

# Studies on the utilization of extruded corn gluten and soybean meals in rainbow trout *Oncorhynchus mykiss* diet

学位名	博士(海洋科学)
学位授与機関	東京海洋大学
学位授与年度	2020
学位授与番号	12614博甲第562号
URL	<a href="http://id.nii.ac.jp/1342/00001992/">http://id.nii.ac.jp/1342/00001992/</a>

## Doctoral Dissertation Summary

専攻 Major	Applied Marine Biosciences	氏名 Name	Taan Rena Santizo
論文題目 Title	Studies on the utilization of extruded corn gluten and soybean meals in rainbow trout <i>Oncorhynchus mykiss</i> diet (ニジマス用飼料におけるエクストルーダー処理コーングルテンミールおよび大豆油粕の利用性に関する研究)		

### Dissertation research topics:

- I. Effect of different thermal extrusion processing of soybean and corn gluten meals on their nutritional value for rainbow trout, *Oncorhynchus mykiss* diet.
- II. Utilization of combined extruded soybean and corn gluten meals as feed ingredients for juvenile rainbow trout, *Oncorhynchus mykiss* diet.  
(This part was published in *Aquaculture Research* (2020) with doi 10.1111/are.14731; Publisher: John Wiley & Sons Ltd.)
- III. Effect of high temperature extrusion of soybean and corn gluten meals as feed ingredients for juvenile rainbow trout, *Oncorhynchus mykiss* diet.

### Purpose:

The comprehensive studies on the effect of extrusion cooking on the availability of plant ingredient in rainbow trout, *Oncorhynchus mykiss* diet that were presented in this dissertation had the following purpose:

- I. To determine the nutritional values of soybean and corn gluten meals extruded at 100°C (low temperature, LT) or 150°C (high temperature, HT).
- II. To examine the effects of extrusion cooking temperature on soybean meal and corn gluten meal as combined ingredients in the diet for juvenile rainbow trout with methionine supplementation, in terms of nutritional value, fish growth performance, feed utilization, and apparent digestibility.
- III. To know which among the high temperature extruded ingredients gives improved overall fish performance and feed utilization.

### Methodology:

- I. Four isonitrogenous (41%, CP) and isolipidic (14%, CL) diets were made to proceed for the 12-week feeding trial. Control group is fishmeal based, NE diet contains non-extruded SBM and CGM, LT diet is composed of low temperature extruded SBM and CGM while HT diet is composed of high temperature extruded SBM and CGM. 240 individuals of rainbow trout with initial average body weight of 12.5 g were randomly distributed to 12 60L aquaria and fed two times a day at satiation for six days a week. Sampling was done every 4 weeks to monitor fish performance and feed efficiency. Feces were collected for digestibility study. Chemical analysis including proximate, chromic, and phosphorus were done.
- II. Four isonitrogenous (44%, CP) and isolipidic (14%, CL) diets were made. Control group is fishmeal based, NE diet contains non-extruded SBM and CGM, LT diet is composed of low temperature extruded SBM and CGM while HT diet is composed of high temperature extruded SBM and CGM. NE, LT and HT diet were supplemented with 0.3% D-L methionine. 240 individuals of rainbow trout with initial average body weight of 7.8 g were randomly distributed to 12 60L aquaria and fed two times a day at satiation for six days a week. Sampling was done every 4 weeks. Feces were also

collected for digestibility study. Chemical analysis including proximate, chromic, phosphorus and mineral analysis were done.

III. Another feeding trial was done utilizing 5 isonitrogenous and isolipidic diets. Control is still fishmeal based; NE contains non-extruded SBM and CGM; HTS has HT SBM + NE CGM; HTC has HT CGM+ NE SBM; HTSC has both HT SBM and HT CGM. 300 individuals of rainbow trout juveniles with initial average body weight of 6.9 g were randomly distributed to 12 60L aquaria and fed two times a day at satiation for six days a week. Sampling was done every 4 weeks. Feces were also collected for digestibility study. Chemical analysis including proximate, chromic, phosphorus and mineral analysis were done.

#### Results:

- I. Result of the feeding trial shows that the control group had the highest value for final body weight and weight gain which is significantly different ( $P < 0.05$ ) with NE and HT group but not with the LT group. Specific growth rate (SGR) of HT group had the lowest value and is significantly different with that of the control. Daily feed intake was not affected by the dietary treatments. Feed conversion ratio (FCR) of the control group is significantly different among all treatments and trend for the protein efficiency ratio (PER) was the same with that of the SGR. The result of the total amino acid composition of the fish body is noteworthy because the methionine level of both the LT and HT group are low which reflects that of the methionine level of the respective diets. Moreover, the methionine level of the diets is below the requirement of rainbow trout to support optimum growth of the fish. The digestibility data had promising result as the protein digestibility was found to be highest for LT and HT group and phosphorus and manganese absorption was also found to be highest in HT group.
- II. Result for the digestibility study shows that protein digestibility of LT and HT group were comparable with the control group and significantly different ( $P < 0$ ) with the NE group. For the growth performance, final weight and weight gain, values were found to be highest in HT group which is comparable with the control group and significantly higher than NE group. SGR of NE group was significantly lower among other treatments. FCR and daily feed intake were not affected by dietary treatments. Likewise, PER was found to be highest in HT group and significantly lower than NE group. For the nutrient retention, protein retention was found to be significantly higher in LT, HT and control group than in NE group. Values for lipid retention was significantly higher in LT and HT groups than in control and NE groups which is also reflective of the result for the fish body composition. Levels of phosphorus and manganese were still higher in HT group. It seems that remarkable result was observed for the HT group.
- III. ADC for dry matter, crude protein and crude lipid of control group and HTSC group are the same and significantly higher than others. Moreover, the phosphorus absorption of HTSC group is significantly higher among all treatments. Growth performance in terms of final weight, weigh gain and SGR shows that control group had significantly higher values among others followed by HTSC group. For feed efficiency, NE group had significantly lower values among others. For nutrient retention, it is noteworthy to mention that HTSC group had highest values for both protein and lipid retention. This study demonstrated that combined high temperature(150°C) extruded SBM and CGM resulted to improved growth, feed efficiency, nutrient utilization, digestibility and fish body composition. Also, the performance of fish groups fed HTS or HTC are the same.

Conclusion:

- I. Thermal condition during extrusion cooking had an effect on the nutritional value of SBM and CGM in relation to growth and feed efficiency in rainbow trout. This study demonstrated that extrusion of soybean and corn gluten meal could be helpful for improving feed performance of rainbow trout.
- II. This study demonstrated that extruded SBM and CGM at 150°C can be included in the diet for rainbow trout without adversely affecting fish performance, feed utilization, nutrient retention and fish body composition.
- III. Diets containing high temperature (150°C) extruded SBM and CGM enhanced fish growth, feed utilization, nutrient retention, body composition and digestibility in rainbow trout. Extrusion temperature (150°C) in this study is suitable for the processing of SBM and CGM as feed ingredients for rainbow trout.