Original Article

Inclusion Of Banana (Musa Paradisiaca) Meal In The Diet On The Productive Parameters Of (Oreochromis Spp)

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Abstract

Tilapia (Oreochromis Spp) introduced in many countries susceptible to cultivation, adaptable to different environments, and food and water quality, important in aquaculture for an intensive system, with fast growth and excellent performance. The objective was to determine the inclusion of banana (Musa paradisiaca) meal in the diet on productive parameters as an alternative by-product of fattening (O. spp). The treatments evaluated were banana meal (0, 10, 15, 20%), in the fattening stage with four treatments and four replicates, a total of 128 experimental units, arranged in 16 randomly distributed cages. A DCA and Tukey were used to compare means ($p<0.05$). The results obtained showed that the T1 treatment with the inclusion of 10% banana meal (Musa paradisiaca) presented better yields in weight gain with 15.7 g, feed consumption was palatable, which led the tilapia to consume more, and the initial feed conversion was 28.99% and final 44.47%, there was low mortality with the consumption of this by-product, total growth in the size of 15.52 cm, the proximal analysis of the study carried out provided an additional nutritional assessment in the feeding. Likewise, the fillet and carcass yields were 39.29% and 93.6%, respectively, obtaining a lower value in the by-products of 60.61%. Therefore, it was concluded that among the four treatments, the most acceptable was 10%, determining that the inclusion of these by-products of vegetable origin in the diet does not affect the biological parameters and meat yields.

RESUMEN

La tilapia (Oreochromis Spp) introducida en muchos países susceptibles de cultivarla, adaptables a diferentes ambientes, alimentos y calidad del agua, importantes en acuicultura para sistema intensivo, con rápido crecimiento y excelente rendimiento. El objetivo determinar la inclusión de la harina de banano (Musa paradisiaca) en la dieta sobre los parámetros productivos, como subproducto alternativo en engorde (O. spp). Los tratamientos evaluados harina de plátano (0, 10, 15, 20%), en etapa de engorde con 4 tratamientos y 4 repeticiones, en total 128 unidades experimentales, dispuestas en 16 jaulas distribuidas aleatoriamente. Se utilizó un DCA y para la comparación de las medias se empleó Tukey ($p<0.05$). Los resultados obtenidos el tratamiento T1 con inclusión de 10% de harina de banano (Musa paradisiaca) presentó mejores rendimientos en ganancia de peso con 15.7 gr, el consumo de alimento fue palatable conllevó a que la tilapia consumiera mayor cantidad, la conversión alimenticia inicial de 28.99% y final 44.47%, presentó una mortalidad baja con el consumo de este subproducto, un crecimiento total en talla de 15.52 cm, los análisis proximales del estudio efectuados aportaron una valoración nutricional adicional en la alimentación. Así mismo; el rendimiento del filete y rendimiento a la canal fue de 39.29%, y 93,6%, respectivamente, obteniendo un menor valor en los subproductos 60,61%. Se concluyó que entre los cuatros tratamientos el más aceptable con el 10%, determinándose que al incluir en la dieta estos subproductos de origen vegetal no afectan en nada los parámetros biológicos y rendimientos de la carne.

Palabras clave: análisis, alternativas, dieta, intensiva, subproductos.

INTRODUCTION

Aquaculture is the largest food production sector with accelerated growth, currently representing almost 50% of the world's fish products destined for food (FAO, 2012). Approximately, 600 aquatic species are farmed in a confined manner, most of them with different systems and culture facilities with different degrees of use of inputs and technologies.

In the current decades, tilapia (Oreochromis Spp) has been introduced in all countries susceptible to cultivating it (Vega-Villavisante et al., 2010). It is the fourth most farmed species worldwide, after shrimp and salmonids (FAO, 2012; Scorvo et al., 2010). It is one of the most important species in intensive aquaculture, presenting a fast growth development and excellent yield.

Due to its robustness against diseases, ease of reproduction and adaptability to different environments, food and water quality (Vega-Villavisante et al., 2010). It has become a species considered in aquaculture in developing countries, and the systems used for its cultivation will initially be agricultural, including technological, intensive and super-intensive farms.

The rejection of bananas comes from the national level due to large farms dedicated to small, medium and large producers, causing a disadvantage in the harvesting process, and generating high rejection volume (Lazaridou &

Biliaderis, 2002; Montoya-López et al., 2014). Banana flour has an approximate composition of 68.13% total starch, 3.32% protein, 2.45% lipids and 1.65% crude fiber, based on its chemical components with high starch content. The intensive production of freshwater fish such as tilapia (Oreochromis Spp), an introduced species in Latin America, has somehow displaced the demand for species from our region, which in some way sustain families in the rural sector through artisanal fishing, activities that are traditionally carried out and are still recognized in community groups or associations. However, the development of freshwater fish production in our region is still underdeveloped due to the lack of technical and scientific information, the almost null dissemination of results from research institutes in the region, and the failure to standardize parameters of analyzed studies of their nutritional richness, avoiding that only fresh meat is consumed without any added value in the rural sectors. The banana meal was implemented to reduce costs in fish feed and to make production more profitable, so many current studies have focused on the formulation and finishing of diets, which represent approximately 50% of production costs; in this way, producers strive to obtain a balanced diet that does not significantly reduce the need to use components that affect feed formulations. For this reason, the production of freshwater fish is increased intensively in pools and cages, using raw materials from the area that will allow reducing the costs of feeding, which always result in the greatest increase of investment for the producer and also contribute to their results to mitigate the problem of environmental pollution, with the rejection above of banana from agricultural production.

Red tilapia (Oreochromis Spp)

In 2007, aquaculture production reached a quota of 53 million MT, equivalent to 36.60% of total fish production, provided by both aquaculture and fisheries. However, regarding the contribution of this production to human food intake (excluding fishmeal production), aquaculture represents 49% (8.1 kg/year out of 16.7 kg/year), and an increase is already forecast. Therefore, in 2008, it seems possible that the historical milestone of parity will be reached this year. Tilapia is a freshwater fish, mainly diurnal, from tropical climates generally characterized by its outstanding resistance to environmental variations, great reproductive capacity and ease of colonization of new environments (FAO, 2008).

Tilapia fillet nutritional information.

The nutritional value depends mainly on the fat content of the fish; the differences in the classification of fatty, semi-fatty and lean fish are due to the number of lipids in the meat; there is a proportional relationship for water and fat content; fatty fish has higher lipids and generally lower volume of water, while lean meat has higher water content and lower volume of lipids (Solórzano-Ordónez, 2015).

Nutritional value of tilapia meat.

Tilapia is one of the complete foods due to the quality and quantity of nutrients it provides. An average serving of 100 grams covers more than 50% of the daily protein intake recommended by the FAO (Bravo & Chalén, 2003).

Experts in nutrition and dietetics assure that the major connective tissue protein does not have much fat and the little fat it contains is rich in polyunsaturated fatty acids, this type of fat is an essential component of human nutrition (Bravo & Chalén, 2003).

Banana variety (Musa paradisiaca).

The banana is a perennial crop; its rapid growth will depend on the climate, and its harvest is given throughout the year in tropical areas (Brenes-Gamboa, 2017). Therefore, the objective of this study was to evaluate the inclusion of banana (Musa paradisiaca) meals in the diet on productive parameters and meat quality (Oreochromis Spp).

MATERIALS AND METHODS

Location

Ltda.; located at km 8.5 via Quevedo, Santo Domingo, in the San Jacinto de Buena Fe canton, Los Ríos province, at 0° 53' south latitude and 79°29' longitude, at an altitude of 100 m above sea level. Three levels of the banana meal were evaluated (T0: 0%; T1: 10%; T2: 15%; T3: 20%); 128 units of 80 grams were used in the juvenile stage of tilapia (O. spp), with a standardized weight of 85 grams, in the fattening stage, a product of 4 treatments and 4 replicates. Data processing was performed with the help of INFOSTAT statistical software for analysis of variance (ANOVA) and Tukey's significance tests ($p \leq 0.05$).

Parameters evaluated in the research

Determination of weight gain (g)

The weight increase of the fish was evaluated in each experimental unit, taking the initial weight (g) as a reference. For this purpose, an OHAUS digital scale (precision of ± 0.1 g) was used.

Feed consumption (g).

The amount of fish feed was weighed before offering it to the animals per treatment unit, considering the expected feeding rate of 10% of the pv, to include the value of the raw material to be evaluated, banana meal, adding a binder before supplying it to the fish in their cages, for that an electronic scale digital was used. Where:

Feed Consumption (FC)= (Biomass x feed rate) /100

Total consumption (TC)= Daily feed consumption x time

Feed conversion factor (FCR).

It is defined as the weight gain achieved from one unit weight of feed, the value of 1 indicates perfect utilization of feed to produce one unit of body biomass. Where:

$$FCA = \frac{Pa}{Pg}$$

Survival Percentage (SUP).
It is an indicator of the resistance of the fish under study to handling and confinement, expressed as a percentage. Where:

$$SUP = \frac{Nt}{Ni} \times 100$$

Absolute growth rate (AGR).
The ratio expresses the weight gain of the organism in grams per day. Where:

$$TCA = \frac{PF - PI}{\text{días}}$$

Specific growth rate (SGR) .
Express the percentage increase in body weight per day according to the expression:

$$TCE = \frac{LPI - LPF}{\text{días}} * 100$$

Size (cm).
It measures the distance from the middle of the lip to the end of the caudal fin.

Experimental weight measurements.
The experimental measurements of the test are presented in (Table 1).

Table 1. Biometric parameters.

Fish weight	**Weight of by-products**
Total weight (1)	Scale weight (6)
Gutted fish weight (2)	Weight of fins (7)
Fillet weight with skin (3)	Head weight (8)
Gutted fish yield (4)	Guts weight (9)
Fillet yield (5)	Skeleton weight (10)

R. By-products (11)

RESULTS

Weight gain (g).

In this biological variable studied, weights were taken as a basis related to the treatments with the established densities and their respective repetitions; weights were taken weekly and finally presented significant statistical differences ($P \leq 0.05$) in the T0, T2, T3, and numerical difference, observing that the inclusion of banana flour of 10 % inclusion was greater with 15.7 g generating greater biomass in the T1 treatment.

Feed consumption (g).

The feed consumption of the 32 tilapia per repetition was obtained as a base; weekly and final consumption was obtained, showing significant differences ($P \leq 0.05$) between the levels of 0 % only commercially balanced and 10 % inclusion level with numerical differences, observing a significant consumption in T1 (634.28 g) with better weight gain.

Feed conversion.
The feed conversion is observed in T1 (10 % inclusion level) with T0 (commercial balanced) there were significant differences ($P \leq 0.05$), but obtaining numerical differences in T1 being the optimum feed conversion of 40.47 %, for the 32 experimental units and 1.26 % per fish with better weight gain and lower feed consumption in T1.

Specific growth rate.
In the variable specific growth rate of tilapia, there were significant differences ($P \leq 0.05$) between treatments, but obtaining numerical differences shows that T1 (10 % level and inclusion) has a higher growth rate with a value of 0.72 % in the fattening stage in the 42 days of research.

Carcass yield and its usable proportion (loin and fillet) as a function of the commercial merit of the fish under study.

Considering the evaluated weights of tilapia (Oreochromis Spp), fed with commercial concentrate and inclusion levels of 10 %, 15 % and 20 % of the banana meal, the usable portion was determined, the fillet yield was identified and the carcass yield for the 10 % inclusion level was 39 % and 93.60 %, with higher yields and lower by-product value of 60.96 %, respectively.

DISCUSSION

Weight gain (g).

According to Rojas, B (Rojas, 2017), in his research on intensive rearing of tilapia fed on cassava leaf meal in cachama (Colossoma macropomum), he obtained inferior results with diets supplied with 10% inclusion of cassava leaf meal in the fattening phase with 13.89 g. concerning the trial carried out.

Absolute growth rate

The mentioned results are superior to those reported by Cruz Hernandez et al. 2013. In analysis on the effect of diets with soybean meal on the growth and digestibility of rainbow trout (Oncorhynchus mykiss), the highest results ($P \leq 0.05$) were achieved with T2 (25% soybean meal) obtaining a higher absolute growth rate with the value of 2.5 g in the 50 days of research, mentioning that the consumption of fishmeal with soybean meal improves digestibility and supports the average growth and development of rainbow trout.

Table 2. Commercially usable proportion based on carcass yield and by-products.

Variables	T0. Commercial balancing		T1. 10 % inclusion of banana flour		T2. 15 % inclusion of banana flour		T3. 20 % inclusion of banana meal	
	Weight (g)	(%)	Weight (g)	(%)	Weight (g)	(%)	Weight (g)	(%)
Whole fish	161,82		170,8		169,56		162,95	
Viscera	11,18	6,9	10,92	6,39	10,94	6,45	10,61	6,51
Fins	10,02	6,19	10,82	6,33	10,89	6,45	3,85	6,04
Scales	4,34	2,68	4,39	2,57	4,19	2,47		2,45
Head	39,85	24,62	41,82	24,48	43,7	25,77	41,59	25,52
Skeleton	33.55	20,73	33.74	20,92	35,7	21,05	34,51	21,17
Fillet Yield %	62,81	38.81	67,11	39,29	64,09	37,8	62,47	38,33
Yield in channel %		93,2		93,60		93,54		93,48
By-product yields %		61,13		60,69		62,20		61,71
Total		**99,93**		**99,98**		**99,99**		**100**

Font: Medina, M. 2021.

Carcass yield and its usable proportion (loin and fillet) as a function of the commercial merit of the fish under study.

The usable portion was determined, the fillet yield was also identified, and the carcass yield for the 10% inclusion level was 39%, 93.60% being higher in yield and with a lower value of by-products with 60.96%. According to the study of morphometric characteristics of the residues of (Oreochromis niloticus) at different ages (Sila, et al., 2009), where their fillet and carcass yields were 33.22 % and 59.39 %.

CONCLUSIONS

In the biological variables, the T1 treatment (10% banana meal) presented the best response without affecting any parameter, obtaining better results for feed conversion (1.26 %), weight gain (15.7 %), feed consumption (634, 28 g) and total size with an average of (5.52 cm) 128 experimental units.

Considering the results with the inclusion of 10% banana meal (Musa paradisiaca), it was determined that the fillet yield, and carcass yield, there is a usable value, 39.29%, 93.6%, while a lower value in the by-products, 60.61%, respectively, therefore, it should be produced in greater quantity due to the high demand that exists for the production of (Oreochromis Spp).

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