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Nutrients Requirements and Composition in A Grouper Fish Feed Formulation

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Abstract

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Due to the high nutrients and desirable taste, there is a high demand of grouper fish. However, the supply of wild catch grouper fish is limited and insufficient to meet the cyclical nature of high demand in grouper fish consumption leading to the high price. Consequently, grouper fish is worth to be farmed due to its high value price and high market demand. In order to farm grouper fish, there is a need to have a lot of trash fish, but trash fish is expensive, hard to store, hard to maintain the quality of nutrient and quantity throughout the years. Thus, there is a need to formulate the fish feed based on the nutrients requirements with an extensive survey of literature. Results show that grouper fish need crude protein 40-45%, crude fat 1-10%, crude fibre 0.5-8%, moisture 0.8-95.5%, ash 0.4-18%, phosphorus 0.1-1.8% , calcium 2-4%, and essential acid amino (EAA).This important information can be considered in further study in formulating fish feed to minimize cost and maximize profit in farming grouper fish.

Keywords: Grouper Fish; Fish Feed Formulation; Nutrients Requirements and Composition.

1. Introduction

Nutrient is crucial for all living beings in terms of health and to maintain certainessential functions as such metabolic, mental, physical or chemical well (Gumustekin *et al.,* 2014). All living beings must eat in order to survive, and reproduce and they must balance their consumption, storage and use of food. This evidence can be viewed in the life of bears in the preparation for winter sleep whereby they

will store energy, mostly in the form of body fat. Hence, adequate feed is very vital for all living beings to survive and achieve standard nutrient requirements and daily functions.

In order to farm grouper fish, there is a need to understand the nutrients requirement and nutrient balance to ensure the healthy growth of grouper fish.Nutrient balance means that the nutrient provided is equal to the nutrient needed so that living being can have the same basic nutritional needs as mentioned by Campbell *et al*. (2011) that are (1) fuels to supply all body activities;(2) organic molecules in building the animal's own molecules; and (3) essential nutrients.

These objectives can be achieved through the understanding of the nutrients composition analyses, which eventually has sparked our interest to undertake the problem offish feed for grouper fish as the focus of our study to fill in the gap. Grouper fish is chosen due to thecurrent trend of demands in restaurants and its high price compared to other species of fish (Soong *et al.,* 2015). However, it is difficult to search the relevant data since there are no exact data available. Thus, by doing these analyses, it gives us an overview on the priority of nutrients in feeding the grouper fish in order to formulate the grouper feed formulation.

2. Methodology

2.1. Nutrients Components for Grouper Fish

In this present study, data come from two sources: Data sources (1) are from 30 manufacturers' grouper fish feed meal. These results are with the experts' input summarized in Table 1 and Figure 1 is from the manufacturers. Data sources (2) are from journal papers, researchers and view from expertsand these are summarized in Table 5. SPSS is used to perform the data analysis in this study.

The main nutrients which are needed for grouper fish are crude protein, crude fat, crude fibre, moisture, crude ash, phosphorus and calcium. The fish feed meal with its nutrients components (percentage) are illustrated in Table 1 (experts' input) and Figure 1 (from manufacturers) below. For instance, the maximum nutrient requirements of crude protein is 45% for grouper fish while the minimum nutrients requirements of crude protein is 40 %.

Table 1. Fish feed meal with its range components (percentage) from experts' input.

EAA	Minimum (%)	Maximum (%)
Crude protein	40	45
Crude fat	1	10
Crude fiber	0.5	8
Moisture	0.8	95.5
Ash	0.4	18
Phosphorus	0.1	1.8
Calcium	2	4

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	Crude_protein	Crude_fat	Crude_fibre	Moisture	Crude_ash	Phosphorus	Calcium
1	44.00	7.00	3.00	11.00	16.00		
2	52.00	8.00	6.00	12.00	16.00	1.30	4.00
3	38.00	5.00	3.00	11.00	16.00	1.50	2.50
4	48.00	10.00	3.00	10.00	17.00	1.80	2.00
5	52.00	2.00	6.00	10.00	10.00		
6	46.00	13.00	2.00	10.00	13.00		
7	40.00	5.00	5.00				
8	38.00	2.00	8.00	10.00		0.60	
9	35.00	7.00	4.00	8.00		1.20	
10	5.00	1.00	0.50	0.80			
11	11.00	1.20	5.00	79.00			
12	46.00	14.00	3.00	11.00	13.00		
13	12.00	1.50	3.50	79.00			
14	52.00	9.40	2.00	19.00	18.00		
15	52.00	20.00	1.00	8.50	12.00		
16	43.00	7.00	4.00	9.00	16.00	1.20	
17	60.00	8.00	3.00	5.00			
18	47.00	24.00	1.80	8.50	12.00		
19	7.80	1.60	0.50	87.00			
20	4.00	0.50	1.00	90.00			
21	44.00	10.00	3.00	5.00		1.00	
22	47.00	5.50	0.50	6.00		0.10	
23	14.80	1.01	0.50	1.00			
24	65.00	5.00	3.50	6.50		0.10	
25	6.00	0.50	1.00	90.00			
26	47.00	5.00	3.00	10.00	17.00	1.00	
27	4.70	0.80	0.50	92.00			
28	9.00	8.00	3.00	45.00			
29	37.00	2.00	8.00	12.00			
30	7.00	0.70	0.70	95.50	0.40	0.10	

Fig. 1. Fish feed meal with its range components (percentage) from manufactures.

Table 2. Coefficient of variance of nutrients for grouper fish.

	N	Range	Minimum	Maximum	Mean	Std. Deviation	Coefficient of Variance
	Statistic	Statistic	Statistic	Statistic	Statistic	Statistic	Statistic
Calcium	3	2.00	2.00	4.00	2.8333	1.04083	0.367
Crude_ash	13	17.60	.40	18.00	13.5692	4.64173	0.342
Crude_fat	30	23.50	.50	24.00	6.1903	5.78614	0.935
Crude_fiber	30	7.50	.50	8.00	2.9667	2.12089	0.715
Crude_protein	30	61.00	4.00	65.00	33.8100	19.55319	0.578
Moisture	29	94.70	.80	95.50	29.0276	34.51512	1.189
Phosphorus	11	1.70	.10	1.80	.9000	.59498	0.661
Valid N (listwise)	3						

In this present study, quantitative descriptive statistics include the coefficient of data comes from variance (CV), mean, standard deviation, range of sample, maximum and minimum sample. These are depicted as in Table 2. All the CV of nutrients except moisture are less than 1.0. It shows that crude protein, crude fat, crude fibre, ash, phosphorus and calcium are less dispersed than moisture. In other

words, the smaller CV of crude protein, crude fat, crude fibre, ash, phosphorus and calcium, the smaller residuals to the predicted value are. It is an indication of a good variable. Moisture with a CV of 1.189 can still be considered a lower CV by itself. Thus, it can be concluded that these are good suggestive nutrients.

SPSS was used to perform the one sample test as in Table 3.The seven types of nutrients are significant ($p< 0.05$) and it can be concluded that crude protein, crude fat, crude fibre, moisture, ash, phosphorus andcalcium have a significant to the fish feed for grouper. These nutrients have a positive relation to increase the growth of fish in terms of weight (kilogram) or length (centimetre).

Table 3. One sample test in analyzing nutrients in grouper feed formulation.

One-Sample Test

	Test Value = 0					
	t	df	Sig. (2-tailed)	Mean Difference	95% Confidence Interval of the Difference	
					Lower	Upper
Crude_protein	9.471	29	.000	33.81000	26.5087	41.1113
Crude_ash	10.540	12	.000	13.56923	10.7643	16.3742
Crude_fat	5.860	29	.000	6.19033	4.0298	8.3509
Calcium	4.715	2	.042	2.83333	.2478	5.4189
Crude_fiber	7.661	29	.000	2.96667	2.1747	3.7586
Moisture	4.529	28	.000	29.02759	15.8987	42.1564
Phosphorus	5.017	10	.001	.90000	.5003	1.2997

SPSS was used to performthe correlation nutrients as in Table 4. Positive value indicate that there is a positive correlation among each other. For instance, if crude protein has a positive value on increase in crude protein will also increase crude ash, crude fat and crude fibre indirectly. If crude protein has a negative value, itmeans that an increase in crude protein will decrease the content of phosphorus.

Table 4. Correlation nutrients in groper feed formulation.

Correlation Matrix[a,b]

		Calcium	Crude_ash	Crude_fat	Crude_fiber	Crude_protein	Moisture	Phosphorus
Correlation	Calcium	1.000	-.693	-.127	.971	.533	.961	-.923
	Crude_ash	-.693	1.000	.803	-.500	.240	-.866	.918
	Crude_fat	-.127	.803	1.000	.115	.771	-.397	.500
	Crude_fiber	.971	-.500	.115	1.000	.721	.866	-.803
	Crude_protein	.533	.240	.771	.721	1.000	.277	-.165
	Moisture	.961	-.866	-.397	.866	.277	1.000	-.993
	Phosphorus	-.923	.918	.500	-.803	-.165	-.993	1.000

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Table 5. Pearson analysis for nutrients in grouper feed formulation.

Correlations

		Calcium	Crude_ash	Crude_fat	Crude_fibre	Crude_protein	Moisture	Phosphorus
Calcium	Pearson Correlation	1	-.693	-.127	.971	.533	.961	-.923
	Sig. (2-tailed)		.512	.919	.154	.642	.179	.252
	N	3	3	3	3	3	3	3
Crude_ash	Pearson Correlation	-.693	1	.155	.336	.755**	-.816**	.885*
	Sig. (2-tailed)	.512		.613	.261	.003	.001	.019
	N	3	13	13	13	13	13	6
Crude_fat	Pearson Correlation	-.127	.155	1	-.095	.580**	-.483**	.653*
	Sig. (2-tailed)	.919	.613		.618	.001	.008	.029
	N	3	13	30	30	30	29	11
Crude_fibre	Pearson Correlation	.971	.336	-.095	1	.371*	-.303	.297
	Sig. (2-tailed)	.154	.261	.618		.043	.110	.375
	N	3	13	30	30	30	29	11
Crude_protein	Pearson Correlation	.533	.755**	.580**	.371*	1	-.774**	.150
	Sig. (2-tailed)	.642	.003	.001	.043		.000	.660
	N	3	13	30	30	30	29	11
Moisture	Pearson Correlation	.961	-.816**	-.483**	-.303	-.774**	1	-.400
	Sig. (2-tailed)	.179	.001	.008	.110	.000		.223
	N	3	13	29	29	29	29	11
Phosphorus	Pearson Correlation	-.923	.885*	.653*	.297	.150	-.400	1
	Sig. (2-tailed)	.252	.019	.029	.375	.660	.223	
	N	3	6	11	11	11	11	11

**. Correlation is significant at the 0.01 level (2-tailed).
*. Correlation is significant at the 0.05 level (2-tailed).

A Pearson correlation coefficient was computed to assess the relationships betweencrude protein with crude ash, crude fat and crude fibre as illustrated in Table 5. There is a positive correlation between crude protein with crude ash, r =0.755, n =13, p =0.03, crude fat r =0.580, n =30, p =0.01 and crude fibre r =0.371, n =30, p =0.043. Overall, there is a strong and positive correlation between crude protein with crude ash, crude fat and crude fibre. Increases in crude protein are correlated with increases in crude ash, crude fat and crude fibre. It applies also to phosphorus with crude ash and crude fat.

2.2. Essential Amino Acids (EAAs)

Essential aminoacid (EAAs) which are needed for grouper fish are Arginine, Histidine, Threonine, Tryptohan, Valine, Isoleucine, Leucine, Lysine, Methionine, and Phenylalanine. These ten essential amino acids (EAAs) are adopted and adapted from Muhammadar *et. al.* (2011). The minimum and maximum values for EAAs components as suggested by experts are summarized in Table 6.

Table 6. Components of essential amino acids(EAAs) (percentage).

EAA	Minimum	Maximum
Arginine	3.09	3.29
Histidine	0.83	1.23
Isoleucine	2.19	2.19
Leucine	3.17	3.37
Lysine	2.84	3.04
Methionine	1.37	1.37
Phenylalanine	1.2	1.2
Threonine	1.77	1.99
Tryptophan	1.39	1.79
Valine	2.09	2.29

3. Findings and Discussion

The major findings are: (1) There are five main nutrients needed for grouper fish: (i) crude protein, (ii) crude fat, (iii) crude fibre, (iv) ash and (v) moisture. (2) All other fish feed meals contain a range ofbetween 30-59% of protein content, and the mean of crude protein for all fish feed meals is 33.81%. However, sample 17 and sample 24 from Table 1 are outliners from others which are 60% and 65% of crude protein, respectively. There are 7 samples ofless than 10%. After discussing with experts, crude protein ofless than 10% is not advisable. It should be within a range of 40-45%. Although more percentage of crude protein is encouraged, it is not recommended due to its high cost. (3) For crude fat, a range of 1-10% is advisable. Fish feed meal with less crude fat would avoid excessive growth of lipids in the fish's body. Sample 8 and 29 both have a crude fibre content of 8%, which is the highest content compared to the rest of the fish feed meals and the mean (2.9667%).The rest of the fish feed meals have a content of crude fibre ranging between 0.5-8%. Crude fibre plays its role in the fish's body by removing toxins and waste products with much efficiency. It is a known fact that fibre helps to eliminate waste from its gastrointestinal tract because of its ability to bind water and thus produce firmer stools.It is important to include crude fibre in a fish's daily feed to ensure maximum healthy growth in its length and size. (5) The moisture of the fish feed ranges from 0-95.5% and the mean is 29.03%. The food with a higher moisture would be suitable for groupers that livein the habitat of the oceans and salty water. This is because when the food is left on salty water, it does not become soggy and dissolve away quickly due to its moisture whereas it is different for the fish feed with a lower moisture. The fish feed with a low moisture are such as sample 24 and 21 with merely 6.5% and 5% moisture. It is most suitable to be the feed of a grouper in the clear water and non-sea water.This is because of the neutral pH of the non-sea water that does not change the texture of the feed even though the feed has a low moisture.(6) Lastly, some fish feed meals also contain other nutrients such as ash, phosphorus and calcium.13 types of fish feedmeals have ash which ranges from 0.4-18%,and a mean of 13.57%, others 0%. (7) 11 types of fish feed meals have phosphorus which ranges from 0.1-1.8% and a mean of 0.9%, others 0%. (8) Only 3 types of fish feed meals have calcium which rangesfrom 2-4%, andmean of 2.83%, others 0%. (9) There is a strong and positive correlation between crude protein with crude ash, crude fat and crude fibre. It is also a strong andpositive correlation between phosphorus

with crude ash and crude fat. Thus, we would like to suggest that the ideal nutrient for grouper fish is a high crude protein content to promote itshealthy growth in length and size.

4. Conclusion

From the present study, it can be concluded that the main nutrients needed for grouper fish are crude protein, crude fat, crude fibre, moisture, ash, phosphorus and calcium. Crude protein is very important among the nutrients. This is followed by crude fat and crude fibre. This information can be further studied in the fish feed formulation using Evolutionary Algorithm (EA) to minimize cost and minimize profit in farming grouper fish. On top of that, this study can be a reference to other research related to fish diet.

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