APPLICATION OF CHITOSAN AS A FEED SUPPLEMENT IN AQUACULTURE

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Abstract

There were series of experiments on the aquaculture feed using chitosan as a supplement. The experimental animals were giant freshwater prawn and striped catfish. The research tested feasibility of chitosan to encapsulate prawn feed for post larval stages of giant freshwater prawn (*Macrobrachium rosenbergii*) in nursery system. The results reflected that chitosan encapsulated feed could promote better prawn growth and survival in the post larval stages of the prawn. The preliminary results on striped catfish (*Pangasius hypophthalmus*) indicated that a diet containing 2.5% Chitosan supported good growth rate (daily weight gain 3.0 g/day, survival rate 95.7%) and efficient feed utilization (feed conversation ratio 2.24, PER 1.79, ANPU 43). The whole body lipid content of fish ranged from 36 % to 42%. The lowest body lipid contents of fish were found in treatment with diet containing 2.5% Chitosan as feed supplement. It is concluded that supplementing fish feed with 2.5% Chitosan can significantly reduce fillet fat content.

Keywords: aquaculture feed, chitosan, striped catfish

Introduction

Giant freshwater prawn, *Macrobrachium rosenbergii,* is a good choice for the semi-intensive and extensive farming systems.

Nowadays, adult prawns are fed with artificial food in the form of pellets. Vitamins free amino acids and other low molecular weight water solution substances are important diets included in feed pellets in order to achieve maximum growth rate of the prawn. As the nutrients leached very quickly in water, these are unreachable to the prawns. Encapsulation technique has offered a potentially useful approach for delivering nutrients to freshwater suspension feeders by keeping the nutrients intact in polymer coating until the pellet is ingested. Productivity can be improved as nutrients are successfully absorbed.

This work attempted to apply chitosan encapsulated prawn feed in post larval stages of *Macrobrachium rosenbergii* nursery experiment in order to promote prawn growth weight and survival rate, and to improve water quality of cultural tanks.

Striped catfish (*Pangasius hypophthalmus*) is important for commercial fisheries and aquaculture in Southeast Asia. Striped catfish has high growth rate and it is adaptable to various feed and rearing conditions. It can be cultured in ponds and cages using various methods including integrated cultured with livestock. It is an omnivorous fish that will accept trash fish, pellets, homemade feed formulated from agro and fishery by products, aquatic plants and even animal and human wastes in culture systems. Homemade feeds normally consist of rice bran, broken rice, trash fish and vegetables.

Chitosan is a modified carbohydrate polymer derived from the chitin component of the shells of crustacean. Chitosan is a special fiber which is able to "soak up" or absorb anywhere from six to ten times its weight in fat and oils. In substance, it is chemically similar to the plant fiber, cellulose. However, Chitosan is able to significantly bind with fat molecules and convert them into a form which the human body does not absorb. However, the role of dietary Chitosan on fish body composition has not been well studied.

Hydroxycitric acid, commonly known as HCA, is a chemical compound produced (an acid) in the fruit of the *Garcinia cambogia* plant. HCA extracted from the *Garcinia cambogia* fruit is widely marketed as a weight control or body fat reduction food supplement for humans. However, scientific evidence for it body fat reduction potential is scarce. The use of a high-fiber diet in combination with HCA may reduce gastrointestinal absorption of HCA, since high-fiber diets may reduce absorption of many nutrients and micronutrients.

This study is focused on the evaluation of different level of Chitosan and hydroxycitric acid supplementation to experimental fish feed supplemented in it for reducing lipid and off-flavor to produce better meat quality of juvenile *Pangasius hypophthalmus.* It is assumed that if dietary supplementation of Chitosan and HCA can reduce fat on *Pangasius hypophthalmus,* it may provide consumers with better flesh quality fish.

Utilization of chitosan in aquaculture might develop into a commercially successful application. Chitosan has antiviral immunopotentiating and antimicrobial functions in animals. Furthermore, it uses as coating on feed/chitosan encapsulated feed would promote the prawn growth and to provide better survival rate than the control. Feed enhancement using encapsulation of nutrient supplements and probiotics may also play a role in enhancing quality of post larvae, as well as reducing the need for antibiotic intervention.

Materials and methods

The research on prawn feed tested feasibility of chitosan to encapsulate the feed for post larval stages (Pl 20-25) of giant freshwater prawn (*Macrobrachium rosenbergii*) in nursery system with stocking density of 400 pieces per tank. The animals were fed with three different types of feed. There were used two different concentrations of chitosan solution as 100 ppm and 200 ppm to encapsulate the formulated prawn feed for experiment, and without chitosan for control.

In the cat fish feeding experiment, *Pangasius hypophthalmus* fingerlings were fed to at 5% biomass per day. Feeding was done twice daily. Fish were not sampled during the experimental period to minimize fish stress. During harvesting, cages were pulled out from the pond and fish were collected by using a hand net. Six fish were collected from each cage to analyze body composition. All ingredients, except cassava flour, had a fix ratio in the feed mix. When Chitosan and HCA added to the diet according to the experimental design, amount of cassava flour in the feed mix was reduced.

Results and discussions

Giant Freshwater Prawn

In the experiment on the nursery period of giant freshwater prawn post larval stages, there were three kinds of formulated feed, one was formulated feed only and the others were encapsulated feed pellets using chitosan. Different concentrations of chitosan solution were used as 0,100 and 200 ppm. It was fed at the rate of 20% of biomass for the first week and steadily decreased by the last week as 5% biomass.

Different concentrations of chitosan used as solution coating on prawn feed showed significant effects on growth and survival rates of post larvae. The chitosan feed additive dose at 100 ppm had the final mean body weight of 5.30 gm and survival rate at 84%. The control group had final mean body weight of 3.85 g and survival rate of 80 %. Chitosan solution 200 ppm coated onto feed showed the final mean body weight of 5.21 g and maximum survival rate 86%. The results proved that chitosan could be used to promote the prawn growth.

Chitosan could reduce the feed stuff dissolution and improve water quality of cultural tanks. Some reasons for these better results might be the lower water absorption, longer floating period, and the longer stability time of the chitosan encapsulated prawn feed for all conditions in the rearing tanks.

Striped Catfish

The results is showed slightly high weight gain of fish were found in fish fed diets containing 2.5% Chitosan but it was not significantly different from the fish fed with control. The mean harvested weight of fish fed with 2.5% Chitosan and 5% Chitosan were significantly higher than that of fish fed diet with 3.5% HCA and 1.5% HCA + 2.5% Chitosan, however there were no significant difference in that of fish fed with other diets.

In the present study, the value of Protein Efficiency Ratio (PER) was found to be ranged from 0.99 to 1.79. The value of PER was high among the diets which indicated that efficiency of striped catfish for utilizing dietary protein to the growth is good. PER value of fish fed control diet and diets containing 1.5% HCA + 2.5% Chitosan, 5% Chitosan, 1.5% HCA + 5% Chitosan, and 3.5% HCA + 5% Chitosan were slightly higher than value reported by Webster *et al*., (1992) and Gallagher (1994), which were ranged from 1.20 to 1.39 and from 1.30 to 1.40, respectively. The PER value in present study was similar to that of experiment (0.93-1.43) conducted by Kanjana (2002). Nevertheless, HCA and Chitosan was found no effect on PER. That is because HCA and Chitosan are not related to protein consumption of the fish due to their little or no interaction with the related enzymes.

Body lipid of 40% attained from the diet with 0% Chitosan + 0% HCA that is the fish gained from normal diet without any dietary supplement as a control. The diet with 2.5% Chitosan + 0% HCA was effectively reduced of body lipid (39.74%); moreover, content with 5% Chitosan + 0% HCA was more effective in reducing body lipid content (38.26%). In these treatments of no HCA, increasing the content of Chitosan resulted in decreasing body lipid content. That is what Chitosan can reduce by binding the fat molecules.

Conclusion

From this research, it was found that the higher total weight of post larvae was achieved relative to control (uncoated formulated feed), when chitosan was used as feed coating. Chitosan is highly practical for improvement of prawn growth and water quality control.

Based on the results, it can be found that chitosan dose at 200 ppm could provide higher growth yield than 100 ppm solution encapsulated on prawn feed pellets. Better results could be found in outdoor system than in hatchery.

Nowadays, consumers in developed countries have increasingly becoming interested in organic farming products. Organic farming products are concerned not only with solving toxic residual problems, but also with revival of an environmental ecosystem. Organic aquaculture production has just been started. Chitin and chitosan are naturally biopolymers and the later is potentially an alternative organic material for improvement of both production and water quality in organic prawn farming system. By using chitosan as coating on and adding into prawn feed pellet, improvements could be made in the aquatic animal's health and culture system sanitation. Chitosan concentrations at 100 ppm and 200 ppm were selected for this experiment, and for the next step doses over 300 ppm and 400 ppm, for coating on or adding into prawn feed pellets, should be tested in outdoor nursery system.

Chitosan and HCA had no significant effect on the growth of striped catfish. Supplementing chitosan to feed is effective to reduce fillet lipid levels. Fish fed diets supplemented with 2.5% Chitosan resulted in the lowest fillet lipid. The effects of HCA on lipid of striped catfish are not clear.

Further studies on optimum supplementation level of chitosan and economic performance of feed are warranted.

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