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Research Article

Proximate Composition of On Farm Formulated Fish Diets from Locally Available Ingredients West and North Gojjam Zone, Ethiopia

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Abstract:

Formulated diets are very necessarily for fish growth and meat quality. The study was conducted to investigate proximate composition, on farm formulate diet from locally available ingredients and tested by (AOAC, 2019) methods in triplication. On farm formulated experimental diet were four (diet1, diet1, diet 3 and dite4). The percentage of crude protein and crude lipid different in diet formulation ranged from (31.36. ±0.47,32.92±0.0.59) and (7.31. ±0.17-11.37±0.28) respectively. The highest crude fiber content (10.75±.0.63) was recorded from formulated diet 2 and the lowest diet 4 (5.24±0.29) was recorded formulated diet4. From formulated diets, there were no significance difference in crude protein, moisture and dry matter at ($P>0.05$) but there were highly significance different crude lipid, ash, crude fiber, energy and carbohydrate ($P<0.05$). From the four on farm formulated diets pumpkin seed based was floater than the others but haricot bean based on farm formulate diet was lower than others in floating in water surface. On farm formulated diets were applied based on their proximate analyses profile to minimize the cost and also contributing to sustainable aquaculture production and improved food security in Ethiopia. Based on the result of study, on farm formulated diets were alien international standards so fish farmers. customers and investor should be used on farm formulated diets their fish farm. On farm formulated diets were preferable by Nile Tilapia therefore, future research work will be focus on farm formulated diets which are not addressed by this work.

Key words: nile tilapia; on farm formulated diet; proximate composition; west and north gojjam

1.Introduction

World fish consumption rates are growing faster than the world population because of increased incomes and consciousness of the health benefits associated with consuming fish and fish products. **[1]**. Formulated feeds are very necessarily for fish farming which is contain balanced diets. A balanced ration must be nutritionally adequate and be consumed in sufficient amounts to provide for the level of production desired at reasonable cost. Formulated feed is one of the most critical factors in aquaculture development the world but Cost of fish feed accounts for about 75% to 85% operating expenses of fish production **[2]**. Raw ingredients account for 60% to 70% of the total cost from feed formulation. Fish feed constitutes between 50% and 70% of a commercial farmer's cost of production **[3]**. Fish feed plays a major role in aquaculture viability and profitability because it accounts for at least (40 - 60) % of the total cost of fish production **[4]** although, the desired growth of aquaculture which is necessary in order to meet the increasing demand for fish is only achievable through cost-effective and high-quality fish feed **[5]**. Development of a feed for fish production involves evaluation of proximate composition of feed components and performance efficiency. Insufficient energy in feed causes protein waste due to the increase proportion of dietary protein used for energy and the produced ammonia can reduce the water quality **[6]**. On the contrary, excessive energy in feed can lead to increased body lipid deposition and growth reduction because of lack of necessary nutrient for growth **[7]**. Like all living organisms, fish need energy for maintenance. The energy requirement of fish depends on the species, water temperature and physiological stage of the animal itself **[8]**. Fish feed has been a bottleneck for many African countries **[9]**, even in the most developed aquaculture countries (Egypt and Nigeria) **[10].**

Fish production cost took (75% to 85% operating expenses **[2]**. Fish feed has been a bottleneck for many African countries including Ethiopia **[9]**), even in the most developed aquaculture countries (Egypt and Nigeria) **[10]**. Lack of cheap and efficient locally available quality fish feeds is a challenge for expanding fish farming activity by farmers in most

developing countries like Ethiopia **[11]**. There is no **single** feed ingredient can supply all the nutrients and energy required for optimal growth of fish. The aim of this study was investigating proximate composition of on farm formulated fish feed from locally available ingredients.

Study Area The study area was found at West Gojjam of the Amhara region, western Ethiopia at a location of 11°09' 60.00" N and 37° 14' 60.00" E. Based on the census conducted by the central statistical agency of Ethiopia [12].

2. Material and Methods

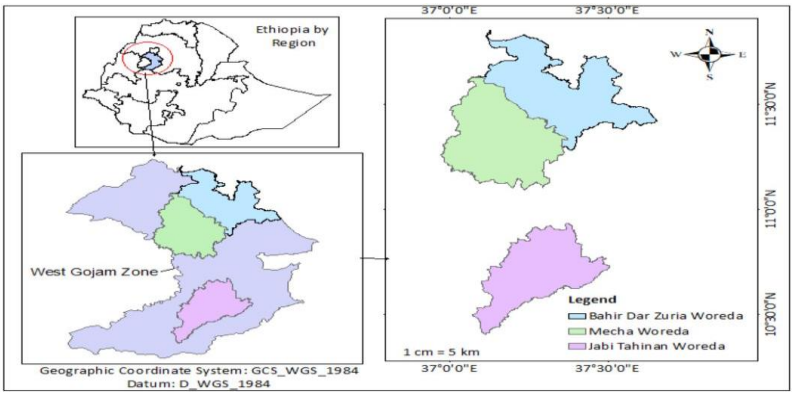

Figure 1: Map of study area

2.1. Fish Feed Resources

Animal and plant based globally, fishmeal has become an expensive feed ingredient due to its limited availability and high competition amongst diverse animal production sectors **[13]**. Fishmeal is still the major dietary protein source, comprising between 20 and 60 % of fish feed **[14]**. Animal by-products most commonly used as protein feed ingredients in fish feed are high in Crude protein and are therefore able to meet the protein requirements of Tilapia for growth, reproduction and development **[15]**. Plant ingredients are considered cheap protein sources that could replace fishmeal in aqua feed without compromising feed quality **[16]**. The ingredients were locally available and affordable, unprocessed (Blood & bone meal), Dried fish meal, Haricot bean, Pumpkin seed, Soybean meal, Wheat bran, Tree Lucerne. Among these seven locally available fish feed ingredients were identified in West and North Gojjam Zone in three woredas including (Jabitehenan, Mecha and Bahir Dar Zuria) for the purpose of fish diets formulation.

2.2. Sample Collection and Preparation

Experimental diets formulation was done after laboratory tested each ingredient and changing to powder to mixed easily. After mixed completed, the mixed diets-soaked hot water for the purpose of gelatinization which is increase diet quality and compaction. After completed diets preparation, proximate analysis was done to check mixed diets nutritional value. There were four diets tested among theses, (diet3) contains Tree Lucerne (a), Wheat bran (b), blood and bone meal (c) Dried fish meal (d) (Fig 2). It is typical example of experimental diet formulation. The diet 3 on farm formulated experimental ingredients presented (**Figure 2)** and experimental on farm formulated pellet diets presented (**Figure 3) and** the proximate analysis of on farm formulated experimental diets processing system in laboratory presented **(Figure 4).**

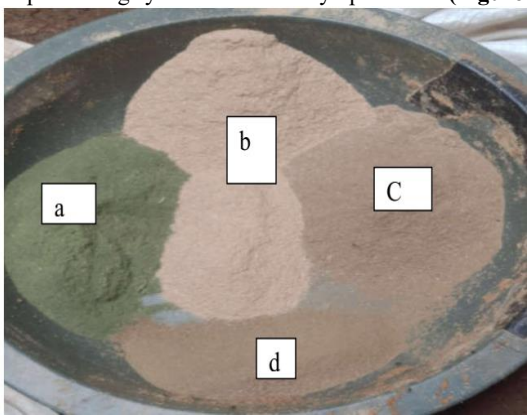

Figure 2. Fish feed powder used diet formulation

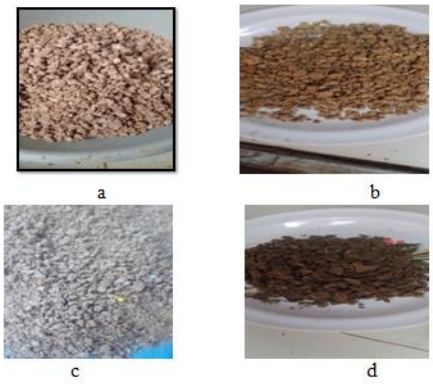

Figure 3: Formulated experimental diets (a)=diet1 (b)=diet 2, (C)=diet3, (d)=diet 4

Figure 4: Proximate analysis was done food chemistry laboratory-FCFE, Bahir Dar University Poly Campus.

2.3. Methods of on farm Fish diets Processing and Formulation

Feed formulation is the process of quantifying the number of feed ingredients that need to be combined to form a single uniform mixture for livestock including fish and animal industry. The ingredients used in the formulation and preparation of the on farm feed formulation were selected based on their nutritional value, availability all year round and costs. The farmers used locally available ingredients to prepare the on farm formulated feeds. However, the nutrient compositions of the ingredients used were not a consideration in terms of formulation **[17]**. **[18]** noted that it was not desirable to have fiber content above 8-12% in diets for fish, since the increase in fiber content would consequently result in the decrease of the quality of usable nutrient in the diet. A high fiber and ash contents reduce the digestibility of other ingredients in the diet resulting in poor growth of the fish. Feed ingredients were subjected to proximate analysis before feed formulation to determine the crude protein, crude lipid, crude fiber, ash and. moisture content Experimental feed were formulated using Win feed Ver. 2.8 software and trial and error methods. The ingredients were weighed and ground to small particle size (approximately 250 µm) and thoroughly mixed with water to obtain a 12% moisture level. Oil, Sesbania Sesban leaf and salt were added to the feed as premix.

(a). Pearson square method: is a simple method of balancing rations better used only when two ingredients and one nutritional requirement are used. It is mostly used for protein content This method can't be applied for complex feed mixes **[19]**. A good fish diet should contain protein, lipids (fats), ash, fiber, moisture, nitrogen free extracts (carbohydrates) and vitamins in the right proportion and formulated in a balanced ration which will be acceptable, palatable and durable to the fish for its optimum growth **[20].**

(b). Trial and error methods is a way of calculating formulations unite the nutritional requirements are fulfilled. It can be done manually on paper or on a computer **[21]** and (Win feed version 2.8) computer program. feed processing and formulation. steps were collection of samples, cleaning, washing milling, manually pellet, drying and stored safe place. Diets formulation were look like the following ways (Table 1)

	Experimental Diet Combinations					%CP
Diet 1	Haricot bean	Dried fish meal	Wheat bran	Blood & bone meal	Salt, Oil and Sesbania	32
Diet 2	Pumpkinseed	Dried fish meal	Wheat bran	Blood & bone meal	Salt, Oil and Sesbania	32
Diet 3	Tree Lucerne	Dried fish meal	Wheat bran	Blood & bone meal	Salt, Oil and Sesbania	32
Diet 4	Soybean meal	Dried fish meal	Wheat bran	Blood & bone meal	Salt, Oil and Sesbania	32

Table 1: Nile Tilapia diet formulation the same protein value at (32%)

* Salt, oil and Sesbania leaves were premixes

After laboratory test of ingredients Diet formulation were done based on their inclusion leaves (Table 2). The most dominant ingredients in diet formulation were Haricot Bean, Pumpkin seed, Tree Lucerne leaf, and Soybean meal (Table2). The highest and the lowest contribution of formulated diets were diet 1 (44.75% and (Blood & bone meal) 14%. in diet 2, diet 3, diet 4 the highest and the lowest contribution were (50.5, 15%**),** (53.5%, 8.5%) and (48.2 %, 16.8%) (Table2 and 3)

Diet 1	*% CN*	*Diet 2*	*% CN*
Haricot bean-based diet	44.75	*Pumpkin Seed based diet*	*50.5*
Blood and bone meal	14	*Blood & bone meal*	*15*
Dried fish meal	17.25	*Dried fish meal*	*17*
What bran	22	*Wheat bran*	*15.5*
Premixes	2	*Premixes*	*2*
Total	100		100

** %CN= Contribution of each ingredient in diets formulation*

Table 2: Contribution (%) of ingredients used in the on farm formulated fish diets

Diet 3	*% CN*	*Diet 4*	*% CN*
Tree Lucerne based diet	53.5	*Soybean meal based diet*	*48.2*
Blood and bone meal	16	*Blood & bone meal*	*15*
Dried fish meal	20	*Dried fish meal*	*18*
What bran	8.5	*Wheat bran*	*16.8*
Premixes	2	*Premixes*	*2*
Total	100		100

** %CN= Contribution of each ingredient in diets formulation*

Table 3: Contribution (%) of ingredients used in the on farm formulated fish diets

*2.4. Methods of Proximate Analysis of Formulated Diet Determination Proximate analysis formulated Diets were carried out in triplicates the following standard methods **[22]**. The protocol was applied in the determination of the percentage of crude protein crude lipid, crude fiber, ash), moisture, dry matter, energy and carbohydrate, The nitrogen content was analyzed using Kjeldahl procedure and CP was calculate as N x 6.25.*

(a). Moisture Content = $\frac{\text{(Initial mass of sample - Mass after drying) *100}}{\text{Initial mass of sample}}$

(b). Ash Content = $\frac{\text{(Mass of ash) *100}}{\text{Dry mass of sample used}}$

(c). % Crude Lipid = $\frac{\text{(Mass of fat obtained) *100}}{\text{Dry mass of sample used}}$

(d). % Nitrogen= $\frac{\text{(VS-B)}^{NA}\text{*0.01401) *100}}{W}$

VS = Volume of acid used in titration, NA= Normality of acid VB = Volume of base and W =Mass of sample used.

(e). % Crude Fiber= $\frac{\text{(Mass of fiber) *100}}{\text{Dry mass of sample used}}$

(f). Determination of gross Energy Value

Gross energy values (kcal/g) were calculated by overall addition of the protein content multiplied by 4 and the total lipids content multiplied by 9 and using Atwater's conversion factors **[23]**. The result was expressed as (kcal per 100 g.)

Gross energy value= (4×crude protein content) +(9×crude lipid content) adopted from **23]**

(g) Carbohydrate Value Determination

Carbohydrates are abundant, low-cost, excellent sources of energy and carbon in diets formulations, improving growth and protein utilization, and are efficiently utilization in several fish species **[24]**. This was calculated summation of % moisture, % crude protein %crude lipid, % crude fiber and % ash Values Subtraction from 100.

Nitrogen-Free Extract (NFE) was calculated as

% Carbohydrate = (100) - (% moisture + % crude protein + % crude lipid + % crude fiber + % ash) **[25]**.

2.5. Data Collection

Data were recorded - crude protein, crude, lipid, moisture, ash and crude fiber value of formulated diets from laboratory results but energy and carbohydrate values of on farm formulated diets calculated based on laboratory recorded data.

Data Analysis

The data obtained from this experiment were subjected to one-way analysis of variance test,
and the means compared using SPSS version 28 software and descriptive statics.

Results And Discussion

Diet preparation and proximate analysis of on farm formulated diets were subjected to proximate analysis before diet formulation to determine the crude protein, crude fat, crude fiber, ash moisture dry matter, energy and carbohydrate. The results of the proximate composition of four on farm formulated diets were presented in Table (4). The four formulated experimental diets have slightly the same crude protein, moisture and dry matter value but there was difference in crude lipid, crude fiber, ash, energy and carbohydrate (Table 4)

Diets	CP)	CL	CF	Ash	MO	DM	CH	EN
Diete1	31.36±1.47	7.31±0.17	5.59±0.9	7.88±0.11	6.08±0.52	93.92±0.52	47.86±1.21	263.5±3.66
Diet 2	31.49±0.54	11.37±0.28	10.75±0.63	10.83±0.1	6.05±0.14	93.95±0.14	*35.11±1.23*	269.89±2.68
Diet 3	32.36±1.21	7.98±0.07	9.55±0.27	8.93±0.1	6.55±0.76	93.45±0.76	41.19±1.11±	245.43±2.80
Diet 4	32.92±0.59	10.170.05±10.17	5.24±0.29	10.12±0.14	4.84±0.5	95.16±0.05	41.54±0.64	265.18±1.16

*Cp= Crude protein, CL= Crude lipid, DM= Dry matter, CF= Crude fiber and MO= Moisture, CH= Carbohydrate and EN= Energy

Table 4: Proximate composition of formulated experimental diets forms local available ingredient (Mean ±SE)

The four formulated experimental diets showed highly significance difference in crude lipid, Crude fiber, ash, energy and carbohydrate at ($p< 0.05$) but there were no significant difference crude protein, moisture and dry matter values at ($P>0.05$) (Table 4)

		SS	DF	MS	F	Sig
Crude Protein	Between Groups	3.946	3	1.315	.413	.748
	Within Groups	25.471	8	3.184		
	Total	29.417	11			
Ash	Between Groups	15.265	3	5.088	216.750	.000
	Within Groups	.188	8	.023		
	Total	15.452	11			
Moisture	Between Groups	4.792	3	1.597	2.468	.137
	Within Groups	5.179	8	.647		
	Total	9.971	11			
Crude Lipid	Between Groups	32.092	3	10.697	119.915	.000
	Within Groups	.714	8	.089		
	Total	32.806	11			
Dry Matter	Between Groups	4.792	3	1.597	2.468	.137
	Within Groups	5.179	8	.647		
	Total	9.971	11			
Crude Fiber	Between Groups	69.474	3	23.158	43.125	.000
	Within Groups	4.296	8	.537		
	Total	73.770	11			
Carbohydrate	Between Groups	243.823	3	81.274	23.575	.000
	Within Groups	27.579	8	3.447		
	Total	271.402	11			
Energy	Between Groups	1035.975	3	345.325	15.398	.001
	Within Groups	179.418	8	22.427		
	Total	1215.393	11			

*SS=Sum square and MS= Mean square

Table 5: ANOVA Table showed significance difference between formulated diets

Conclusion and Recommendation

4.1. Conclusion

In the present study there was highly significance different between four formulated diets in crude lipid, crude fiber. ash, energy and carbohydrate content at ($P< 0.05$) but there was no significant difference in crude protein, moisture and dry matter value at ($P> 0.05$). The four formulate diets fulfill the fish feed requirements which is aliened international standards (recommended protein content (30-32). Fish farmer can easily formulated diets for their fish on farm and minimize fish feed cost and increase the benefits. The four diets were tested laboratory and identified nutritional values at the detail. Diets have high crude fiber value showed that low digestibility, absorption and have low impacts on growth performance of fish but low crude fiber value of diets have high impacts of fish growth because low fiber value showed that high digestibility in fish. On farm formulated feeds were quality in nutritional contents so fish farmers can apply their own farm.

West Gojjam Zone is rich fish feed resources, therefore fish farmers can get various formulated diets. Locally available and affordable fish diets were formulated and identified on farm in the study area. There is no **single** feed ingredient can supply all the nutrients and energy required for optimal growth of fish. Mixed of ingredients were provide more balance nutrients than only use limited single ingredients. Consequently, the fish farmers can observe the proximate **composition** of different ingredients seriously and select the right diet formulated from ingredients. Nature by itself is rich in fish feed resource but there is limitation on identification

of ingredients and diet processing and formulation on farm. Now a day, the development of agro-industry in Ethiopia is a good opportunity to produce fish diet and other animals. Based on laboratory results, the crude lipid value of formulated diet 2 and diet 4) were higher compare to (diet 1 and diet 3) the reason it might be the presence of Soybean meal and Pumpkin seed. In crude fiber value diet 2 and diet 3) were also higher due to the dominance of Pumpkin and Tree Lucerne in the formulation. The presence of high crude fiber value in the formulated diet, it indicates that the digestibility of diet lower in fish There were highly significant difference in proximate composition of crude lipid, ash energy and carbohydrate. On farm formulated diets were applied based on their proximate analyses profile to minimize the cost and also contributing to sustainable aquaculture production and improved food security in Ethiopia.

4.2. Recommendation

During fish diets purchasing, customers consider proximate composition of formulated diets and consider factors that affects fish growth, at least the stage of fish, species type and body weight of fish. The best formulated fish diets were diet 4 and dite1 based on nutritional compotation of laboratory result so it recommended local fish farmers applied. Dried fish meal was one of the most impotent and expensive fish diet ingredients in the world market but in the study area, fish offal was useless and cause of environmental pollution therefore, fish offal will be collected and use fish diet formulation. The government should encourage on farm formulated diet processors by incentives and design supportive policy which encourage diet formulation and production in the country. Fish diet producer enterprise will be organized by governmental and nongovernmental NGO supports to grow aquaculture in Ethiopia. There are five animal diet processing plants in Ethiopia. From these diet/ feed processing plants, Alema kudus is the only fish diet producers processing plant as a secondary objective. It can be recommended that all animal diet prosing plants should be produce fish diets as a primary objective to transform aquaculture development in Ethiopia. On farm formulated diets were cheapest compare to commercial diets therefore, future research work will be focus on farm formulated diets which are not addressed by this work.

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