

**Long Term Evaluation of Dehulled Soybean Meal as Fish Meal Replacement for
Flounder (from growing size to commercial size) at Practical Fish Farm**

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Abstract

The project, "Long term evaluation of dehulled soybean meal (DHSBM) as fish meal (FM) replacement for flounder (from growing size to commercial size) at the practical fish farm", is the cooperative research between the United Soybean Board/American Soybean Association/Korea (Say Young Jo, Country Director) and Feeds & Foods Nutrition Research Center (Sungchul C. Bai, Director) attached to the Pukyong National University. The goal of this project was to evaluate the possibility of utilizing of Dehulled Soybean Meal (DHSBM) as a fish meal replacement in flounder reared at the practical fish farm for a whole production period.

The research lasted for about 12 months in Pohang, Korea. Four experiments were : (1) Evaluation of the effect of dehulled soybean meal as fish meal replacement on growth of flounder from grower to market size at the commercial fish farm; (2) Evaluation of water pollution parameters; (3) Economical evaluation; (4) Investigation of the palatability of flesh.

The results indicated that dehulled soybean meal could replace up to 30% of fish meal from the growing size to commercial size of flounder with the supplementation of attractant. When considering the pollution degree and economic effect, the formulated feeds based on further researches on the proper replacement levels of dehulled soybean meal in different fish species should be developed in the future.

1. Summary

Experiment 1. Evaluation of the effect of dehulled soybean meal as a fish meal replacement on growth of flounder from grower to market size at the commercial fish farm

This research was conducted to evaluate the possibility of dehulled soybean meal (DHSBM) as a fish meal replacement in flounder from grower to market size (150-800g) for the long term (44 weeks). The inclusion level of DHSBM was based on the previous experiment conducted in 2002. Four experimental diets were prepared: Moist pellet diet (the popular trash fish based diet, MP), Commercial diet (one of the popular commercial diets, COMD), basal diet (fish meal based laboratory-formulated diet, DHSBM₀), soybean meal based diet (30% of fish meal was replaced by DHSBM, DHSBM_{30+Att}). DHSBM₀ and DHSBM_{30+Att} were formulated to contain 50% crude protein and 16.7 kJ g⁻¹ energy. In DHSBM₀, the main protein source was 100% white fish meal, and in DHSBM_{30+Att}, 30% of fish meal was replaced by dehulled soybean meal (70% FM + 30% DHSBM) with attractant. Except the MP, the remaining three experimental diets were manufactured by a commercial company which produce commercial fish feeds in Korea.

The experimental fishes averaging 120 g were conditioned in 20 tons of concrete tank by feeding commercial diets for 2 weeks to adjust to the experimental conditions. After the conditioning period, experimental fishes averaged 151.2±0.3 g (mean±SD) and they were distributed into the four rectangular concrete tanks (4.5m×4.5m×0.8m) as a group of 500 fishes per tank. The number of fish in each tank was adjusted according to growth phase of fish. After checking body weight at the time of mid-term reporting, the final number of fish was reduced to 300 per tank.

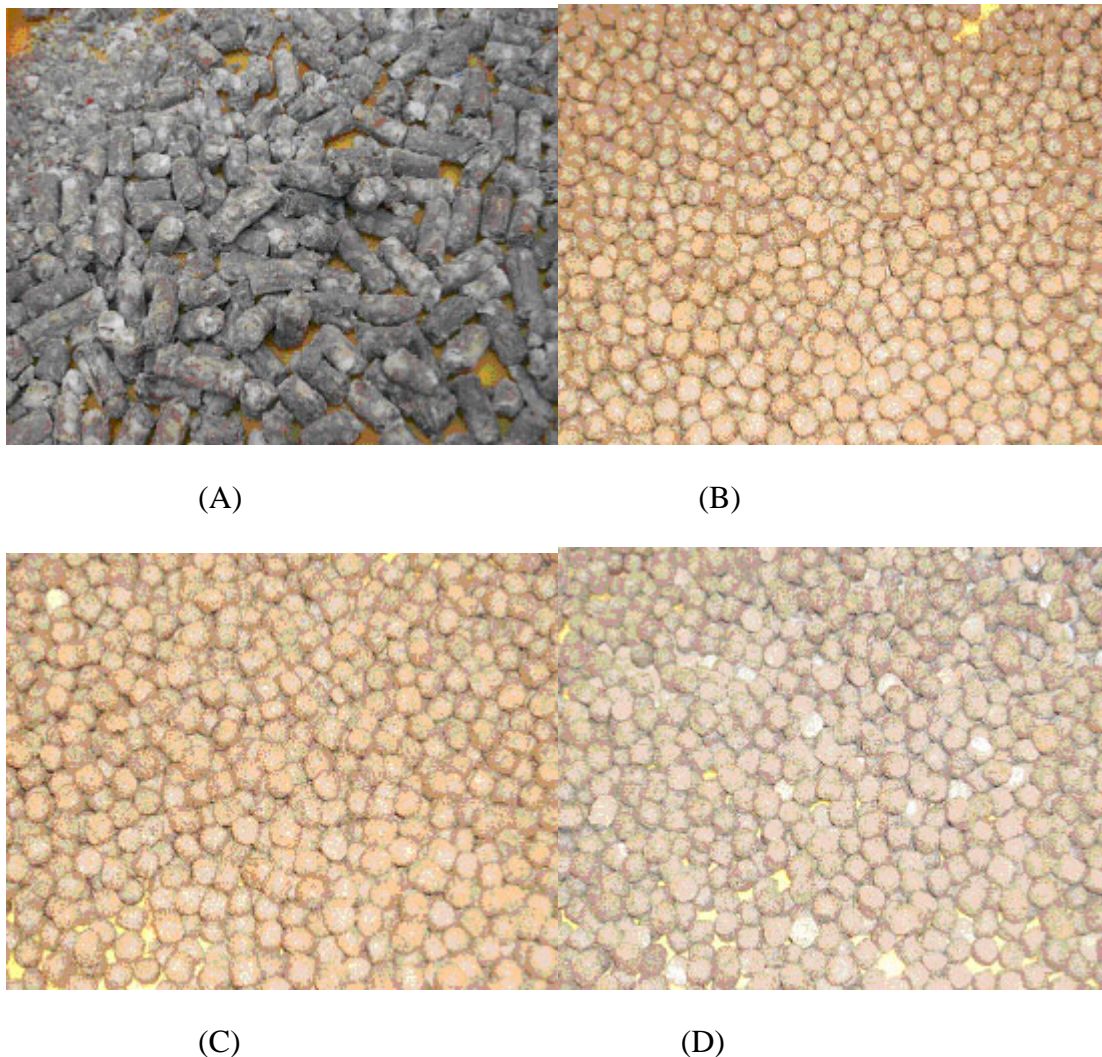


Fig 1. Four experimental diets

A: Moist diet, B: Fish meal diet, C: Soybean meal diet, D: Commercial diet.

Percent weight gain (WG, %), feed efficiency (FE, %), specific growth rate (SGR), protein efficiency ratio (PER), hepatosomatic index (HSI), condition factor (CF) and survival (%) of fish fed the experimental diets for 44 weeks were investigated.

There was no significant difference in WG, FE and SGR in fish fed MP, DHSBM₀ and DHSBM_{30+Att} diet. However, the WG, FE and SGR of fish fed MP, DHSBM₀ and DHSBM_{30+Att} diet were significantly higher than those of fish fed COMD diet ($P < 0.05$). PER of fish fed DHSBM_{30+Att} diet was significantly higher than those of fish fed MP, DHSBM₀ and COMD diets ($P < 0.05$). There was no significant difference in PER of fish fed MP and COMD diets. No significant difference in HSI was observed in fish fed DHSBM₀, DHSBM_{30+Att} and COMD diets, however HSI of fish fed DHSBM₀, DHSBM_{30+Att} and COMD diets was significantly higher than those of fish fed MP diet ($P < 0.05$).

There was no significant difference in condition factor (CF) among all dietary treatments. No significant difference was observed in survival rate of fish fed DHSBM₀, DHSBM_{30+Att} and COMD diets, however, the survival rate of fish fed DHSBM₀ and DHSBM_{30+Att} was significantly higher than that of fish fed MP diet (P<0.05). There was no significant difference in survival rate between the fish fed MP and COMD diets. Whole body proximate compositions were similar among all dietary treatments. The apparent digestibility coefficient of protein was calculated 92.0±2.6% without significant difference among MP, DHSBM₀, and DHSBM_{30+Att} diets. However, the apparent digestibility coefficients of protein in fishes fed MP, DHSBM₀, and DHSBM_{30+Att} diets were significantly higher than that of fish fed COMD diet (P < 0.05).

Based on these results, it can be concluded that dehulled soybean meal could replace up to 30% of fish meal in the diet for flounder ranging from grower to marketing size.

Experiment 2. Evaluation of water pollution parameters

During the 44 weeks of the feeding trial, triplicate water samples were taken every month after 30 minutes (turn-over time for tank water) of feeding at the inflow, center and outflow points of each tank.

The suspended solid (SS), chemical oxygen demand (COD), NH₄⁺-N, and NO₂⁻-N of the tank offered with the DHSBM₀, DHSBM_{30+Att} and COMD diets were significantly lower than those of the tank fed the MP diet (P < 0.05). There was no significant difference in SS, COD, NH₄⁺-N, and NO₂⁻-N of the tanks fed the DHSBM₀, DHSBM_{30+Att} and COMD diets. NO₃⁻-N content of the culture water was similar among all dietary treatments. The total phosphorus content in culture water fed soybean meal diets was significantly lower than the other experimental groups, and the total phosphorus content in culture water fed the formulated diets such as DHSBM₀, DHSBM_{30+Att} and COMD diets was significantly lower than that of MP diet (P<0.05).

When dehulled soybean meal was used as a dietary ingredient, it would be possible to reduce discharge of phosphorus and nitrogen from fishes, as a result, improving water quality of commercial flounder growing operations.



Fig. 2. Water quality after feeding of DHSBM_{30+Att} based on dehulled meal



Fig. 3. Water quality after feeding of Moist pellet based on trash fish.

Experiment 3. Economical evaluation

The feed production cost for basal diet (fish meal based laboratory- formulated diet, DHSBM₀) and soybean meal based diet (30% of fish meal was replaced by dehulled soybean meal, DHSBM_{30+Att}) were calculated to compare. The total feed cost required to market 1,000 ton of flounder when feeding DHSBM_{30+Att} compared with DHSBM₀ could be saved by 280,000,000 won (approximately \$280,000), assuming that the price of fish meal was 1200 won(\$1.2)/kg and the price of soybean meal was 360 won(\$.36)/kg (based on the price of January, 2004).

Experiment 4. Investigation of the palatability of flesh

After the feeding trial, the palatability of flesh (raw fish) of flounder fed the 4 different experimental diets was investigated. The parameters including odor, taste, texture and overall acceptability together with the functional parameter such as gloss were determined. A panel of 50 persons including people who do not refuse to eat raw fish such as the undergraduate, graduate students, university staffs and professors in the Department of Aquaculture,

Department of Food Science and Feeds & Foods Nutrition Research Center in the Pukyong National University, and the people who related to the feed company were invited to the test and then divided into triplicate groups. The statistical analysis of palatability test was performed using SAS (Statistical Analysis System). One way ANOVA test was used to test the difference among the treatments. Treatment effects were considered to be significant at $P < 0.05$.

The result of the palatability test indicated that there was no significant difference between DHSBM_{30+Att} diet and MP diet. However, the palatability of DHSBM_{30+Att} diet appeared to be higher than that of DHSBM₀ and COMD diets ($P < 0.05$). There was no difference in palatability of fish fed the MP, DHSBM₀ and COMD diets. Odor was similar among fishes fed DHSBM_{30+Att} and MP diets. However, odor of fish fed DHSBM_{30+Att} diet was significantly higher than fish fed DHSBM₀ and COMD diets ($P < 0.05$). There was no significant difference among fish fed the MP and COMD diets and among fish fed DHSBM₀ and COMD diets. No difference in color was observed in fish fed MP, DHSBM₀ and DHSBM_{30+Att} diets. However, the color of fish fed DHSBM_{30+Att} was significantly better than that of fish fed COMD diet ($P < 0.05$). There were no significant difference in texture and taste among fish fed the experimental diets.

This study indicated that the palatability of flounder flesh (raw fish) could maintain even by partial replacement of fish meal with soybean meal (30% of fish meal). It suggests that the commercial value of cultured fish fed dehulled soybean meal could be improved with proper supplementing of feed attractant or additives.



Fig 4. Olive flounder fed DHSBM_{30+Att} diet.