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Dietary protein/energy ratios for adult Florida pompano, *Trachintous carolinus*: feed, growth and nitrogen utilization.

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Introduction:

Selecting a new fish species with a potential value for aquaculture has essential importance for the future development of the aquaculture industry. In the United States, Florida pompano, *Trachinotus carolinus*, is among the marine fish species with aquaculture potential that has caught the interest of the industry for being a truly euryhaline species. Research is needed to complete our knowledge of the nutritional requirements of Florida pompano at different ages in order to develop cost-effective and environmentally-friendly diets. With the recent interest in high market-value carnivorous species, cost concerns are extremely important since carnivorous fish require greater amounts of protein and fishmeal represents the primary protein source in feeds formulations. A review of the literature confirms the importance of completing the nutritional requirements for Florida Pompano at different ages in the development of cost-effective and environmentally-friendly diets. Our goal was to examine the nutritional requirements in terms of protein and energy for Florida Pompano close to its typical marketable weight, which is between 400 and 600 g. To date, only the nutritional requirements for juvenile fish weighing up to 45 g have been examined. Since nutritional requirements have been well described to change as a fish grows and develops, it is essential that the requirements for larger Pompano, which consume greater quantities of foods than their smaller counterparts, be elucidated. This is most important for protein and lipid levels as they are the most expensive dietary components.

Methods and Results:

The formulated DP/DE ratios of the five diets included in this study were 26.2, 25.4, 24.3, 23.3, and 21.7 mg protein kJ^{-1}. Fish meal,

soybean meal and corn gluten meal were used for protein sources and included at various levels to create diets with increasing DP/DE ratios; fish oil was used to increase the lipid content of diets. The diets were also being supplemented with a mineral and vitamin mix. The formulation and proximate composition of theses diets are displayed in Table 1. The Florida pompano used in the experiment were spawned and reared at the University of Miami experimental fish hatchery (UMEH). An initial stocking density of 3 kg/m^3 was placed in each tank. The five practical diets were randomly assigned to tanks, each having three replicates. Fish were fed by hand once per day at 0900hr for 88 days, to apparent satiation or up to 10 minutes. The total amount of feed consumed per day was recorded daily.

Table 1. Formulation and proximate composition of the experimental diets (*g/100 g* of dry diet) fed to adults, Florida Pompano *Trachinotus carolinus*.

Experimental diets	Protein/Energy (DP/DE) ratios				
	Diet 1	Diet 2	Diet 3	Diet 4	Diet 5
Anchovy meal [1]	31.82	25.14	32.53	41.00	39.95
Soybean meal [2]	22.00	15.00	19.00	28.00	24.00
Corn gluten meal [3]	10.00	10.00	10.00	6.19	10.00
Wheat flour [4]	22.92	40.28	29.21	12.68	14.87
Anchovy oil [5]	10.27	6.46	6.29	9.92	6.27
Mineral-vitamin premix [6]	0.50	0.50	0.50	0.50	0.50
Luctamold	0.20	0.20	0.20	0.20	0.20
Antox	0.05	0.05	0.05	0.05	0.05
Others	2.24	2.37	2.22	1.46	4.16
Analyzed Composition (n=3)					
Crude protein (g/100 g DM)	51.6	47.4	48.7	46.3	42.9
Crude lipid (g/100 g DM)	18.4	14.4	19.0	19.5	20.2
Phosphorous (µg/g dry weight)	18,000	16,000	16,000	17,000	15,000
Energy (MJ/kg DM)	19.5	19.17	20.0	20.0	20.0
DP/DE (g/MJ)	26.2	25.4	24.3	23.3	21.7

[1] Anchovy meal (Naltech., Lima, Peru). (Crude Protein: 66%; Crude Lipids: 8.5%, Ash: 18%).
[2]Soybean meal (Naltech., Lima, Peru).
[3] Corn gluten meal (Naltech., Lima, Peru).
[4]Wheat flour (Naltech., Lima, Peru).
[5]Menhaden oil (Naltech., Lima, Peru).
[6]Mineral Premix composition (g/kg): Ca(H2PO4)2 H2O, 136.00; Ca(C6H10O6) 5H2O, 348.553; FeSO4 7H2O, 5.00; MgSO4 7H2O, 132.00; K2HPO4, 240.00; NaH2PO4 H2O, 88.00; NaCl, 45.00; AlCl3 6H2O, 0.084; KI, 0.15; CuSO4 5H2O, 0.50; MnSO4 H2O, 0.70; CoCl2 6H2O, 1.00; ZnSO4 7H2O, 3.00; NaSeO3, 0.0127. Vitamin Premix composition (g/kg): Ascorbic acid, 50; dl-calcium pantothenate, 5.0; Choline chloride, 36.2; Inositol, 5.0; Menadione sodium bisulfite, 2.0; Niacin, 5.0; Pyridoxine HCl, 1.0; Riboflavin, 3.0; Thiamine mononitrate, 0.5; dl-alpha-tocopherol acetate (250 IU/g), 8.0; Vitamin A palmitate (500,000 IU/g), 0.2; Vitamin micro-mix[c], 10.0; Cellulose, 874.1 Vitamin Micro-mix composition (g/100g): Biotin, 0.50; Folic acid, 1.8; Vitamin B12, 0.02; Cholecalciferol (40 IU/ug), 0.02; Cellulose, 97.66

Over the course of the experiment the survival was 100%. As displayed in Table 2, the average biomass attained was 6.67 kg/m3 per tank at final harvest. Diet 5 with DP/DE of 21.7 mg kJ^{-1} displayed inferior results in terms of mean weight gain, FE, and FCR. While all other diets

showed no significant difference in growth and efficiency parameters. All the experimental diet had no effect on NRE of Florida pompano ($P<0.05$). However, diets 1 and 2 DP/DE had numerically higher NRE of 31% (average across diets) compared to 24% for diets 3, 4, 5. Difference or changes in FE and NRE could be related to the cost of protein and lipid deposition (Azevedo et al., 2004).

Diets 1-4 with DP/DE of 26.2, 25.4, 24.3 and 23.3 mg kJ^{-1} appear to be optimal in growth for adult Florida pompano. There were no significant differences in the visceralsomatic or hepatosomatic indices among the five dietary treatments.

Discussion:

Over the course of the 88 days trial, survival rates were high and good fish health was maintained, that means a relative well-balance diet was administered throughout the study. It was concluded that a DP/DE content ranging from 23.3 to 26.2 mg kJ-1 was optimal for growth, FCR, and FE. The ratios found in this study were similar to that of the previous study (Riche, 2009) accomplished on juvenile Florida pompano size fish, with a mean weight of 6.3g ,where DP/DE ratio of 23.8 to 25.1 mg kJ-1 were found to display optimal growth and feed efficiencies.

Even though the optimal DP/DE ratio for both adult and juvenile pompano the same, this does not hold true for all species. For example, in juvenile Atlantic salmon a DP/DE ratio of 18.8 mg kJ-1 provided is optimal for growth, while for adult salmon, the optimal DP/DE ratio is 16.4 mg kJ-1 (Eien and Roem, 1997). Likewise, in gilthead seabream the optimal DP/DE ratio decreased from 28.35 to 19.5 mg kJ-1 as the fish grew larger (Lupatsch et al., 2001).

Application for Industry:

This project will provide valuable data for the formulation of more efficient diets, as nutritionists will be able to formulate feeds specifically for fish of a certain size range, diminishing the high operation costs associated with the feed. The results of this project can and will likely be readily used by the aquaculture industry and the scientific community. There is a widespread interest in developing pompano aquaculture by the industry (e.g. Open Blue Sea Farms in Panama and Beaver Street Fisheries from Florida as well as Tropic Seafood from the Bahamas, which are all important industry partners of our R&D Program.

Table 2: Growth, feed efficiency and selected efficiency parameters in Pompano, *Trachinotus carolinus* fed diets of varying DP/DE ratios for 88 days (means of three replicates, means±std).

Dietary Treatment	DP/DE	Final biomass	IMW[1]	FMW[2]	MWG[3]	SGR[4]	MDI[5]	FE[6]	PER[7]	FCR[8]	NRE[9]
	g MJ^{-1}	g fish/tank	g	g	g	%/d	g/d	g gain/ g fed	%	g fed/ g gain	%
1	26.2	6877±275 [a]	269±21	607±96	338.2±10 [a]	0.92±0.05 [a]	10.4±0.4 [a]	0.37±0.005 [a]	0.68±0.01 [a]	2.7±0.03 [a]	29.17±1.03[a]
2	25.4	6746±605[a]	288±38	634±98	347.2±26 [a]	0.90±0.04 [a]	10.3±1.4 [a]	0.38±0.02[a]	0.76±0.05[a]	2.6±0.17 [a]	33.48±6.60[a]
3	24.3	6774±158 [a]	255±10	580±96	325.7±10 [a]	0.93±0.01 [a]	9.8±0.5 [a]	0.38±0.02 [a]	0.74±0.04 [a]	2.6±0.15[a]	26.03±4.28[a]
4	23.3	6719±276 [a]	247±15	560±95	312±23.5 [ab]	0.92±0.05 [a]	9.8±0.6[a]	0.36±0.02[ab]	0.72±0.04[a]	2.7±0.16[a]	23.42±5.99[a]
5	21.7	6226±463 [a]	247±22	519±81	272.2±32 [b]	0.84±0.09 [a]	9.6±0.7[a]	0.32±0.03 [b]	0.71±0.07 [a]	3.14±0.33 [b]	23.45±0.78[a]

[*]Values in a column that do not have the same superscript letters are significantly different according to Duncan's multiple range test ($P < 0.05$).
[1]IMW= Initial mean weight
[2]FMW= Final mean weight
3MWG= Mean weight gain
[4]SGR= Specific growth rate
[5]MDI= Mean daily intake
[6]FE= Feed efficiency
[7]PER= Protein efficiency ratio
[8]FCR= Feed conversion ratio
[9]NRE= Nitrogen retention efficiency

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