in the whole world for its special aroma and for its antioxidant and antimicrobial qualities. The main active substances in oregano are thymol and carvacrol with antioxidant properties. (Simona Drăgan [1])

Zheng [9] evaluated the effect of oregano essential oil (*Origanum heracleoticum*) on growth, antioxidant effect and resistance against *Aeromonas hydrophila* in channel catfish (*Ictalurus punctatus*). Oregano was administered in different forms (carvacrol, thymol, a combination of carvacrol and thymol and OregoStim® - commercial product containing natural oregano essential oil) to determine the effects of oregano extracts on growth performances and antioxidant activity. Groups fed with oregano essential oil showed enhanced growth performances. Oregostim addition determined an enhanced hepatosomatic and viscerosomatic index, also enhancing antioxidant activity and promoting a better sedimentation of muscle protein. After the *Aeromonas h.* infection the lowest mortality rate was observed in the group receiving OregoStim.

Ginger (*Zingiber officinale*)

Ginger is a member of the *Zingiberaceae* family and it's being used mainly as a spice due to its sweet-spicy taste. It's being used successfully in eastern popular medicine as an antioxidant and anti-inflammatory agent.

Nya and Austin [10] used ginger to control an experimental infection of *Aeromonas hydrophila* in rainbow trout. Ginger was added in feeds, in quantities of 0.05, 0.1, 0.5 and 1g/kg feed. At a dose of 0.5g ginger /kg feed, mortality was reduced to zero compared to the control group, at the same time an enhancement of growth rate, feed conversion and protein efficiency being observed. Also there was a proliferation in the numbers of neutrophils, macrophages and lymphocytes and enhanced phagocytic and lysozyme activity.

Echinacea (*Echinacea purpurea*)

The Echinacea plant is a part of the *Asteraceae* family, endemic to central end eastern North-America. The active components in the Echinacea plants are phenols, represented by cichoric and caftaric acid. In the early 20th century Echinacea was used to treat snakebites, anthrax and as an analgesic. Echinacea has anti-tumor and immunostimulator effects, especially in the case of non-specific immune system.

Salah [11] studied the effect of Echinacea on growth rate and disease resistance in Nile tilapia. The experiment was carried out on 1200 Nile tilapia, reared in earth ponds. A controlled infection with *Pseudomonas fluorescens* was also carried out by intraperitoneal inoculation. The test group showed a significant increase in body weight gain, specific growth rate, hematocrit values, lysosyme activity and total leukocytic cont. the survival rate was significantly enhanced in the experimental group prior and post inoculation.

Cinnamon (*Cinnamomum verum*)

Cinnamon is a member of the *Lauraceae* family and comes from tropical Asia and Africa. Cinnamon essential oil has antibacterial, antifungal, antiviral anti-diabetes and antioxidant properties. It's been used as a treatment for cancer, gonorrhea and typhoid fever. Cinnamon is also used in food industry for its capacity to inhibit the development of bacteria, molds and yeasts.

Pongsak and Parichat [12] have studied the cinnamon oil potential to control a *Streptococcus iniae* infection on Nile tilapia. They studied and compared inhibitory capacity of four essential oils: leech lime (*Citrus hystrix*), lemon grass stems (*Cymbopogon citratus*), tumeric (*Curcuma longa*) and cinnamon (*Cinnamomum verum*). The highest inhibitory activity was observed in cinnamon oil. As for growth parameters, there was no significant difference observed between the control group ant the experimental groups. The group that received cinnamon oil did not have any losses prior to *Streptococcus i*. infection. After the infection, mortality rate at the same group was reduced significantly, no adverse effects being observed as a result of cinnamon administration. Further studies revealed that the doses used in the experiment where insufficient to inhibit the bacterial activity. It is believed that the protective effect of cinnamon is the result of combination between the antimicrobial effect of cinnamon and the stimulated immune system as a result of cinnamon administration.

Mistletoe (*Viscum album*)

A member of the *Viscaceae* family, mistletoe is native to Europe and southern and western Asia. It's used in popular medicine to treat blood circulation problems, respiratory problems; some researchers suggest it has anti-cancer effects.

Nettle (*Urtica dioica*)

Nettle is a plant from *Urticaceae* family and spontaneously grows in Europe, Asia, Africa and North America. Nettle is rich in vitamins C, B2 and K, β-carotene, calcium, magnesium, iron, silicon and phosphorus. In popular medicine it's being used to treat dandruff, rheumatism, arthritis, anemia and renal disorders.

Süheyla [13] studied the effects of dietary intake of nettle, mistletoe and ginger in rainbow trout. So, for three weeks they administered feeds containing 0.1 and 1% aqueous extracts to rainbow trout, determining various parameters of non-specific defense mechanisms. The addition of these plants led to an enhancement of cellular activities. Group fed feeds containing 1% aqueous extract of ginger showed the most significant non-specific immune response. Rise in plasma protein levels has been observed in all experimental groups excepting the group fed 0.1% ginger. The highest plasma protein level was recorded in the group that received feeds containing 1% ginger.

Conclusions:

Phytoadditives represent alternative solutions to substitute antibiotics used in aquaculture. They can be used as growth promoters, recent studies showing their effects as immunostimulants, immunomodulators, antimicrobials and antioxidants. However, further researches are necessary, including total commercial cost and benefit analysis, before they can be used on a large scale in aquaculture.

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