Substitution of fermented soybean juice dregs on catfish (*Pangasius pangasius*) feed formulation toward specific growth rate, efficiency of feed, feed conversion ratio, digestibility of crude protein, and energy

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Substitution of fermented soybean juice dregs on catfish (*Pangasius pangasius*) feed formulation toward specific growth rate, efficiency of feed, feed conversion ratio, digestibility of crude protein, and energy

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Abstract. The highest cost in catfish farming is feed. One of the imported feed ingredients is fermented dregs flour of soybean juice. This study aims to determine the effect of substitution of soybean meal flour with fermented dregs flour of soybean juice in catfish formulation feed (*Pangasius pangasius*) toward specific growth rate, the efficiency of feed, feed conversion ratio, digestibility of crude protein and energy. This research was experimental using 5 treatments which included P0 (100% soybean meal flour), P1 (90% soybean meal flour + 10% fermented dregs flour of soybean juice) , P2 (80% soybean meal flour + 20% fermented dregs flour of soybean juice), P3 (70% soybean meal flour + 30% fermented dregs flour of soybean juice), P4 (60% soybean meal flour + 40% fermented dregs flour of soybean juice) with 4 times treatments repetition. The main parameters observed were specific growth rate, the efficiency of feed, feed conversion ratio, digestibility of crude protein, and energy. The results showed that the substitution of soybean meal of specific growth rate, the efficiency of feed, feed conversion ratio, digestibility of crude protein and energy were not significantly different ($p > 0.05$).

1. Introduction

Catfish (*Pangasius pangasius*) is one of the most cultivated freshwater commodities because it has high economic value to be developed and has rapid growth [1]. Catfish have a high protein content so that catfish is consumed a lot [2]. Catfish production in Indonesia increased in 2016, reaching 437,112 tons compared to Catfish production in 2015 reaches 339,069 tons [3].

The feed is an important factor in supporting the success of fish farming activities so that the supply of feed is a determining factor in fish farming activities [4]. The problems that occur regarding fish feed are the increasing prices of raw materials such as fish meal and soybean meal flour. The effort that can be done to reduce the use of soybean meal is to search for local feed raw materials at lower prices but has good nutritional content as an alternative. One of the alternative ingredients for soybean meal flour is by using dregs of soybean juice.

The availability dregs of soybean juice are easily obtained along with the increasing homemade's production of soybean juice. Dregs of soybean juice have the nutritional content of crude protein 27.62%, crude fat 2.95%, BETN 52.66%, crude fiber 13.81%, and ash 2.96% [5]. The crude fiber content, which is quite high in dregs of soybean juice, can be reduced by fermentation. Fermentation is an activity of using microorganisms to improve nutritional quality, reduce or eliminate the negative effects of certain feed ingredients [6]. Proximate analysis (2019) states that fermented soybean juice based on BK 100% contains crude protein 29.24%, crude fat 12.81%, crude fiber 10.19%, ash 4.07%, and BETN 43.66%. This study aims to determine the effect of substitution of soybean meal flour with fermented dregs flour of soybean juice in catfish formulation feed (*Pangasius pangasius*) toward specific growth rate, the efficiency of feed, feed conversion ratio, digestibility of crude protein and energy.

2. Materials and methods

2.1. Materials

The tools used in this study were 20 pieces of aquarium with a size of 50x30x20 cm^3, tanks, aerators, aeration, hose, spoon, ruler, milling, pellet molding device, thermometer, pH pen, DO meter, ammonia test kit, cup petri, analytical scales, plastic clips, 1 kg plastic bags, basin, spoon and label paper.

The test animals to be used in this study are 7-9 cm catfish (*Pangasius pangasius*) obtained from the Gunung Sari Ornamental Fish Market Surabaya. Each aquarium contains ten catfish with a total of 200 fish. The materials used in this study were fermented dregs flour of soybean juice, fish meal, soybean meal flour, cornflour, rice bean, fish oil, mineral mix, multivitamin, CMC, equates, probiotics, containing bacteria *Enterobacter* sp., *Bacillus* sp., *Cellulomonas* sp., and *Actinomyces* sp., sugar cane crops. Dregs of soybean juice are obtained from home industry which producing soybean juice in Surabaya, East Java.

The study was conducted on November 2018 until April 2019, which is located at the Laboratory of Anatomy and Cultivation of the Faculty of Fisheries and Marine Airlangga University Surabaya. Proximate analysis was carried out at the Laboratory Examination Service Unit for the Consultation and Training of Veterinary Testing and Feed Analysis Units at the Faculty of Veterinary Medicine, Airlangga University, Surabaya. The method used in this study is the experimental method using a completely randomized design (CRD) consisting of 5 treatments with each of 4 replications as follows:

P_0= 100% soybean meal flour
P_1= 90% soybean meal flour + 10% fermented dregs flour of soybean juice
P_2 = 80% soybean meal flour + 20% fermented dregs flour of soybean juice
P_3 = 70% soybean meal flour + 30% fermented dregs flour of soybean juice
P_4 = 60% soybean meal flour + 40% fermented dregs flour of soybean juice

2.2. Produced of fermented dregs flour of soybean juice

Dregs of soybean juice are squeezed to reduce the water content, then dried under the sun. Dried dregs of soybean juice finely ground into dregs flour of soybean juice. Dregs flour of soybean juice then weighed with a ratio of 100 grams of dregs of soybean juice, 3 ml of molasses, 36 ml of distilled water and 1 ml of probiotics containing bacteria *Enterobacter* sp., *Bacillus* sp., *Cellulomonas* sp., and *Actinomyces* sp. All ingredients are mixed until homogeneous, then put in plastic and fermented for seven days in anaerobic conditions.

2.3. Preparation of catfish feed formula

The feed ingredients such as fish meal, fermented dregs flour of soybean juice, soybean meal, cornflour, and rice bran, fish oil, mineral mix, multivitamin, CMC each composition is calculated according to the formulation and weighed using analytical scales. The weighed ingredients are mixed until evenly distributed. Feed ingredients that have been homogeneously mixed are then printed using

a pellet molding device. The pellets then dried in the sun. The dried pellets are stored in a plastic bag that has been labeled and stored in a dry place. The composition of feed ingredients can be seen in Table 1.

Table 1. Composition of feed ingredients.

Feed Ingredients	Dietary Treatments(%)				
	P0	P1	P2	P3	P4
Fish Meal	27	27.8	28.6	29.5	30.3
Fermented Dregs Flour of Soybean Juice	0	2.4	4.8	7.2	9.6
Soybean Meal	24	21.6	19.2	16.8	14.4
Corn Meal	35.5	34.7	33.9	33	32.2
Rice Bran Flour	10.5	10.5	10.5	10.5	10.5
Fish Oil	0.5	0.5	0.5	0.5	0.5
Mineral Mix	1	1	1	1	1
Multivitamin	0.5	0.5	0.5	0.5	0,5
CMC	1	1	1	1	1
Total	100	100	100	100	100
Dry Matter	97	97	97	97	97
Ash	5.40125	5.35733	5.31341	5.27267	5.22875
Crude Protein	32.44545	32.42513	32.40481	32.43136	32.41104
Crude Fat	6.76565	6.98909	7.21253	7.44236	7.6658
Crude Fiber	7.4475	7.47214	7.49678	7.52021	7.54485
Nitrogen Free Extract	44.9271	44.74302	44.55894	44.31966	44.13558
Metabolizable Energy (kcal/kg)	3239.061	3247.7722	3256.4834	3265.18293	3273.89413

2.4. Preparation of media for maintenance of catfish

The aquarium is first cleaned and sterilized to avoid disease. Cleansing is done by using chlorine and draining it thoroughly, and then the aquarium is dried. The fish maintenance media is freshwater which has been aerated for one day to increase the oxygen content dissolved in water.

2.5. Maintenance of catfish

The fish used in this research were 7-9 cm fish. Each aquarium is contained with ten catfish (*Pangasius pangasius*). The acclimatization process is carried out first to adjust the physiological conditions of the fish with maintenance media. Feeding is as much as 3% of the weight of fish biomass with the frequency of administration two times per day.

2.6. Data collection

The main test parameters in this study were specific growth rates, feed efficiency, feed conversion ratio, and crude protein and energy digestibility in catfish (*Pangasius pangasius*).

a. Specific growth rate (SGR)
SGR is calculated by formula [7]:

$$\text{SGR } (\%) = \frac{(\ln Wt) - (lnWo)}{t} x100\%$$

Description :
SGR = Percentage of average individual weight per day (% body weight/day)
Wt = Final average weight (g)
Wo = Initial average weight (g)
t = Time (days)

b. Feed Efficiency (FE)
FE is calculated by formula [8]:

$$FE\ (\%) = \frac{(Wt+D)-Wo}{F} \times 100\%$$

Description :
FE = Feed efficiency (%)
Wt = Biomass at the end of maintenance (g)
Wo = Biomass at the beginning of maintenance (g)
D = weight of dead fish (g)
F = Feed consumed (g)

d. Feed conversion ratio (FCR)
FCR is calculated by formula [9]:

$$FCR = \frac{F}{(Wt+D)-Wo}$$

Description :
FCR = Feed conversion ratio
F = Feed consumed (g)
Wt = Biomass at the end of maintenance (g)
D = weight of dead fish (g)
Wo = Biomass at the beginning of maintenance (g)

e. Crude protein digestibility
Crude protein digestibility is calculated by a formula [10]:

$$\text{CP digestibility (\%)} = \frac{\text{CP Consumtion (g)} - \text{CP in feses (g)}}{\text{CP consumption (g)}} \times 100\%$$

Description :
CP consumtion = the amount of feed consumed (g) x %CP of feed x %DW of feed
CP in Feses= total of feses (g) x % CP of feses x % DW of feses

f. Energy digestibility
Energy digestibility is calculated by formula [10]:

$$\text{Energy digestibility (\%)} = \frac{\text{Energy consumption (g)} - \text{Energy in feses (g)}}{\text{Energy consumption (g)}} \times 100\%$$

Description :
Energy consumption = the amount of feed consumed (g) x %Energy of feed x %DW of feed
Energi in feses = Total of feses (g) x %energy of feses x % DWof feses

3. Results and discussion

Based on the statistical test results of analyze of variance (ANOVA), the results of the calculation of the average value of specific growth rate, feed efficiency, feed conversion ratio and digestibility of crude protein and energy can be seen in Table 2.

Table 2. The average value of specific growth rate (SGR), feed efficiency (FE), feed conversion ratio (FCR), crude protein digestibility (CPD), and energy digestibility (ED)

Parameter	Average (%) ± SD				
	P0	P1	P2	P3	P4
SGR (%/day)	2.03 ± 0.28	2.09 ± 0.28	2.19 ± 0.26	2.26 ± 0.19	2.24 ± 0.11
EF (%)	67.34 ± 3.01	68.54 ± 2.23	70.39 ± 6.67	74.26 ± 2.98	72.21 4.75
FCR	1.48 ± 0.06	1.46 ± 0.04	1.43 ± 0.13	1.34 ± 0.02	1.39 ± 0.09
CPD (%)	99.54 ± 0.35	99.63± 0.10	99.66± 0.16	99.79± 0.06	99.73± 0.11
ED (%)	99.70± 0.15	99.71± 0.05	99.71± 0.13	99.81± 0.04	99.76± 0.10

Description: SD = Standard deviation

3.1. Specific growth rate

Based on the results of the statistical test of ANOVA, the results of the calculation of the average value of the specific growth rate showed that there were no significant differences (P> 0.05) between each treatment given. The average value of the specific growth rate can be seen in Table 2. The average yield of the specific growth rate of catfish between treatments is 2.03 - 2.24%/day.

Feed formulations given to catfish have the same protein content between treatments, which is 32% which [11] the requirements for artificial feed for catfish contain at least 28% protein. The availability of protein in feed is closely related to fish growth. The higher the protein contained in the feed, the more stimulating the accumulation of body protein is higher than the lower protein content [12].

Factors that can affect growth are internal and external. External factors that can affect fish growth are environment and feed. Feeds that have the appropriate nutritional content and feed, which are sufficient for fish can affect the speed of fish growth and ensure fish survival [13]. Protein in feed is used as an energy source. The energy produced was not directly used for growth, but it was used as metabolic activity, life necessities, and reproduction. If the need for metabolism, life, and reproduction needs are met, and energy is still left, it will be used for growth [14].

3.2. Feed efficiency

Based on the results of the statistical test of ANOVA, the results of the calculation of the average efficiency of feed showed that there were no significant differences (P> 0.05) between each treatment given. The average value of feed efficiency can be seen in Table 2. The value of the average efficiency of catfish feed is in the range of 67.34 to 74.26%.

Factors that can determine the high and low efficiency of feed are the types of nutrient sources in the feed and the number of each component of the nutrient source in the feed. The higher the value of feed efficiency, the response of the fish to the given feed is good. The good response given by fish to the given food is indicated by rapid fish growth [15].

3.3. Feed conversion ratio

Based on the results of the ANOVA statistical test, the results by calculation of average feed conversion ratio showed that there were no significant differences (P> 0.05) between each given treatment. The average value of feed conversion ratio can be seen in Table 2. The value of the average conversion ratio of catfish feed is in the range of 1.34-1.48.

Feed conversion values indicate the amount of feed consumed to produce Biomass in the fish body. According to[16], the FCR value is quite good, in the range 0.8-1.6, which means that 1 kilogram of consumption can be produced from giving 0.8-1.6 kg of feed. According to[17], the value of feed efficiency shows the percentage of feed used by fish for growth (represented by the addition of body weight) compared to the amount of feed consumed. The lower a feed conversion value indicates the level of efficiency of good feed utilization. However, if the feed conversion value is higher, the efficiency of feed utilization is not good. It can be said that the value of feed conversion illustrates the level of efficiency of feed utilization achieved [18].

3.4. Crude protein digestibility

Protein digestibility is the amount of feed protein absorbed by the body and not released in the form of feces. Protein digestibility depends on the protein content in the ration [19]. Based on Table 2, it is known that the average value of crude protein digestibility ranges from 99,541-99,791%. Calculation of the results of ANOVA shows that the substitution of soybean meal flour with fermented dregs flour of soybean juice in catfish formulation feed (*Pangasius pangasius*) shows that there is no significant difference from each treatment to crude protein digestibility. This means that the substitution of soybean meal flour with fermented dregs flour of soybean juice in catfish formulation feed did not affect the digestibility of crude protein catfish (*Pangasius pangasius*).

The crude protein content of feed in each treatment from P0 to P4 was 32.4%. The results of the study were not significantly different or relatively similar because of suspected each treatment which has different doses substitution; it has almost the same source of crude protein so that there was no difference value of crude protein digestibility in each treatment. The absence of differences in the value of crude protein digestibility indicates that the use of fermented dregs flour of soybean juice can replace the use of soybean meal flour until 40%and able to fulfill their crude protein of basal ration.

The results showed that the value of crude protein digestibility was high, ranges from 99.541 to 99.71% [20] state that protein digestibility in fish is generally very high to reach more than 90%. According to [21] that the quality of rations based on digestibility is divided into three categories, namely digestibility values in the range of 50-60% are of low quality, 60-70% are of medium quality and above 70% are of high quality. The high and low digestibility depends on the ingredients of the ration and the amount of protein that enters the digestive tract [22].

3.5. Energy digestibility

Energy digestibility is the amount of energy that can be digested by fish and not released through feces. Energy digestibility is the amount of energy that can be digested by fish and not released through feces [23]. Based on Table 2, it is known that the average value of energy digestibility ranges from 99.703 to 99.819%. Calculation of the results of Analyze of Variance (ANOVA) shows that the substitution of soybean meal flour with fermented dregs flour of soybean juice in catfish formulation feed (*Pangasius pangasius*) shows that there is no significant difference from each treatment to energy digestibility. This means that the substitution of soybean meal flour with fermented dregs flour of soybean juice in catfish formulation feed did not affect the digestibility of energy catfish (*Pangasius pangasius*). The results of the study were not significantly different or relatively similar because of suspected on each treatment which has different doses substitution; it has almost the same source of energy so that there was no difference value of energy digestibility in each treatment. The absence of differences in the value of energy digestibility indicates that the use of fermented dregs flour of soybean juice can replace the use of soybean meal flour until 40%and able to fulfill their crude protein of basal ration.

According to [24] referenced in [25] states that energy is obtained from feed components of protein, fat, and carbohydrates. The three components of the complex compound will be overhauled into simpler compounds (amino acids, fatty acids, and glucose)so that it can be absorbed by the body to be used or stored. The availability of energy is very important in fish feed. The amount of energy digestibility indicates that there will be more energy available so that it can be used as maintenance and activity for fish [26].

4. Conclusion

The substitution of soybean meal flour with fermented dregs flour of soybean juice in catfish formulation feed (*Pangasius pangasius*) up to a dose 40% of the total use of soybean meal flour did not affect the specific growth rate, feed efficiency, feed conversion ratio and digestibility of crude protein and energy.

5. References

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