STUDY OF THE EFFECT OF CHOLESTEROL ADDITION TO THE SHRIMP DIET ON THE GROWTH AND FINISHING OF WHITE INDICUS PRAWN (*PENAEUS INDICUS*)

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Abstract. Population increase, enhancing demand for food, especially the optimal use of marine resources, low levels of production in shrimp farms, lack of planning, and pleasant nutrition in farms, requires that research projects on manual feeding in cultural farms of shrimp take place according to the conditions of each region. Recently, shrimp feeding in the world has been accompanied by various innovations in order to maximize the productivity of both the existing ecosystem and the physiological potential of this aquatic species. Cholesterol is one of the ingredients that, in addition to the urgent need for it to be used in the metabolic system to gain weight, as an essential nutrient, increases the number of molting and as a stimulantion for growth. In this regard, the present research, which is the first manual feeding in the Chah-Bahar region of Iran, evaluates the most appropriate and optimal amount of cholesterol in white indicus prawn (*P.indicus*) diets. In this research, different levels of artificial cholesterol levels of 0, 0.25, 0.5, 0.75 and 1% of total feed were added to the shrimp feed of Iranian commercially pellets by dissolving in refined and spray soybean oil and then, in a 100 day culturing period in semi-intensive system, the effects of these cholesterol levels were evaluated and investigated. Finally, it was concluded that the addition of 0.5% artificial cholesterol in prawn (shrimp) diet, significantly increased levels of food intake by *0.05* and *0.01* probability level, the final weight gain of each shrimp and the increase in the final harvest of shrimp per unit area by using a completely randomized design (CRD). Also, adding this amount of cholesterol in shrimp dietaries has led to improved survival rate and feed conversion ratio (FCR).

Keywords: Aquatic Food Industry, cholesterol, shrimp diet, white indicus prawn (*Penaeus indicus*)

Introduction. Economic importance of shrimp (prawn) and its role in human nutrition

Today's thinkers, rather than worrying about nuclear waste or nuclear warfare, are thinking about providing food for the population that needs human growth [1-3]. The idea that a population of 10 billion people in the late next century, about twice the size of the current population of the world, seems to have a nightmare that forces a person to upgrade existing methods of food production and new techniques invented and applied, maybe find an approach to this problem. Meanwhile, aquaculture is one of the activities that will be called a solution today and tomorrow's hope [4, 5]. Because, despite the fact that part of the food needed by humans is currently supplied through this theme, the production is not at its maximum level due to the defects and weaknesses that exist in the biotechnology of breeding many types of aquaculture. This is special reality of shrimp duplication and breeding. The history of shrimp farming in Asia has grown to more than a century, and Far Eastern countries, like China, have been culturing shrimp about 300 years ago in the traditional and traditional ways. Although these countries have been paying special attention to shrimp farming for many years, the nutritional requirements of nursery and shrimp nutrition are among the issues that are not seriously followed up by the old history, and the history of this activity dates back to the early 1970s. Since then, much has been achieved in this regard, but given the expansion of the profession and the development process, these activities should be expanded simultaneously. In our country (Iran), which began the breeding of shrimp on its southern coast from a few years ago and is about to start its place among breeding aquatic animals, it is no exception and the nutritional problems of native breeding and production shrimp species in Iran, needs to be accomplished as soon as possible. On the other hand, if we want to provide shrimp food from abroad (same the past years), the price of food, which is a major component of production costs, It will be very expensive, and perhaps shrimp farming is not at all affordable. Thus, the nutritional requirements of native breeding shrimp species in our country should be determined by conducting the necessary projects to produce the appropriate pellets that can grow more in the lower cost conditions.

The nutritional value of shrimp

High levels of protein, all sorts of minerals and delicious taste of shrimp make this marine product have a highly nutritious and, of course, expensive product. Although the nutrients of shrimp species are almost the same, many scholars believe that shrimp species in Persian Gulf have a higher nutritional value [5].

Table 1: Shrimp Nutritional Value

Type / Compounds	Humidity%	Protein%	Fat%	Ash%	Calcium%	Phosphorus%
Frozen shrimp without shell	76	30.28	1.53	3.25	0.141	0.625
Frozen shrimp with	84.48	18.17	0.69	6.07	0.514	1.544

shell						
Cow	60	17.5	22	0.9	0.10	0.15
Sheep	68	19.1	12	1	0.11	0.194
Broiler chicken	65.8	19.3	11.9	1.09	0.75	0.385

Research Objectives

The main objectives of the research

- The effect of cholesterol on the growth rate, survival, and finishing of white indicus prawn (*P.indicus*).
- Investigating and determining the optimal level of cholesterol in the diet of shrimp nutritionally and economically.

Research Sub-Objectives

- Investigating the quantitative and qualitative increase of breeding prawn produced by using the additional cholesterol.
- Investigating the potential of Indian white prawn (*P.indicus*) for using this type of ingredients at Chah-Bahar specific-region conditions of Iran.
- Helping the region's poor economy by raising production level in the shrimp farms.

Ecological characteristics

The average annual rainfall at the research site (Chah-Bahar district of Iran) is about 100 millimeters, it has a warm and humid climate, the monthly average is 26 ° C, the average monthly relative humidity is 73%, the pH is around 7.83%, and the electrical conductivity is 3930 µm. The total water severity (about CaCo3) is 784 mg/L, and the total alkalinity is around 250 mg/L, and the average regional salinity of the research site is around 37ppt.

Comparison of the final dietary consumption of different treatments per unit

The table of analysis of variance of this indicator shows the difference in final food consumption between treatments at *0.01* probability level that is quite significant (table below). The highest amount of food consumed throughout the entire period is related to shrimp fed with 0.5% cholesterol-supplemented food. After being fed with diets containing 0.25, 0.5, 0.75, 1 and 0% cholesterol, they consumed more food, so that the difference in the amount of food consumed during the whole period between diets including 1 and 0 percentage of cholesterol fed was not significant.

Table 2: Analysis of variance of standard error of the mean of total food consumption of diverse treatments per unit area

Sources of changes	Degrees of freedom	Average of squares
Treatment	4	416.38
Standard Error (SE)	10	3.11

Correlation coefficient factor (R2) = 0.98

Coefficient of variation (CV) = 0.51

Table 3: Comparison of total food consumption of different treatments per unit area

Treatment	Average (g)
Treatment 1	333.02 ^{d}
Treatment 2	352.88 ^{d}
Treatment 3	361.17 ^{d}
Treatment 4	343.42 ^{d}
Treatment 5	335.74 ^{d}

Comparison of final weights of each prawn margin in different treatments

The variant analysis table of this indicator shows that the final weight difference of each shrimp in different treatments at *0.01* probability level is completely significant. The highest final weight of each piece of prawn is related to prawn

fed with 0.5% additional-cholesterol diet followed by shrimps fed with diets containing 0.25, 0.75, 1 and 0% cholesterol, with a higher weight, respectively. So that the difference in final weight of each shrimp fraction in treatments fed with diets containing 0.5 and 0.25% cholesterol is quite significant among other treatments.

Table 4: Variant analysis standard error of the mean weight of each prawn (shrimp) in different treatments

Sources of changes	Degrees of freedom	Average of squares
Treatment	4	0.32
Standard Error (SE)	10	0.02

Correlation coefficient factor (R^2) = 0.89

Coefficient of variation (CV) = 1.46

Table 5: Comparison of final weights of each piece of prawn in different treatments

Treatment	Average (g)
Treatment 1	8.41^b
Treatment 2	8.94^a
Treatment 3	9.11^a
Treatment 4	8.47^b
Treatment 5	8.45^b

Comparison of the final harvest of prawn in different treatments per unit area

The variant analysis table of this indicator shows that the difference between the final harvesting of prawn per unit area in diverse treatments at the level of one percent of additional cholesterol is exactly significant. The most harvesting of shrimp was about group that was fed with 0.5% cholesterol-supplemented diet, then the highest final harvesting of product was about group that was fed with diet contains 0.25% cholesterol, and the difference between two treatments with three other treatments is quite significant. Eventually, the final harvest of prawns were higher in treatments that were fed with 0.75, 0% and 1% cholesterol diets, respectively.

Table 6: Analysis of variance of standard error of the mean of final prawn harvest in different treatments per unit area

Sources of changes	Degrees of freedom	Average of squares
Treatment	4	151.45
Standard Error (SE)	10	11.82

Correlation coefficient factor (R^2) = 0.84; Coefficient of variation (CV) = 2.91

Table 7: Comparison of final harvesting average of each prawn in different treatments per unit area

Treatment	Average (g)
Treatment 1	114.13^b
Treatment 2	123.06^a
Treatment 3	128.15^a
Treatment 4	115.74^b
Treatment 5	110.66^b

Comparison of logarithms of final number of prawn in different treatments per unit area

To analyze the variance of this index, several changes and data transformations were initially made, which include logarithmic variation and transformation of arc sinus [6].

Finally, in the statistical results, there was no discrepancy between this tone without any discrepancy between this change and the statistical changes, but since the change is more appropriate, with the lowest coefficient of variation and the highest detection coefficient, therefore, during this change and conversion, the logarithmic transformation that had the lowest coefficient of variation and the highest detection coefficient was selected and evaluated. The variance analysis table of this index shows that the difference between mean logarithms of the final number of prawn in different treatments is not significant at *0.05* probability level. The best survival ratio was about the shrimps fed with 0.5% cholesterol-supplemented food. Afterwards, the survival rate of prawns were for treatments, which were consumed diets containing 0.25, 0.75, zero, and 1% cholesterol, respectively.

Comparison of total food conversion ratio in different treatments

The analysis of variance table of this index shows that the difference in nutritional conversion ratio between treatments is not significant at *0.01* probability level.

Considering the amount of food consumed, the best food conversion factor (FCR) is fed with 5% colesterol-supplemented pellets because the lowest food conversion factor is related to this treatment. And the end, the best FCR were for groups of shrimps which they were consumed the pellets including 0.25, 0, 0.75 and 1% cholesterol in diets.

Table 7: Analysis of variance of standard error of the mean of food conversion ratio (FCR) of different treatments in the whole period of culturing

Sources of changes	Degrees of freedom	Average of squares
Treatment	4	0.02
Standard Error (SE)	10	0.008

Correlation coefficient factor (R^2) = 0.50; Coefficient of variation (CV) = 3.13

Table 8: Comparison food conversion factors (ratio) of different treatments in the whole cultural season

13	Average (g)
Treatment 1	2.92^{Ab}
Treatment 2	2.87^{ab}
Treatment 3	2.82^{b}
Treatment 4	2.97^{ab}
Treatment 5	3.03^{b}

Review and compare this research with previous tests

Comparing the current research with the experiments that we have previously used on other species indicates that the results are consistent. With increasing shrimp weight, cholesterol requirement of shrimp, reduced. In this experiment, the fourth biometry was based on a variance analysis table that fed a diet containing 0.25% cholesterol, a better weight gain was about treatments treated with diets containing 0.75 the percentage of cholesterol was fed. If the mean daily weight gain of prawn, the diets containing 0.75% cholesterol in the diet was higher than the average daily weight gain of the treatments that was consumed the diet containing 0.25% cholesterol.

The effect of disruption on the entire test

One of the disadvantages of the first month of breeding season was the lack of electricity and the absence of a central aeration system; this problem, however, was eliminated by purchasing large aquarium pumps and electric motors and was not ultimately a particular problem at the beginning of the culture periode. In addition, the conditions for all trial treatments were the same.

Conclusion and Suggestions

According to the results of this research, the amount of natural cholesterol in the Iranian pellets of shrimp diets currently produced by the Iranian company are less than the amount of requirement cholesterol of Indians' white shrimp in different stages of growth. Therefore, it is recommended to add 0.5% artificial cholesterol to the current beginning diets (starter 1 and starter 2. Also, is offered that around 0.25% cholesterol add to the grower pellets. If the food in the whole course of a formulation is in different sizes, then the amount of artificial cholesterol added to feed 0.5% of the

total diets are suggested. And, of course, it should be noted that there are other researchers and projects that are needed to make these materials more complete, including the period of pellet durability in the water. The durability time of this food in water is less than the optimal one for shrimps in Chah-bahar region, the durability ratio of this kind of pellets was about 2 hours, so it is best to first experiment on the durability of this pellet in water, therefore, this time will reach to the desired level. The protein content of this pellets is 40%, which is less than optimal considering the amount of protein needed for Indian white shrimp at the beginning of culture period (starter 1 and starter 2), and although this feed is currently responding to applicants, but to complete it, on the protein requirements of different stages of Indian shrimp, experiments and designs are also being carried out in order to achieve a certain amount of protein for the better growth of Indian white shrimp (*P.indicus*).

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