THESIS INFORMATION

Title: Research on production technology of formulated feed for grow - out culture of Orange spotted grouper (*Epinephelus coioides*).
Major: General food technology
Code: 2.11.01
PhD Student: Nguyen Van Nguyen
Advisors: Asso. Prof. Dr Sc. LE XUAN HAI and Dr. NGUYEN VAN HAO
University: HoChiMinh University of Technology, Vietnam National University – HoChiMinh City.

Abstract

Orange spotted Grouper (*E.coioides*) is one of the high value species of marine fish widely cultured throughout coastal areas of Vietnam. However, cultured grouper are fed trash fish, is commonly as the main feed for feeding. Using trash fish in grouper culture relating to the damage of environment, overexploitation of wild fish, disease outbreak and low–yield aquaculture. Formulated feed, therefore, is a suitable replacement for trash fish and also to address concerns. In this thesis, basing on the scientific fundamentals of the biological behaviors and digestibility of orange spotted grouper, composition of selected ingredients, the feed formula for this species has been established and optimized. In addition, a thorough study has conducted to obtain the optimal technical solution for the production technology.

General objective

The major objective of this thesis is to develop a pelleted feed production technology that suitable to the present status of orange spotted Grouper cultured and the trend forward the impetus on sustainable and cost-effective aquaculture development at Vietnam. To obtain this aim, two sub-objectives of the thesis are:

- Basing on the study results of biological and digestible properties for this species, a feed formula for orange spotted grouper juvenile developed that suitable for present status, farming scale and direction of sustainable and cost-effective aquaculture.

- An optimal feed formula established meets all nutritional balance of fish with fast growth, high survival rate and low FCR

Contents

1. Research on biological properties of orange spotted grouper and chemical composition of feed ingredients commonly used as scientific bases for feed formulation.

2. Research on feed formulation for orange spotted grouper.

3. Research on feed manufacturing process, especially the effect of extrusion on the physical properties of grouper feed.

4. Evaluation of diet efficiency for grouper juveniles reared in tanks.

Methods

The pyloric ceacal crude enzyme extract of orange spotted grouper (OSG) juvenile (*E.coioides*) was characterized by SDS-PAGE electrophoresis method. Biochemical assays were conducted to partially characterize various types of enzyme present in the digestive organs of grouper juvenile. Ingredients, fish samples and diets were analyzed for proximate composition by chemical analytical methods following the TCVN standards. Moreover, combining with the *in vivo* method used to evaluate the apparent digestibility of fish for feed ingredient selection. Amino acids were analyzed by HPLC- Picotag and fatty acids were analyzed using gas chromatography (GC-ISO/CD 5509:94). Carcass analysis was used to determine the dietary essential amino acid (EAA) requirement at varying protein level of OSG juveniles. Besides, system approach method used for partition and integration of the grouper feed manufacturing technology. Physical properties of pellet feed were determined by bulk density (Harper, 1979) and water stability (28TCN 102:2004) measuring. Optimization of grouper feed formulation and extrusion process by the Restrictive Area Method. Finally, the parameters collected from OSG juveniles reared in tanks used to determine diet efficiency were environmental parameters, weight gain, specific growth rate (SGR), survival and feed conversion ratio (FCR).

Main results

- The characterized Biological properties and amino acid, fatty acid profile of whole body and nutrient requirements of orange spotted grouper were

determined. These results are the scientific contributions and grouper database added, moreover, it is the vital science fundamentals for aquaculture feed formulation.

- The feed ingredient model generalized and used in aqua - feed production, combined with the physicochemical properties of ingredients and apparent digestibility of OSG in feed ingredient selection. The selected ingredients for feed formulation were Peru fish meal, Indian soybean meal, wheat flour, squid liver powder, squid liver oil, lecithin, mineral - vitamin premix and additives.

- Grouper feed formula established by solving the problem of optimalization for the multi-component objectives associated with the change of the limited nutritional contents to the objective functions. The ratio of selected ingredients in the feed formula for OSG juveniles were 45.5% Peru fish meal, 13.5% Indian soybean meal, 5% squid liver powder, 19.2% wheat flour, 7.8% wheat gluten, 3.4% squid liver oil, 1.0% lecithin and 4.6% of mineral - vitamin premix and additives

- The optimal extrusion regime were determined with the feed rate of 1188 g/min, moisture of the ingredient mixture 37.81%, barrel temperature of 103,75^{0}c, height of pellet 5mm. The finished pellet feed meets all the nutrient requirements, slow sinking, and good water stability for feeding habits of this species.

- The bulk density and water stability of formulated feed were 0.54 g/cm^3 and higher than 2 hours, respectively. Proximate composition of the pellet feed was crude protein (45.58%), moisture (8.63%), crude fat (8.56%), crude fiber (1.62%), NFE (23.27%), crude ash (12.34%), gross energy (4.33kcal/g). The crude protein: gross energy as well as calcium: phosphorus ratio was 105 mg/kcal and 1.34, respectively and total cost of ingredients in feed formula calculated as 16.242 VND/kg (at the time of production).

.

- After 60 days of feeding in tank study, grouper juveniles fed by FON attained specific growth in length 7.9 %/day and weight 3.26 %/day, mean body weight 75.8 g. Correspondingly, Survival was 100%, FCR was 0.81 and significantly different ($p < 0.05$) from the commercial feed.

Scientific contribution of the thesis

1. By using mathematical techniques, the problem of multi - component objective optimalization was conducted rationally and fully accuracy as well as allowing to integrate the fundamentals of biological and mathematical science to establish feed formulation for orange spotted grouper particularly and cultured fish generally.

2. Mathematical modeling and optimalization of multi- component objectives with the combinated optimal criteria (R-criteria) were exploited and applied thoroughly to study the effect of extrusion factors on the physical properties of feed pellet and moreover, to control and improve grouper feed pellet quality.

Application of the thesis to the aquaculture industry

1. The technology of formulated feed production was established in accordance with the present status, small scale grouper culture and development of grouper aquaculture in Vietnam.

2. Allowing to actively solve in feed formulation and produce the formulated feed which meets all nutrient requirements of grouper juvenile. Moreover, it is possible to expand the application of the study methods used in this thesis for other cultured marine species.

Supervisors PhD. Student

Asso. Prof. Dr Sc. LE XUAN HAI and Dr. NGUYEN VAN HAO Nguyen Van Nguyen