# Evaluation of protein reduction and essential amino acids supplementation of plant- and animal protein-based diets on rainbow trout *(Oncorhynchus mykiss)* production

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## Overview

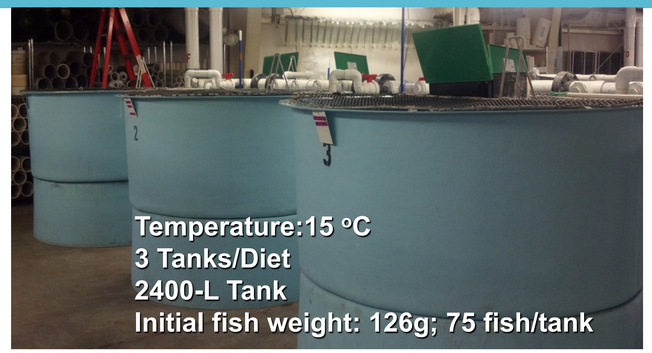
- The use of fishmeal in aquafeed industry is limited due to shortage in supply from capture fisheries, which affect sustainability of the aquaculture industry.
- The use of alternative ingredients in aquafeed industry for carnivorous fish like rainbow trout is challenging.
- Our alternative diets from animal- and plant formulated were balanced with amino acids to supply 40% digestible protein using the Ideal Amino Acids Concept.
- Seventy-five rainbow trout of 126g average weight were fed the animal- and plant protein based diets for a 16-week period in a recirculating system at 15°C.
- Cost, growth performance, nutrient utilization by gut microbes were compared between fish fed the alternative diets to the commercial trout diet.
- Alternative diets supported trout performance. The plant protein diet is more economical for trout production and the diet did not alter microbial compositions in trout gut.

### Table 1. Experimental Diets

| Ingredient | Animal Protein Diet | Plant Protein Diet |
|---|---|---|
| Fishmeal | 0.00 | 0.00 |
| Chicken 42-ADF | 13.02 | 0.00 |
| Blood meal | 2.97 | 0.00 |
| Corn protein concentrate | 8.80 | 20.30 |
| Soybean meal 48%CP | 12.39 | 15.96 |
| Soy protein concentrate | 0.00 | 20.30 |
| Wheat flour | 20.62 | 17.83 |
| Menhaden fish oil | 7.45 | 18.34 |
| Lecithin | 0.93 | 1.00 |
| Stay---C 35 | 0.14 | 0.15 |
| Monocalcium phosphate | 1.21 | 3.80 |
| Choline Cl 50% | 1.00 | 1.00 |
| DL---Methionine | 0.67 | 0.64 |
| Lysine HCl | 2.67 | 3.11 |
| Threonine | 0.85 | 0.81 |
| Trace mineral | 0.93 | 0.94 |
| Vitamin mineral premixes | 2.28 | 2.26 |

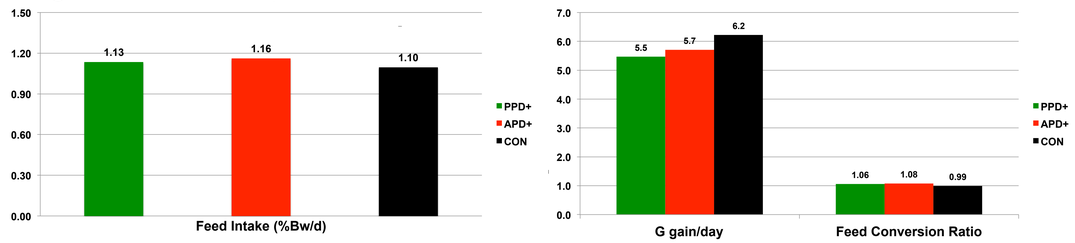
CON - The Proprietary commercial diet contains 45% crude protein

## Feeding Trial




## Results

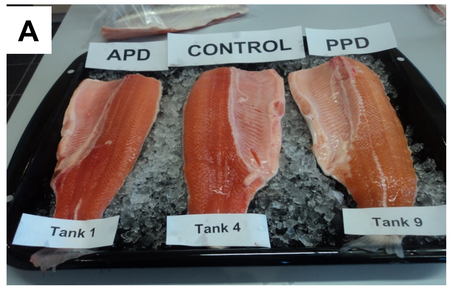
**Fig. 1 Rainbow Trout performed well on the alternative diets**

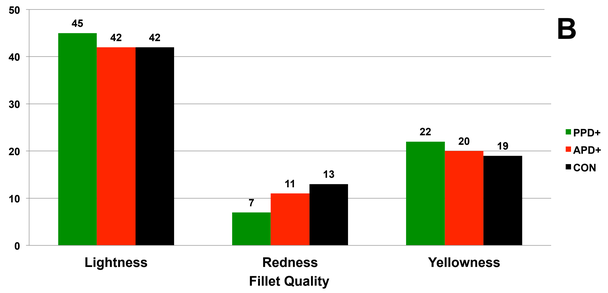



Feed intake, gram gain per day and feed conversion ratio were not significantly affected by feeding the alternative animal and plant diets to rainbow trout ($p>0.05$).

**PPD⁺ = Plant Protein Diet; APD⁺= Animal Protein Diet; CON = Commercial Diet**

**Fig. 2 Fillet Quality of Rainbow Trout**




Trout fillet color determined by physical (A) and Minolta color reader (B) showed that fish fed plant protein diet tend to be lighter in color compare to the normal red color of fillet from animal and commercial trout diet.

**Table 2. Cost Analysis of Alternative Diets**

| Dietary treatment | Ingredient cost ($/lb ingredients) | Ingredient cost/gain ($ ingredient cost/lb gain) |
|---|---|---|
| CON | 0.656 | 0.646[b] |
| APD⁺ | 0.688 | 0.741[a] |
| PPD⁺ | 0.656 | 0.695[b] |

[b]Production cost of the PPD⁺ was the same as the control diet

## Microbial Profiles

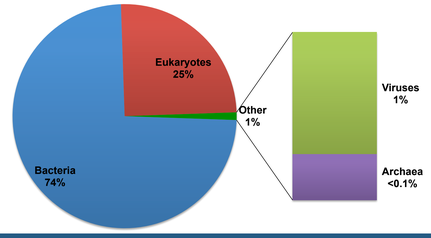
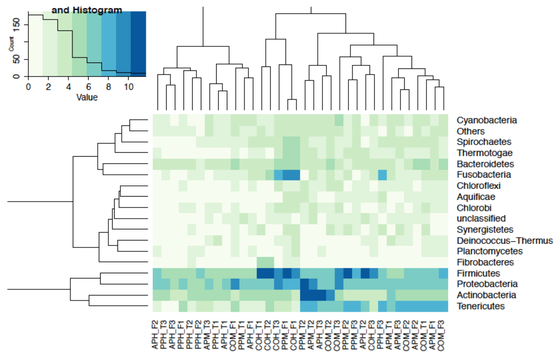



**Fig. 3 Microbial Profiles by Diet**




Bacteria level heatmap compositions was not negatively altered by alternative diets

## Implication

Reducing dietary protein level and using alternative protein blends may lead to a sustainable and economical rainbow trout production.

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