

## Effects of Dietary Prebiotic Immunogen on Growth Performance, Hematological Parameters and Body Composition of Koi Carp (*Cyprinus carpio* var. Koi) Fingerlings

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### Abstract

This study was conducted to evaluate the effect of different levels of dietary prebiotic Immunogen on the growth performance, hematological parameters and body composition of koi carp (*Cyprinus carpio* var. Koi) fingerlings. For this reason, 360 koi carp fingerlings ( $4.98 \pm 0.11$  g) were randomly distributed in 12 tanks ( $n=30$  per tank). The fish fed on four different levels of Immunogen (0, 2, 5 and 10 grams of prebiotic per kg diet) for 60 days. The results showed that the highest final weight and specific growth rate (SGR) were observed in the T2 ( $P < 0.05$ ). Minimum condition factor ( $0.81 \pm 0.07$ ) and FCR ( $1.34 \pm 0.08$ ) were measured in T2. However, there was no significant difference between T2 and T3, in this respect ( $P > 0.05$ ). The numbers of red blood cells showed a significant difference between T1 (control) and three other treatments. A significant difference was observed in hemoglobin and hematocrit levels, between T1 and T2. T2 contained the highest number of white blood cells (WBC). The number of lymphocytes were increased and the number of neutrophils were decreased, with increasing the amount of Immunogen ( $P > 0.05$ ). Body composition analysis showed no significant difference between treatments. However, crude protein showed an increasing trend with increasing levels of prebiotic. The results showed that the addition of 2 to 5 grams of Immunogen per kg diet can improve the growth performance, final production, and health (immune system) in Koi fingerlings. Therefore, due to the fact that there was no significant difference between T2 and T3 in measured parameters, 2g Immunogen per kg diet was chosen as the optimum level.

**Keywords:** Immunity, Immunogen, Prebiotic, Diet, Growth, Koi.

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## Histopathological Changes of the Gill and Liver of *Aphanius sophiae* Exposed to Carbaryl

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### Abstract

The present study investigated effects of the pesticide Carbaryl on the liver and gill of *Aphanius sophiae* over 9 days and concentrations of 0.5, 1 and 1.5 mg L<sup>-1</sup>. The tissues were sampled on days 1, 5 and 9 after the start of the experiment for histological studies. The symptoms found in the gill were: hyperplasia, necrosis, peeling of secondary lamella, hypertrophy and epithelial lifting of secondary lamella, curling, fusion, clubbing and destruction of secondary lamella. The symptoms found in the liver were: vacuolation and necrosis of hepatocytes, necrosis of nucleus, regeneration of hepatocytes and autophagy. The present study indicated that histopathological changes of the gill intensified over time while those of the liver decreased.

**Keywords:** Carbaryl, *Aphanius sophiae*, Liver, Gill, Pesticide.

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## Dietary Effects of Turmeric (*Curcuma longa*) on Reducing Liver and Kidney Damage Caused by Exposure to Copper Sulfate in Common Carp (*Cyprinus carpio*)

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### Abstract

Copper sulfate is an approved chemical for snail and aquatic plant control with a wide range of application in warm water fish ponds. In the present study, effects of oral turmeric (*Curcuma longa*) were investigated on suppressing liver and kidney pathology of common carp (*Cyprinus carpio*) exposed to copper sulfate. For this, a total of 180 carp fingerlings with average weight of  $16.51 \pm 2.43$  g were distributed in 12 fiberglass tanks. Three experimental treatments and one control group (with 3 replications) were used for this experiment. The fish were fed (3% of body weight) with diets containing 0, 0.5, 1 and 2% supplemented turmeric for 6 weeks. At the end of this period, the fish were challenged with 1 ppm copper sulfate for one week and then, hepatic enzymes and liver and kidney histopathology were monitored. According to the results, activity of alanine transaminase and aspartate transaminase activity significantly decreased in the fish fed 1 and 2% turmeric compared to the other treatments; however, alkaline phosphatase activity of these two treatments was higher after copper sulfate challenge ( $p < 0.05$ ). Liver and kidney histopathological severity were markedly lower in the turmeric treatments. According to the present study, 0.5-2% dietary turmeric supplementation remarkably decreases potential liver and kidney damage due to copper sulfate challenge in carp.

**Keywords:** Common carp, Turmeric, Histology, Hepatic enzymes, Copper sulfate.

# Effect of Dietary Fish Oil Replacement by Grapeseed Oil on Growth Performance, Body Composition and Lipase Activity of Rainbow Trout (*Oncorhynchus mykiss*)

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## Abstract

In this study, the replacement effect of dietary fish oil with grapeseed oil was assessed on growth performance, body composition and lipase activity of rainbow trout (*Oncorhynchus mykiss*) ( $40 \pm 2$  g mean individual weight) over a period of 60 days. At the beginning of trial, 5 experimental diets were formulated with fish oil as control (A) and diets with 25% (B), 50% (C), 75% (D) and 100% (E) grapeseed oil, respectively. At the end of feeding trial, growth performance, body composition and lipase activity from pyloric caeca and intestine were measured. The findings showed the significant differences in parameters of WG, HIS, VSI, FCR, moisture and crude protein among experimental diets ( $P > 0.05$ ). The parameters of SGR, CF, crude fat and ash had no significant differences among experimental diets ( $P < 0.05$ ). The highest lipase activity from pyloric caeca and intestine was observed in the fish fed with diet C with a significant difference than that from other diets ( $P > 0.05$ ). Based on the results of growth performance, body composition, lipase activity and broken line data analysis was revealed that the diet containing 50% grapeseed oil (C) could be appropriate for rainbow trout growth.

**Keywords:** Fish oil, Grapeseed oil, Lipase, Growth performance, *Oncorhynchus mykiss*.

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## Identifying Factors Involved in Illegal Fishing in the Southwestern Caspian Sea

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### Abstract

Excessive and illegal exploitation of aquatic resources, especially Caspian sturgeon, are serious threats to their long term protection. Given the importance of maintaining stocks of sturgeon, the study on major causes of committing illegal fishing by fishermen is inevitable. In this study, data were collected through field-based surveys and a questionnaire. Validity and reliability of the questionnaire were assessed based on expert's knowledge and Cronbach's alpha coefficient. Sample size was estimated using Cochran's formula, and then 201 questionnaires (designed based on Likert scale) were distributed among fishermen in Guilan province during spring and summer 2016 to answer questions related to social, economic, fisheries and conservation factors. Data were analyzed using Logit Model. Results showed that social and economic factors such as study level, income and job satisfaction had significant correlations with the occurrence of illegal fishing ( $P < 0.05$ ). Fishers who had less income and job satisfaction and lower study level were more likely to be involved in illegal fishing ( $P < 0.05$ ). In addition, fishermen with no license, giving less value for the protection of aquatic animals and who used non-standard fishing nets in deeper waters showed higher probability of committing illegal fishing. In conclusion, it appears that the probability of the occurrence of illegal fishing has a close association with a range of social, economic, fisheries and conservation parameters, and these findings could help fisheries managers in preventing the occurrence of illegal fishing activities.

**Keywords:** Illegal fishing, Logit model, Sturgeon, Southwestern Caspian Sea, Fisheries management.

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## The Effects of Tomato Pomace with Enzyme on Growth, Body Composition and Digestibility of Common Carp (*Cyprinus carpio* L.)

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### Abstract

This study was to evaluate growth performance, nutrients digestibility and body composition in common carp, *Cyprinus carpio*, fed different levels of tomato pulp supplemented with enzyme complex. This research was conducted in the frame of a completely randomized design with seven four treatments and three replicates each. The diets were formulated by exchanging 10, 20 and 30% of tomato pulp with soybean meal and wheat flour. The three experimental diets were made by inclusion of enzyme complex (at 0.4 g/kg) to the pulp diets. A diet with no enzyme and tomato pulp was considered as a control diet in the current study. The result showed that maximum growth in common carp was obtained with diet contained 10 % tomato pulp ( $P<0.05$ ). Inclusion of 10% tomato pulp also improved substantially feed conversion ratio than the other diets ( $P<0.05$ ). In addition, 30% tomato pulp inclusion did not change carp growth compared with the control diet. Dry matter digestibility in carp was not affected by addition of progressive levels of tomato pulp with enzyme. However, protein digestibility was decreased with increasing the tomato pulp levels. Maximum protein digestibility was observed in common carp feeding on control diet and this is followed by diets with 10, 20 and 30% tomato pulp ( $P<0.05$ ). Fat digestibility improved with increasing tomato pulp levels in the diets. Moreover, tomato pulp with enzyme did not influence body composition in common carp ( $P>0.05$ ).

**Keywords:** Tomato pulp, Enzyme complex, Digestibility, Growth, Common carp.

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# Phylogenetic Relationship of Members of the Genus *Rutilus* Rafinesque, 1820 in the Southern Caspian Sea (Bandar Turkman, and Shalman and Aras Rivers) Based on Osteological Characters

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## Abstract

The phylogenetic analysis of the members of the genus *Rutilus* from the southern Caspian Sea was analyzed based on the osteological characteristics. For this purpose, three population of Roach from Bandar-e Turkman, Shalmanrood River and Aras River (each 10 specimens) as in-group and 10 specimens of Kutum fish (*Rutilus kutum*) were used as out-group. The fish were stained and cleaned according to standard methods for osteological examination based on direct observation. Phylogenetic analysis was performed based on 24 osteological character states and the phylogenetic tree was constructed based on maximum parsimony algorithm using TNT software. The results showed the monophyly of the three Roach populations. The Turkman population with 7 automorphic characters was the plesiomorphic (65% bootstrap number) and the other two Roach groups formed sister taxa. The osteological differences of the Aras population compared to other populations of the Caspian Sea maybe due Phenotype plasticity corresponding to their environmental factors. Based on similarities observed between *R. rutilus* and *R. caspicus* from the Kura, it can be proposed that they belong to same species. Also it can be proposed that the *R. caspicus* from Turkman may be a distinct taxon.

**Keywords:** Phenotype plasticity, Taxonomy, Caspian Sea, Cyprinidae, Ichthyology.

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## Histological and Biochemical Properties of Overripped Oocytes in the Persian Sturgeon (*Acipenser persicus* Borodin, 1897) Broodstocks

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### Abstract

The objective of this study was to examine structural, histological and biochemical properties of overripped oocytes of the Persian sturgeon (*Acipenser persicus*). Oocytes (ripe or overripe) were removed from wild pre-spawn Persian sturgeon during spawning season run to the river of the southern Caspian Sea. Overripening in Persian sturgeon oocyte had a negative effect on egg viability. The percentage of eggs fertilized and hatching rates in overripe oocytes indicated a significant decline compared with the ripe oocyte ( $P<0.05$ ). In the ripped oocytes from Persian Sturgeon broodstocks, four layers of zona radiata were clearly separated and the yolk was made up of homogenous particles and its perivitelline space shape had no considerable difference in different regions. Where as in overripped oocytes, zona radiata layers vanished and became an integrated layer, while the yolk distribution turned into heterogeneous and was more accumulated in the animal pole. The perivitelline space shape varied among different areas of overripped oocyt. The most notable difference were observed in the oocyte fatty acid profiles, which can be showed the higher concentration ( $P<0.05$ ) of saturated fatty acid (SFA) in ripe oocytes ( $26.29\pm 1.76$ ) than overripe oocytes ( $21.70\pm 1.53$ ). Moreover, difference in  $\omega$ -6 fatty acids were higher ( $P<0.05$ ) in overripe oocytes ( $6.21\pm 0.33$ ) than ripe oocytes ( $4.42\pm 0.37$ ). SFA was dominated by palmitic acid, whereas MUFA was dominated by oleic acid in oocytes. The results obtained in this experiment specifies that, in addition to the differences in the zona radiata and oocyte follicular layers, some fatty acids in the Persian sturgeon oocyte such as palmitic acid, palmitoleic acid, arachidonic acid and eicosapentaenoic acid can be used as key factors for the diagnosis of overripped oocytes.

**Keywords:** Persian Sturgeon, Oocyte, Overripe, Structural changes, Fatty acid.

## The Effect of Dietary Nucleotides on Reproduction Indices, Hematological Indices of Rainbow Trout Broodstock (*Oncorhynchus mykiss*)

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### Abstract

The roles of nucleotides and metabolites in fish diets have been sparingly studied for over 25 years. Beside possible involvement in diet palatability, fish feeding behavior and biosynthesis of non-essential amino acids, exogenous nucleotides have shown promise most recently as dietary supplements to enhance immunity and disease resistance of fish produced in aquaculture. This experiment was conducted to examine the effect of dietary nucleotides on Reproduction indices, hematological indices of rainbow trout broodstock. A basal diet supplemented with 0 (control), 1 and 2 g nucleotide Kg<sup>-1</sup> to formulate three experimental diets. 90 female rainbow trout were randomly divided into three experimental groups (30 fish per group) and were fed with one of the three experimental diets over four months prior to spawning. Broodstock fed with 2.0% of nucleotides, exhibited the highest absolute fecundity, gonad weight, white blood cell (WBC), red blood cell (RBC), lymphocytes ( $P>0.05$ ). The results suggest that dietary nucleotides administration at 2 g Kg<sup>-1</sup> exerted positive effects on Reproduction indices, hematological indices of rainbow trout broodstock.

**Keywords:** Rainbow trout, Nucleotides, Reproduction indices, Hematology.

## Effect of Chitosan Nanocomposites and Rosemary Extract (*Rosmarinus officinalis* L.) Coating on Chemical Properties of Inoculated Fillet of *Huso huso* with *Listeria monocytogenes* during Refrigerated Storage

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### Abstract

This study aimed to evaluate the antioxidative and antimicrobial effects of chitosan nanocomposites and rosemary extract coating in the inoculated fillet of *Huso huso* with *Listeria monocytogenes* during refrigerated storage ( $4\pm 1^\circ\text{C}$ ). Fish were filleted and divided into four groups as control (without coating), 0.5% rosemary extract treatment (RET), 1% chitosan treatment (CT) and combination of 1% chitosan and 0.5% rosemary extract as chitosan nanocomposites treatment (CS/RE). Then all samples inoculated with *L. monocytogenes*. Subsequently, the chemical parameters (TVB-N, PV, pH and TBA) and antilisterial properties of coatings were monitored during 16-days of refrigerating storage at  $4\pm 1^\circ\text{C}$ . According to the results, CS/RE demonstrated a significant ( $P<0.05$ ) ability to inhibit the growth of *L. monocytogenes* from 4.14 log cfu/g to 2.23 log cfu/g at the end of the storage period, followed by CT and RET treatments, respectively, compared to the control. In terms of chemical parameters, even though samples coated with CS/RE had the lowest pH, and TVB-N values ( $P<0.05$ ), however, this coating was not able to pause the protein denaturation after 8 days of storage ( $P>0.05$ ) compared to the other treatments. On the other hand, CS/RE coating retarded lipid oxidation by decreasing PV and TBA production in the samples compared to the control up to the end of refrigerated storage ( $P<0.05$ ).

**Keywords:** Chitosan nanocomposite, Rosemary extract, Chitosan, *Listeria monocytogenes*, *Huso huso*.

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