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308 Lasani Town, Sargodha Road, Faisalabad - Pakistan
Mob: +92 300 3008585, Fax: +92 41 8815544
E-mail: editorijps@gmail.com

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Effect of Partial Replacement of Soybean Meal with Fish Silage on the Performance of Broilers on Conventional Starter and Finisher Diets

Aphzal Mohammed[1], Harry Ramlall[2], Andell Edwards[1], Shenese Sieuchand[1] and Angelisah Khan[1]
[1]Eastern Caribbean Institute of Agriculture and Forestry,
Faculty of Biosciences Agriculture and Food Technology (BAFT),
University of Trinidad and Tobago, Caroni North Bank Road Centeno Arima, Trinidad, West Indies
[2]Retired Animal Nutritionist, Sugar Cane Feeds Centre, Porkhor Road, Longdenville, Trinidad

Abstract: Four batches of broilers (40 birds/batch) were randomly allocated to diets in which some of the soybean meal (control) was replaced with a dry mixture of acid fish silage and wheat middlings (experimental). The initial weight of the broilers was taken when the birds were 10 days old and they were fed until they were 56 days of age. The average final weight (kg) was taken when the birds were 2.254 and 2.194 and, over 46 days, 2.014 and 1.944 in the control and experimental diets, respectively and were significantly ($p>0.05$) different. The average daily gains (g) over 56 and 46 day periods were 44, 43, 44 and 42 for the control and experimental diets, respectively and were significantly ($p<0.05$) different. The feed conversion efficiency of 2.06 and 2.20 g for the control and experimental diets, respectively, were significantly ($p>0.05$) different. The average daily gain and Feed Conversion Ratios were higher ($p<0.05$) for the conventional diet compared to the acid silage replacement diet.

Key words: Fish silage, average daily gain, FCR

INTRODUCTION

Waste from fish processing and other materials that are not suitable for human use have been modified (Raa *et al*., 1983) using inorganic (Alveres, 1972) or organic acids (Norman *et al*., 1979; Gildberg and Raa, 1977; Winter and Javed, 1981; Espe *et al*., 1989), a mixture of both acids (Asgard and Austreng, 1981; Ramirez-Ramirez *et al*., 2016), or other biological processes (Hasan and Health, 1987; Krishnaswamy *et al*., 1965). Silage can be fed to livestock either wet (Pike and Tatterson, 1980) or dry using carbohydrate ingredients as carriers (Disney *et al*., 1979; Ramirez *et al*., 2016; Machin *et al*., 1990).

According to Al-Marzooqi *et al*. (2010), fish silage is an efficient means of processing fish by-products for feed ingredients. Proteolytic enzymes present in fish hydrolyze protein and fat and accelerate auto-analysis by weak or strong acids, reaching the highest activity at pH levels between 2 and 4 (Tanuja *et al*., 2014). This process creates conditions more suitable for enzyme activity and bone breakdown and prevents spoilage from a proliferation of microorganisms (Vieira *et al*., 2015), resulting in a safe and nutritive product which can be used as animal feed (Ramirez-Ramirez *et al*., 2013; Ferraz de Arruda *et al*., 2007; Raa *et al*., 1983).

The study was carried out to evaluate the effect of partially replacing soybean meal in broiler diets with a dry mixture of fish silage carried in wheat middlings on weight gain.

MATERIALS AND METHODS

One hundred and sixty meat-type chicks were divided in four groups, housed on deep litter (wood shavings) and assigned the two diets randomly using a 2 x 2 factorial design. The pens were oriented east to west. Pen space per bird was approximately one square foot. Day-old chicks were vaccinated with Marex-Gumboro-Fowlpox combined vaccine subcutaneously and with Newcastle/Bronchitis intraocularly and debeaked at the hatchery. In the third and fifth week, Amprolium solution (0.012%) was added to the drinking water (1 g/litre) at the 3rd and 5th week.

During the first 4-5 days, four 1 gallon baby waterers and one kilogram galvanize feeders were used. In the first week, four 200-watt bulbs were used at the ground level; these were reduced to two which were raised to the ceiling and provided light until the end of the grow out period.

The starter ration was fed up to the 4th week and then gradually changed over to the finisher ration until approximately eight weeks. Weighed quantities of feed were added *ad libitum*.

The ingredients listed in Table 1 were mixed manually on a weekly basis. The vitamin mineral premix was incorporated into one kilogram of feed mixture; one was mixed into 2 and then 3 successively until 20 kg before final manual mixing into the remaining ingredients.

The fish silage was made from whole herring and modified using 50% sulphuric acid (w/v) at a rate of 60 mL/kg

Corresponding Author: Aphzal Mohammed, Eastern Caribbean Institute of Agriculture and Forestry, Faculty of Biosciences Agriculture and Food Technology (BAFT), University of Trinidad and Tobago, Caroni North Bank Road Centeno Arima, Trinidad, West Indies

(Alveres, 1972). After 24 h, the silage was heated, mixed with wheat middling in a 3:1 ratio and sun dried. The mixtures were incorporated into the starter (16%) ad finisher (10%) diets. The birds were given an adaptation period of 10 days, fed the starter ration for 28 days and fed the finisher ration for 56 days. For the first 3 days, they were fed a commercial starter ration. The birds were then adapted to the experimental diets for 7 days. The initial weight was taken on day 10 and the final weight was taken on day 56.

Chicks were weighed as a group (10 birds/rep) at day 10 and weekly up to the 6th week and then individually during the 7th and 8th weeks. Data were analyzed using the General Linear Model (GML) with Minitab Software 16 (Minitab 16, 2011).

RESULTS

The live weight gains (g) of and feed conversion efficiencies by the birds fed the two diets are shown in Table 2.

The average final weight (kg) over the entire 56 day period adjusted to 46 days for the soybean meal and fish silage diets were 2.25, 2.19, 2.01 and 1.94, respectively. The average daily gains (g) for the corresponding periods were 44, 42.5, 43.8 and 42.3, respectively and were not significantly different ($p>0.05$). However, the average feed conversion ratios and the average weight of the birds at the end of 46 days (days 10-56) were significantly higher ($p<0.05$) for the conventional feed group compared to the fish silage replacement diet group (Table 2).

DISCUSSION

The results reported here are comparable to those of Ramirez-Ramirez *et al*., 2016 who used fish silage/rice bran mix as a replacement (partial and total) for meat and bone meal in broiler diets. Live weight gain was not significantly different in this study but feed conversion efficiency in the starter stage was significantly improved by the replacement of the fish silage. These results are also similar to those reported by Nwokola and Sim (1990) in which broilers were fed diets containing biologically-processed silage. However, in the former report, the final weight at 72 days was much lower (about 1.4 kg) than the 56-day weight found in this study; these differences in results could have been due to several factors, including diet, breed and environmental factors.

Although the total feed consumed over the 46-day period increased (242 g) non-significantly ($p>0.05$) in the group fed the fish silage diet, the lower feed cost would result in increased income. In addition, the material, a waste product with environmental pollution potential, was replaced with a by-product from an imported raw material. The silage process utilizes a local industrial product containing sulfur, which has a sparing effect on certain amino acids in the chick (Harms, 1973).

An organoleptic evaluation was not carried out on the birds in this study; however, Al-Marzooqi *et al*. (2010)

Table 1: Ingredient and partial nutrient (calculated) composition of starter and finisher diets

Ingredients mixed/Nutrients	Soybean	Fish	Soybean	Fish
Corn	58.0	59.3	68.35	69.25
Soybean meal	28.7	12.3	19.0	9.0
Fish silage/wheat middling mix	-	16.0	-	10.0
Wheat middlings	-	-	5.0	5.0
Poultry by-product meal	10.0	10.0	4.5	4.5
Dicalcium Phosphate	1.0	-	1.1	0.5
Limestone	1.25	0.35	1.0	0.7
Salt	0.45	0.45	0.45	0.45
Premix	0.5	0.5	0.5	0.5
Coccidiostat	0.1	0.1	0.1	0.1
	100.0%	100.0%	100.0%	100.0%
Crude protein (%)	21.1	20.6	17.5	17.4
Lysine (%)	1.14	1.13	0.87	0.87
Methionine + cysteine (%)	0.75	0.79	0.59	0.59
Calcium (%)	1.05	1.20	0.81	0.95
Phosphorous, available (%)	0.49	0.06	0.41	0.49
Metabolizable energy (Kcal/kg)	2780	2880	2930	2995
Vitamin A (IU/kg)	5500	5500	5500	5500

Table 2: Average performance parameters of broilers on 46 day-diet

Diet	Average ADG (g)	Average FCR (kg)	Average weight (kg)
Fish silage	43.05[a]	2.29[a]	1.98[a]
Conventional	43.25[a]	2.09[b]	2.22[b]
SEM	0.530	0.003	0.023

Means with different superscripts are significantly different ($p<0.05$)

reported no adverse effects on taste acceptability in broilers fed diets containing fish silage.

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