THE VALUE OF DRIED FISH SILAGE FOR PULLETS AND THE LAYER HEN

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(Received 14 April 1988; accepted for publication 10 May, 1988).

ABSTRACT

Two experiments were conducted with golden Hubbard pullet chicks to investigate the replacement effects of locally prepared fish silage for imported fish meal in pullet and layers' rations. Acidic and neutral fish silage preparations concentrated with either maize or cassava plus groundnut meal and wheat offals, were fed as a substitute for fish meal. Results with pullets showed good feed consumption for all dietary treatments but feed efficiency was decreased ($P<0.05$) for neutral cassava, acidic maize and acidic cassava fish silage treatments. Pullet mortality was between 0.18 and 4.17%, being significantly ($P<0.05$) highest in the acidic fish silage diets. Lipid retention, metabolizable energy (ME) and efficiency of energy utilization (ME%) were similar across all treatments except for *neutral maize fish silage, in* which ME was slightly high and lipid retention low. Egg production and egg size significantly ($P<0.05$) decreased among groups of birds fed acidic maize acidic cassava and neutral cassava fish silage diets. Similarly, the efficiency of feed conversion to eggs decreased ($P<0.05$) in all fish silage substituted diets.

Key Words: Fish silage Pullets, Layer Hen. Metabolizable Energy, Egg Production.

INTRODUCTION

Good quality fishmeal is generally accepted as a high quality protein supplement for chicks. Many investigations have indicated that the nutritive value of chick rations could be enhanced if reasonable levels of fishmeal were included in the ration, in addition to plant protein supplements (Avilla and Balloun, 1972; Hinner and Mckinney, 1972; Olomu, 1976). Although Nigerian waters contain an abundant supply of different fish species, local production of International grade fishmeal and fish protein concentrates, has not been popular because of high establishment costs and the use of highly sophisticated technology. Hence, most of the fishmeal used in livestock feed formulation are imported as a finished product. In recent times, however, the cost of fishmeal has followed an upward trend due largely to a ban on their importation into Nigeria.

This increase in price has also reflected on the final prices of poultry meat and eggs, which are now beyond the purchasing power of many Nigerians.

Fish silage is another product from fish but it is different from fishmeal or fish solubles because it exists in an emulsified form, in which all nutrients have been solubilized. It is very popular in Europe and considerable data have been accumulated, concerning the use of fish silage as an ingredient in poultry rations. Krishnaswamy *et al* (1965) reported that fish silage prepared from fresh water fish, lactose citric acid and yeast extract, gave a comparable biological value with skimmed milk when fed to rats. Nelson and Rydin (1968) reported poultry feeding trials using silage prepared from a mixture of malt, cereal and miced fish and observed that the health of the birds, and the production of eggs, were good. The carcasses were also of good quality, lacking any unpleasant taste or flavour. Arneson & Einarssen (1967) used a mixture of cod viscera and fish offals and, preliminary feeding trials with chicken, indicated that the prepared fish silage was equal to commercial fishmeal as judged by weight increases.

Very little is however known about the preparation and use of fish silage in the tropics, although interest is now generated in view of the astronomic increase in the prices of poultry feed ingredients including fishmeal.

The study reported here is part of a general investigation, designed to evaluate the replacement value of dried fish silage for fishmeal, in the diets of pullets and laying hens.

MATERIALS AND METHODS

The raw materials for fish silage were fish processing wastes (Herring fish offals), which were collected from the Astra Sea Foods in Lagos, Nigeria. The acid fermentation and neutralization procedures have been reported (Ologhobo *et al*, 1988) The acidic and neutral liquid fish silages were concentrated by adding maize or cassava flour plus groundnut meal and wheat offals as filler materials. The resulting fish silage products, were sundried in shallow trays for five days and the dried products substituted for fishmeal in experimental rations. The basal pullet and layers' diets were composed (Tables 1 and 2) to contain 16% and 18% crude protein respectively.

Experiment 1

240 day-old Golden Hubbard pullets were used in this study. There were five dietary treatments of three replicates each. The birds were housed in an open sided deep litter house, the floor of which was covered with wood shavings. The birds were fed a commercial ration from day old to eight weeks, when they were placed on the experimental rations for ten weeks. The feed consumption of each group was recorded.

At the end of 18 weeks, 15 pullets, close in body weight, were selected per treatment and assigned at random to individual cages of metabolic unit having a water trough, a feed trough and dropping board for each compartment. Feed was supplied *ad libitum* throughout the period of metabolism study. The first seven days in the cages were for adjustment, followed by another seven days, when records of feed consumption and of droppings were obtained (Lewis & Morgan, 1963). Polythene sheets were placed on dropping boards for collection of the droppings. Contaminants, like

Table 1.

COMPOSITION OF THE BASAL PULLET DEVELOPER DIET

Ingredient	%
Groundnut meal	56.00
Fish meal	5.00
Blood meal	3.00
Maize	56.00
Groundut meal	5.00
Fishmeal	3.00
Blood meal	2.00
Palm kernel meal	12.00
Wheat Offal	10.00
Bone meal	4.00
Oyster shell	7.00
Salt	0.5
Vit./min premix	0.5
Dry matter (%)	91.79
Chemical Analyses (g/100g DM)	
Crude Protein	16.50
Crude fibre	12.99
Ether extract	2.50
Gross energy (Kcal/g)	3.77

feathers and scales, were removed from the feed remnant in each trough and to this remnant, any spilled feed was added after being dried (if in water trough). The remnants were weighed. Droppings were also freed of contaminants before being weighed.

A sample amounting to 10g of each diet was taken on any occasion that feed was supplied and bulked with others. The droppings of each bird were collected every 24 hours and also bulked; droppings and feed were stored in a deep freezer.

The droppings of each birds were dried in forced drought oven at 85°C for 24 hrs, after which they were finely ground in an electric grinder. Proximate chemical composition were determined (AOAC, 1970). The gross energy values were determined with a ballistic bomb calorimeter and apparent metabolizable

Table 2.

DIET COMPOSITION (%) – EXPERIMENT 2 [18.00% crudes protein, 2800 kcal/kg DM as ME Energy

	I	II	III	IV	V
Ingredients	*Fishmeal control diet*	*Neutral maize fish silage*	*Acidic maize fish silage*	*Neutral cassava fish silage*	*Acidic cassava fish silage*
Maize	62.27	54.91	54.91	50.64	50.88
Groundnut meal	14.93	21.86	21.86	26.70	26.50
Fish meal	5.00	–	–	–	–
Fish silage	–	5.00	5.00	5.00	5.00
Blood meal	2.00	4.00	4.00	4.70	4.66
Brewer s grain	5.00	3.43	3.43	2.16	2.16
Bone meal	4 00	4 00	4.00	4.00	4.00
Oyster shell	5.70	5.70	5.70	5.70	5.70
Salt	0.30	0.30	0.30	0.30	0.30
Vit/min. premix	0.50	0.50	0.50	0.50	0.50
Methionine	0.30	0.30	0.30	0.30	0.30
Determined Chemical Composition (% dry matter)					
Crude protein	18.75	18.22	18.36	18.50	18.40
Ether extract	2.69	2.40	2.19	2.30	2.50
Crude fibre	4.50	3.40	3.70	2.98	2.88

energy values of diets calculated based on the total collection procedure. Apparent retention of nitrogen and fat were calculated from the analyzed values.

Experiment 2

In this study, seventy-five pullets at 20 weeks of age, were chosen from those used in the first experiment. They were housed in cages placed in an open sided building at the rate of two birds per compartment, having 25cm front width, 45cm front height and 42cm depth. Fifteen birds were placed on each dietary treatment for a period of six months and each treatment was subdivided into three replicates of five birds. Food and water were available *ad libi tum.* A preliminary period of two weeks was allowed to enable all birds to come into lay, after which the birds were weighed. Records per replicate comprised of the percentage hen day production, egg size, yolk colour and Haugh unit. Yolk colour determination was by objective method of using a yolk colour, with scores from 0–24.

Data were analyzed by variance analyses in accordance with Steel and Torrie (1960) and Duncan's (1955) multiple range test was used to determine significant differences between means.

RESULTS

The results of the performance and economics of production of pullets fed experimental diets are shown in Table 3. Feed consumption was as good for all treatments as the control. However, the lowest feed consumption was recorded for pullets on acidic maize and acidic cassava – fish silage diets. Pullets on fish meal gained more weight than those on fish silage diets but the differences were small. Feed efficiency decreased in all fish silage diets. The decrease was significant ($P<0.05$) for neutral cassava, acidic maize and acidic cassava-fish silage diets. Mortality in the various groups ranged from 0.18 to 4.17%, being significantly ($P<0.05$) highest in the acidic fish silage diets.

Data on economic performances showed that feed costs significantly ($P<0.05$) decreased with fish meal substitution. While the fishmeal diet cost ₦620.50 per metric ton, the acidic and neutral fish silage diets ranged between ₦421.32 and ₦388.65.

Results on nutrient utilization by pullets are summarized in Table 4. Dietary treatment effect on matter digestibility was not significant except on nitrogen retention. Pullets on acidic maize and acidic cassava fish silage diets retained significantly lower nitrogen ($P<0.05$) than those on fish meal or neutral maize-fish silage diets. Lipid retention, metabolizable energy and efficiency of energy utilization were similar across all treatments and the dietary treatments were not significant. Pullets on neutral maize and neutral cassava-fish silage diets, also, tended to utilize energy slightly but significantly more efficiently than those on the fishmeal or acidic fish silage rations.

Experiment 3

The average monthly production percentages of the laying pullets were significantly ($P<0.05$) decreased among groups fed acidic maize, acidic cassava and neutral cassava-fish silage diets (Table 5). The egg weight of the pullets was, however, significantly ($P<0.05$) depressed by acidic cassava-fish silage diet A significnatly ($P<0.05$) brighter yellow colour of yolk was obtained with the fishmeal diet, followed by neutral maize-fish silage and neutral cassava-fish silage diets while acidic cassava-fish silage diet gave the lowest yolk colour score.

The efficiency of converting feed to eggs was depressed ($P<0.05$) by all fish silage diets. Body weight gains were lower ($P<0.05$) for the layers on acidic fish silage diets than those on the neutral fish silage diets, which were also lower ($P<0.05$) than those on the fish meal diet. There was no definite trend in the mortality rate of the birds.

DISCUSSION

The results presented for the performance of the pullets fed the various fish silage diets, indicated that feed consumption and body weight gains were similar and compared favourably with pullets on the control fish meal diet, even though efficiencies of feed conversion were poorest and percentage mortalities were highest for pullets fed the acidic fish silage diet. These results are in agreement with those of Disney & Hoffman (1976), who observed that in growing chicken fed silage products at 20% protein level, the rate of feed consumption was low compared with birds on

Table 3.

EFFECTS OF FISH SILAGE ON PERFORMANCE OF PULLET CHICKS

Parameters	I *Fish meal diet*	II *Neutral maize fish silage*	III *Acidic maize fish silage*	IV *Neutral cassava fish silage*	V *acidic cassava fish silage*	*SEM* ±
Avegage Feed Intake (kg)	6 30	5.86	5.18	5.79	5.15	0.22
Average body weight gain (kg/bird)	1.61	1.30	1.05	1.18	0.98	0.11
Feed efficiency (feed/gain)	3.94^{b}	4.51^{b}	4.96^{a}	4.90^{ab}	5.26^{a}	0.23
Mortality (%)	0.18^{c}	0.41^{c}	2.50^{b}	0.83^{c}	4.17^{a}	0.75
Cost of production						
Feed costs ₦/metric ton*	$620\ 50^{a}$	421.32^{b}	106.93^{bc}	410.72^{b}	388.65^{c}	12.97
Feed costs ₦/kg body weight gained	0.07	0 05	0.04	0.04	0.04	0.006

a b,c —— Means within the same rows differently superscripted are significantly different from one another (P<0.05)

* 1₦ = 0.22US$ and 0.13 Pound Sterling.

Table 4.

NUTRIENT UTILIZATION BY PULLET CHICKS FED FISH SILAGE PRODUCTS

	I *Fish meal* *Fish meal diet*	II *Neutral maize fish silage*	III *Acidic maize fish silage*	IV *Neutral cassava fish silage*	V *Acidic cassava fish silage*	*SEM* ±
Apparent dry matter digestibility (%)	79.51	78.74	83.15	82.76	81.11	0.87
Apparent nitrogen retention (%)	82.13[a]	80.40[a]	77.77[b]	78.95[b]	75.48[b]	1.13
Apparent lipid retention (%)	93.53	91.71	93.68	93.47	93.44	0.37
Apparent metabolizable energy (Kcal/g)	3.09	3.11	3.01	3.10	3.06	0.02
ME_n (Kcal/g)	2.91	2 97	2.83	2.95	2.89	0.03
Effieicny of energy utilization ($\frac{ME}{GE}$)%	81.96	82.49	79.84	82.23	81.17	0.48

a,b,c —— Means within the same rows with different superscript are significantly (P<0.05) different.

Table 5.

EFFECT OF DIETARY FISH SILAGE ON PERFORMANCE AND EGG QUALITY OF LAYING HENS

	Average Feed Consump. (Kg/bird)	*Average Hen-day production (5)*	*Average Egg weight (g)*	*Yolk colour (objective score: 0–24)*	*Average Haugh unit*	*Average Feed Conversion ratio (Kg feed per dozen egg)*	*Average Mortality (%)*	*Average Live weight gain (g)*
Fish meal	19.73^{a}	58.00^{a}	56.22^{a}	14^{a}	75.88	3.16^{c}	4.95	$188,62^{a}$
Neutral maize fish silage	19.50^{a}	56.9^{a}	54.97^{a}	12^{ab}	76.10	3.50^{b}	5.08	173.39^{b}
Acidic maize fish silage	18.66^{b}	50.8^{b}	54.13^{ab}	10^{b}	76.00	4.00^{a}	4.73	159.11^{c}
Neutral cassava fish silage	19.95^{a}	53.7^{b}	53.95^{ab}	12^{ab}	76.62	3.68^{a}	4.69	168.75^{b}
Acidic cassava fish silage	18.60^{b}	43.8^{c}	52.7^{b}	9^{b}	75.44	4.20^{a}	5.15	155.46^{c}
Standard Error of Mean (SEM)	±0.33	±2.54	±0.58	±0.87	±0.19	±0.19	±0.10	±5.84

a,b,c —— Means in the same column with different superscript are significantly different ($P<0.05$).

commercial control rations. Rao (1965) also observed, that, feed intake and weight gain of birds fed fish silage preparations, were lower than those of the control group. The acidic nature of the silage diets probably conferred some astringency on them and hence reduced their palatability and consumption. This could lead to a reduced availability of nutrients for growth purposes, which, together with the acidic silage diets, might have accounted for the relatively poor performance of the pullets.

Results presented on nutrient utilization showed significant ($P<0.05$) differences in nitrogen retention values, while lipid retention was not significantly influenced by dietary treatments. Pullets fed fish meal diet, gave the highest body weight gain and nitrogen retention values, while in pullets fed acidic cassava silage diet, both body weight gain and nitrogen retention were lowest. This result suggests that pullets nearing sexual maturity, require good quality protein diet for tissue protein synthesis, which agrees with the views of Gilbert (1971). Thus, the acidic cassava fish silage was the poorest of all the experimental diets in terms of its protein quality.

There were no significant differences between treatment means with regard to lipid retention, which suggests that maize and cassava silage products could be good sources of energy for pullets. The equally high metabolizable energy (ME) among dietary treatments confirms this observation, although, there were slight differences in the efficiencies of energy utilization of the different groups as indicated by their (ME/GE%) values.

The results presented in Table 5 revealed that all measured criteria for the laying hen, were significantly ($P<0.05$) depressed by fish silage rations. The better performance of layers fed the fish meal ration, was evidently due to the better protein quality of fish meal and to greater ability of the birds to metabolize energy and retain nitrogen. Fish meal is higher in crude protein than fish silage (Ologhobo *et al*, 1988), and the substitution of fish meal with fish silage on weight basis (Table 2), resulted in a decrease in protein quality of the substituted diets. According to Jensen and Schmidtsdoff (1977), methionine and tryptophan in fish silage are destroyed during acid liquifaction process, while histidine is decomposed by enzymes during ensilation (Gilberg, 1977). Thus, the poor responses of the layers in terms of egg production, egg weight and feed conversion efficiency, were due largely to the poor protein quality of fish silage products, which were prepared from herring fish *(Clipea harengus)*, that originally contained 15% protein and 11% fat, to which filler materials (maize/cassava flour plus groundnut meal and wheat offal), were added to raise protein level to 30% (Ologhobo *et al*, 1988).

Interestingly, feed consumption was high for birds fed fishmeal and the different fish silage rations. This was not due to the improved palatability of the diets, as chickens have poorly developed taste buds. All the same, this, coupled with the poorer ($P<0.05$) egg production of the layers, accounted for the lower feed efficiencies of the birds fed the fish silage diets.

The cost of the fish silage products including filler materials, at the time of the experiment was ₦2.80/kg as compared with ₦5.20/kg for fishmeal. This suggests that the replacement of fishmeal with fish silage products was likely to be economical. However, with respect to egg production, it is evident that fish silage cannot completely

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replace fishmeal as a substitute in layers' rations. Although comparatively high amounts of feed were consumed by layers on all treatment rations, average hen-day production was significantly (P<0.05) poorer for layers on fish silage than on fishmeal. Thus, more feed would be required in these birds to produce comparable number of eggs. The poor utilization of feed relative to egg production by layers, does not make fish silage a good substitute for fishmeal in terms of profitability and economics of production.

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