A Replacement of Fishmeal by Earthworm (*Eisenia fetida*) Meal Together With Garlic Powder on Growth Parameters, Carcass Composition and Digestibility of Rainbow Trout (*Oncorhynchus mykiss*)

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Abstract

In this study, the effects of different replacement levels of earthworm meal (*Eisenia fetida*) with fish meal with and without garlic powder on growth performance, carcass composition and digestibility of Rainbow trout (*Oncorhynchus mykiss*) were studied over 8 weeks. For this purpose, different replacement levels of earthworm meal with fish meal including 0, 25, 50 and 75 % with or without 2.5% garlic powder were used. Fingerlings with mean initial weight of 30±0.27 g were distributed in a completely randomized design with four treatments (three replicates) in the same conditions. During rearing period, mean temperature and oxygen level were 12.28±2.14°C and 6.32±1.12 mg/l, respectively. At the end of trial, growth indices, carcass composition and digestibility were determined. Addition of earthworm meal in diet caused to significant decrease in final body weight, specific growth rate and increase feed efficiency ratio, conversely addition of garlic powder caused to significant increase in final weight, specific growth rate and decrease feed efficiency ratio (P<0.05). Garlic powder effect on carcass composition was not significant but with increasing the earthworm meal levels, body moisture and lipid content deceased and protein and ash content increased (P<0.05). Dried material's digestibility didn't have any significant difference by earthworm meal replacement from 0 to 25% (without garlic) (P>0.05) and significantly deceased in 50% inclusion level (P<0.05). Addition of garlic powder caused to significant decrease in each replacement level (P<0.05). Digestibility of lipid and protein had significant increase in diet containing earthworm meal compare to control group (P<0.05), but garlic powder supplementation couldn't significant effect on lipid and protein (except 50% replacement level) digestibility in each replacement level (P>0.05). Results showed that earthworm meal can replaced with fish meal in rainbow trout diet up to 50% together with 2.5% garlic powder without any adverse effects on fish growth performance.

Keywords: Rainbow trout, Earthworm meal, Digestibility, Growth, Garlic.

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The Effects of 11-ketotestosterone Implantation on Biochemical and Hematological Parameters of Previtellogenic Cultured Great Sturgeon (*Huso huso*)

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Abstract

Understanding the reproductive regulation in sturgeon is a precondition for controlled reproduction. Although 11-ketotestosterone (11-KT) has been found in blood of female in several fish species, the importance of this androgen in great sturgeon female has not been investigated. To address this issue, the effect of 11-KT on previtellogenic *Huso huso* was examined for the first time. A total number of twelve fish (mean weight 5,580±165 g) were divided into two circular tanks and reared under natural conditions (natural river water with a natural temperature profile). The fish were surgically implanted with slow-release pellets containing only a carrier matrix (95% cholesterol, 5% cellulose) without or with 2.5 mg 11-KT. Changes in the plasma levels of hematological and biochemical parameters were evaluated three weeks and two months following implantation. The results showed that red blood cells and its related parameters and white blood cells were affected significantly (P<0.05), while other hematological parameters were not affected. Also, after three weeks, biochemical parameters including glucose, albumin, calcium, phosphorus, alkaline phosphatase activity, HDL and VLDL in fish which treated with 11-KT implant were decreased and the amount of cholesterol was increased, but after two months all biochemical parameters were increased that increment of cholesterol and HDL was significant (P<0.05). The results showed that an 11-KT implant can affect fish physiological parameters. Also, 11-KT has positive effects in order to sexual maturity promotion and ovarian development in previtellogenic female great sturgeon.

Keywords: Hormone, Androgen, 11-KT, Blood parameters, Reproduction.

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Effects of Osmotic Shock on Some Physiological parameters in Caspian Kutum Juveniles (*Rutilus kutum*)

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Abstract

We examined the processes associated with Osmoregulation in Caspian kutum following their sudden entrance into the waters with 6 and 11 ppt salinity. We sampled the whole body and gill tissues of Caspian kutums for parameter measurements on 24, 72 and 168 hours after exposure to different salinities. The enzyme Na^+/K^+ ATPase in the first group (6 ppt) at 24 hrs after exposure, increased significantly compare to control group ($P<0.05$) and decreased but did not show any significant difference ($P>0.05$). In 11 ppt salinity, the maximum enzyme concentration was seen in 24 hour after exposure again, and then decreased, but it was higher compare to control group ($P<0.05$). Protein content in 6ppt salinity did not differ significantly compare to control but in other group, the protein decrease with significant difference. The Osmolarity of the second group increased with a greater slope than the first group, but at all time, they differed significantly ($P<0.05$). The RNA concentration in 6 ppt, had not any significant difference compared to control ($P>0.05$), but in 11 ppt, decreased with significant difference ($P<0.05$). The mortality rate was 7.33±1.52 % in second group and we did not see any mortality in 6 ppt concentration as well as controls. The water content decreased with the salinity enhancement ($P<0.05$). The results of this study illustrates that, all the indicators fluctuations reached desirable point after 7 days, so releasing them into the environments near to Caspian Sea with more salinity because of escaping from several pollutants in estuaries would be better.

Keywords: Osmoregulation, Salinity, Na^+/ K^+ATPase, RNA, Caspian kutum, Caspian Sea.

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Effect of Dietary Lettuce (*Lactuca sativa*) on Growth Indices and Body Composition of Caspian Kutum (*Rutilus kutum*)

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Abstract

A completely randomized design was conducted to determine the effect of dietary lettuce (*Latuca sativa*) leaves as plant protein on growth indices of Caspian kutum (*Rutilus kutum*). Four levels (percent) of dried leaves lettuce, including A (control), B, C and D (0, 4, 8 and 12, respectively), made up experimental treatments for replacing with fish meal, wheat and oat at the kutum diet. Growth indices were significantly different among treatments (P<0.05). Food conversion ratio (FCR), food protein efficiency (FPE) and weight gain (WG) rates in treatment C were significantly (P<0.05) higher than other treatments. Specific growth rate in treatment C was higher than other treatments. The highest mortality rate was recorded at treatment B (68%) and this rate in treatment C was least with the rate of 98 percent. The results indicated that dietary lettuce with the rates of between 8-10% would be usable diet for culture of Caspian kutum without any negative effect on its growth.

Keywords: Kutum, Fish meal, Growth indices, Fish diet.

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Assessment of Indices of Species Sensitivity Distributions of Fe_3O_4-MNPs on Different Trophic Levels of the Aquatic Environment Food Chains

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Abstract

In recent decades, improving and expanding the application of magnetic iron oxide nanoparticles in various fields of science caused to double concerns among ecologists about the benefit or potential life-threatening effects of these chemical nanoparticles on human health and ecosystem. In this regard, the present study introduces the ecosystem modeling approach to the toxicity assessment of chemical magnetic nanoparticles (magnetite or Fe_3O_4) at the level of species sensitivity distributions (SSDs) in 5 different taxonomic groups of food chains of salt water and also in four taxonomic groups of freshwater chains was performed. The comparison of the average acute lethal concentration ($ML(E)C_{50}$) and mean mortality (MM) in both species organism in the food chain of aquatic ecosystems showed that a species sensitivity to Fe_3O_4 nanoparticles in aquatic marine ecosystems (MM=36.3%, and $ML(E)C_{50}$=692.9 mg/l) was higher than the organisms in the freshwater ecosystem (MM=33.8%, and $ML(E)C_{50}$=739.7 mg/l), and differences between groups was significant (P<0.05). Among the 9 different taxonomic groups, the most sensitive organism to magnetite nanoparticles was micro-algae *Chlorella* (M = 50%, and $L(E)C_{50}$=130 mg Fe_3O_4/l) and then crustaceans, barnacle (M=70%, and $L(E)C_{50}$=263.5 mg Fe_3O_4/l). However, as the species sensitivity to the acute toxicity of magnetite nanoparticles was evaluated low in all taxonomic groups, this nanomaterial can be classified as non-toxic materials.

Keywords: Environmental model, SSDs, Food chain, Fe_3O_4, Nanoparticles.

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Investigation of Different Levels of Water Oxidation Reduction Potential (ORP) on Physicochemical Parameters of Water, Blood Biochemical Indices and Cortisol Hormone of the Common Carp (*Cyprinus carpio*)

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Abstract

Water Oxidation Reduction Potential (ORP) is a physicochemical indicator of water that is affected by a combination of oxidation and reduction agents in water and wastewater. In addition to affecting many water quality parameters, this indicator alone indicates a general quality of water and wastewater. With due attention to the importance and effects of this indicator on aquatics biosafety, the present study aims to investigate of different levels of water Oxidation Reduction Potential (ORP) on blood biochemical indices and cortisol hormone of the Common carp (*Cyprinus carpio*) and water physicochemical parameter includes COD, BOD, TOC, nitrate and phosphate. To do this research, 72 numbers of the common carp with an average weight of 60±5 gr in 4 treatments with ORP levels 200-250 (control), 250-300, 300-350, 350-400 mv in triplicates were performed. The studied fish were moved in 70 liter tanks for 4 weeks research period. During the research, different levels of ORP in different treatments and the ozone generator was set daily and the ORP measurement was done with the digital ORP-meter device. The results showed that at the end of the study that with increasing trend of ORP levels in the treatments, cortisol hormone levels increased significantly in the fish body. Results of blood biochemical indices included white blood cell count (WBC), red blood cell (RBC), mean cellular volume (MCV) and neutrophil with Increased ORP levels were directly increased significantly based on ORP levels. However, between mean levels of hemoglobin (MCH), hematocrit (HCT), hemoglobin (HB), moderate hemoglobin concentration in red blood cells (MCHC) and monocyte there were no significant difference in the treatments. In general, the results of the research showed that the ORP level in the range of 200 to 300 mv not only has not a negative effect on the fish and their mortality, but also improves the conditions for fish species by improving the water quality indices.

Keywords: Oxidation Reduction Potential, Blood biochemical factors, Cortisol hormone, Ozonation.

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Effects of Kilka and Rapeseed Oils on Growth Performance of Sterlet Broodstock (*Acipenser ruthenus*)

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Abstract

The long-term (6-month) effects of fish oil (Kilka fish) in the diet with vegetable oil (rapeseed oil) were evaluated on the growth performance of Sterlet sturgeon (*Acipenser ruthenus*). Three diets containing fish oil (FO), vegetable oil (VO), and an equal proportion of both fish oil and vegetable oil (FO+VO) were formulated. The fish fed by the FO+VO diet had a higher weight gain in comparison with the other treatments, while fish treated with VO displayed the lowest weight ($P<0.05$). Condition factor indices, average daily growth and increased body weight rates indicated a significant impact in fishes treated by FO+VO diet compared to the fishes fed by VO ($P<0.05$). Assessment of non-specific immune function showed that the number of white blood cells had not affected by FO and VO. The results indicated that using a combination of VO and FO sources can considerably provide necessary lipid for Sterlet sturgeon. This study confirms the importance of nutritional programming in sturgeon to improve growth performance and preserve the health status.

Keywords: Sterlet, Lipid, Vegetable oil, Fish oil, Growth, Nutrition.

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Effects of Slaughtering Methods on Quality of Silver Carp (*Hypophthalmichthys molitrix*) During Refrigerated Storage

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Abstract

To study the effects of different slaughtering methods on the quality of Silver carp, fish were slaughtered by exsanguination, cutting fish gill, and percussion or asphyxiation. For determination of the physical (color: L, a* and b*; texture value and water holding capacity: WHC) and biochemical quality attributes (total volatile basic nitrogen: TVB-N), the fish were stored in refrigerator for 12 days and quality indices were evaluated on 0, 3, 6, 9 and 12th day of storage. The results showed that the slaughtering methods significantly affect the quality of silver carp during storage (P<0.05). Exsanguination treatment showed a delayed onset of TVB-N compared to other groups. The highest values of TVB-N were observed in asphyxiation group that reached to 64.8 mg N kg fish fillet at the end of storage period. Exsanguination, percussion or asphyxiation slaughtering procedures significantly affected on colorimetric mussel color parameters during time and in experimental groups (P<0.05). The results showed slaughtering by exsanguination has higher flesh quality in comparison to other groups.

Keywords: Fish quality; Fish slaughtering method; Shelf-life, Silver carp.

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Study of Herbal Feed Supplement (Contains Zataria and Satureja Powder) on Growth Performance, Survival Rate, Biochemical Blood Characteristics and Body Composition in Common Carp (*Cyprinus carpio*)

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Abstract

The present study performed to examine effect of the herbal supplement, including *Zataria multiflora* and *Satureja khuzistanica* powder (0(H_0), 2(H_1), 5(H_2), 8(H_3) and 13 (H_4) percent per kilogram) on growth indices, survival rate, and biochemical parameters of blood in common carp. Fish were fed with experimental diets for 60 days. The result indicated that the use of different levels of the herbal supplement significantly increase survival rate compared to control group (P<0.05). The highest final weight gain and specific growth rate were observed in the treatment containing H_3 (P<0.05). The best factor for food conversion was observed in H_3 (P<0.05). The highest and lowest condition factor were obtained in H_3 and H_0, respectively (P<0.05). There was no difference between the amount of glucose in fish fed with herbal supplement and that of the control group (P<0.05). The highest value of total protein was measured in fish fed diets, containing 13 g of herbal supplement (P<0.05). The cholesterol and triglyceride levels decreased with increasing herbal supplementation (P<0.05), so that the lowest amount of these factors was observed in the treatment of 8 g of herbal supplement (P<0.05). The amounts of C3 and C4 factors increased with supplementation of herbal and showed the highest amount in H4 treatment (P<0.05). The results of the approximate composition of carcasses of fish showed that protein and carcass ash values in plant supplement treatments were significantly higher than control (P<0.05), and the highest values were observed in H4 treatment (P<0.05), however, no significant difference was found of fat and carcass moisture values among treatments and control treatments (P>0.05). It can be suggested the adding 13 g of herbal supplement per kilogram of carp to improve performance growth, nutrition and biochemical indices in this fish.

Keywords: Herbal supplement, Thyme (*Zataria multiflora*), Satureja, Growth performance, *Cyprinus carpio*.

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Chitosan Production from Indian Squid (*Uroteuthis duvauceli*) Pen and Quality Assessment of the Products

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Abstract

Chitosan, as a biodegradable polymer is widely used for biomedical applications, tissue engineering and medical items. In this study, chitosan produced from Indian Squid, *Uroteuthis duvaucelii*, pen and the quality of produced chitosan was investigated in two ways. In the first method, dry powder of chitin was added to 50% boiling NaOH solution slowly, and in the second method, the chitin was added to the reagent (solid potassium hydroxide, ethanol 96 and monoethylene glycol with a 2: 1: 1 ratio). To determine the physicochemical properties of the extracted chitosan's, the percentage of deacetylation, molecular weight, apparent viscosity, crystallization and elemental analysis using various methods such as infrared spectroscopy, viscometery, XRD and CHN were measured.The results showed that the chitosan molecular weight, produced in first method, was in the range of 1.57×10^5 to 7.8×10^4 Da, and for the chitosan produced in second method was 1.8×10^4 Da. the percentage of the ash of chitin, first chosen and second chitosan was 0.14, chitosan 1.56 and 1.43, respectively. Chitosan elemental analysis showed that the amount of carbon, hydrogen and nitrogen were 12.79%, 17.1% and 22% in first chitosan and 12.90, 0.34 and 0.20 in second chitosan, respectively. The results of FTIR indicated that degree of deacetylation was less than 20%, which is lower compared to commercial chitosan's. Based on the XRD results, the chitosan consisted of strong peak in 26, 33, 36, 38 and 46 crystallization degrees. The chitosan derived from the squid had a low degree of deacetylation, which could be due to different conditions for the preparation of chitosan.

Keywords: Chitin, Chitosan, Squid, XRD, Infrared spectroscopy.

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