

Original Research Article

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## Nutritional and Biochemical Properties of Fish Silage Prepared as an Ingredient in Poultry Feed

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### ABSTRACT

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Fish silage was prepared from fishery wastes collected from KFDC Karnataka. Fishery wastes was added with 1:1 ratio of 3% (v/w) of formic acid and propionic acid and kept it for liquefaction. The pH was checked regularly which was maintained well below 4 and became stable. The proximate and quality parameters were analyzed periodically. The proximate parameters of the liquid silage was showing a moisture level of 81%, protein of 15%, fat of 5.78% and ash of 3.3%. Among the quality parameters PV value ranged from 2.03±0.064 to 2.14±0.062 milliequivalent/kg, TBA value from 4.06±0.02 to 4.25±0.06mg N/100g, TMA value from 2.29±0.16mg% to 3.72±0.13 mg%, TVBN value from 19.01±0.12mgN/100g to 26.33±0.19mgN/100g and TPC value of 6.4×10<sup>6</sup> cfu/g initially and then showed a decreasing trend. The quality of silage remained prime during the storage period and hence can be included as a promising ingredient in the animal feed

### Introduction

Generation of fishery wastes from fish processing plants is now causing alarming issues to environmental pollution. Transportation of these wastes to the area of safe disposal is not always a sustainable practice (Nunes, 1999). These generated wastes can be utilized in the manufacture of other byproducts there by reducing the pollution issues and also paving a way to revenue generation. Among the raw material volume received in the fish processing units the half is turning into wastes. But these wastes are rich source of low cost nutrients which can be well utilized (Oetterer, 2002).

The alternative is the utilization of these available wastes in generating by-products there by reduces the environmental pollution (Maia *et al.*, 1998). The usually followed practice is the preparation of fish meal by using these generated wastes, which is not always a feasible activity. As this process is expensive, high energy consuming and requires highly qualified engineers and large amounts of fish waste. Hence the viable alternative is to produce fish silage out of these wastes which is highly cost effective and also acts as a source of supplement in making animal feed (Rahmi *et al.*, 2008). It has been defined that fish silage is a liquid product produced from the whole fish or parts of it, to

which acids, enzymes or lactic-acid-producing bacteria are added, with the liquefaction of the mass provoked by the action of enzymes from the fish (FAO, 2003). Preparation of fish silage involves the mixing of minced fish or parts of fish with acids or fermentable CHO. Chemical silage is comparatively an easy technique which uses either organic acid or mineral acids. Organic acids are more expensive when compared to inorganic acids. Liquefaction process in organic acids can be carried out within a range of pH 3.5-4.5, which might be considered beneficial due to the anti-bacterial properties present in them. Also the use of organic acid such as formic acid and propionic acid in this pH range eliminates the need to neutralize the final product before it is incorporated as a feed ingredient. Strom *et al.*, (1980) have demonstrated that propionic acid inhibit the fungus growth especially. Silage is a protein rich high biological value product for animal feeding, which involves dead fish, sub-utilized species, fishing by-products and industrial wastes.

These raw materials if not efficiently utilized may cause environmental, health and economic problems (Vidotti *et al.*, 2003). During fish silage preparation the pH is lowered which liquefies the fish by the action of endogenously proteolytic enzymes. Reduction in pH also helps in the breakdown of bones and cartilage and also inhibits the growth of spoilage bacteria (Tatterson, 1982). Proteins are hydrolyzed during liquefaction and prolonged storage and yield soluble peptides, free aminoacids, NH<sub>3</sub> and other metabolic products (Stone and Hardy, 1986). Fish silage has a high nutrient value and has essential amino acids in a balanced ratio where it can be used as promising protein supplement in livestock and aquaculture production (Strøm *et al.*, 1979; Rungruangsak and Utne, 1981; Raa and Gildberg, 1982). In moist diets fish silage can be mixed directly or

dried and mixed as an ingredient in animal feed. Co-dried silages with cereals are used in preparation of poultry feed (Disney *et al.*, 1978). Fish silage is a best alternative to fish meal manufacturer since it can be applied even in small quantities or raw materials, thereby eliminating the need for heavy and expensive processing equipment and maintenance. There is a better chance to produce huge amount of fish silage in tropical countries due to the availability of byproduct from capture, industrial wastes and also by-catch fish (Durairaj *et al.*, 1976; Gildberg and Raa, 1977). In fish farming and animal rearing 60% of the expenses are incurred in feed cost which can be easily reduced to by adding fish silage as a protein supplement in animal feed (Arruda, 2007).

### **Materials and Methods**

Fish wastes were collected from KFDC, Mangaluru, Karnataka. Collected wastes were washed thoroughly in potable water. The wastes were then chopped well and were transferred to a plastic tank. A 1:1 ratio of 3% (v/w) of formic acid and propionic acid was added to the chopped fishery wastes and mixed thoroughly. The initial pH was checked.

The mixture was left in the tank for liquefaction at room temperature and stirred well both in the morning and evening. pH changes was recorded daily. Proximate composition of silage which includes moisture, protein, fat and ash was done. Biochemical parameters such as TVBN, TMA, PV and TBA were performed according to AOAC (2005). AAN measured according to Benjakul and Morrissey (1997), T-VBN measured according to Beatty and Gibbons (1937) and TPC. To determine the quality of the prepared silage microbiological parameter such as TPC was carried out initially to check the acceptability of the product.

**Results and Discussion**

**Determination of pH of the fish silage**

The pH of the silage was monitored daily. 5gm of the sample was taken and homogenized with 45ml of distilled water and checked with pH meter. It showed a regular trend without much fluctuation. The pH showed a slight variation and finally fixed to 4 at the end of day 21. There was not much variation in pH which leads to a complete liquefaction of the sample.

**Determination of proximate composition**

The proximate composition of the fish silage was analyzed and recorded. Proximate composition of the raw fish waste, liquid fish silage and dried fish silage was carried out. The proximate composition of the analyzed sample is given in table 1.

**Determination of PV**

The oxidation of the fish silage was analyzed by analyzing the Peroxide Value (PV). The

PV was found to slow increase in values followed by constant values. The PV of the fish waste initially showed a value of  $2.03 \pm 0.064$  milliequivalent/kg of oil and the final fish silage demonstrated the value  $2.14 \pm 0.062$  milliequivalent/kg of oil by the end of 27 days. Babu *et al.*, (2005) reported PV of 2.32 milliequivalent/kg of oil for 3% formic acid and 4.68 milliequivalent/kg of oil for 2.5% formic acid silages

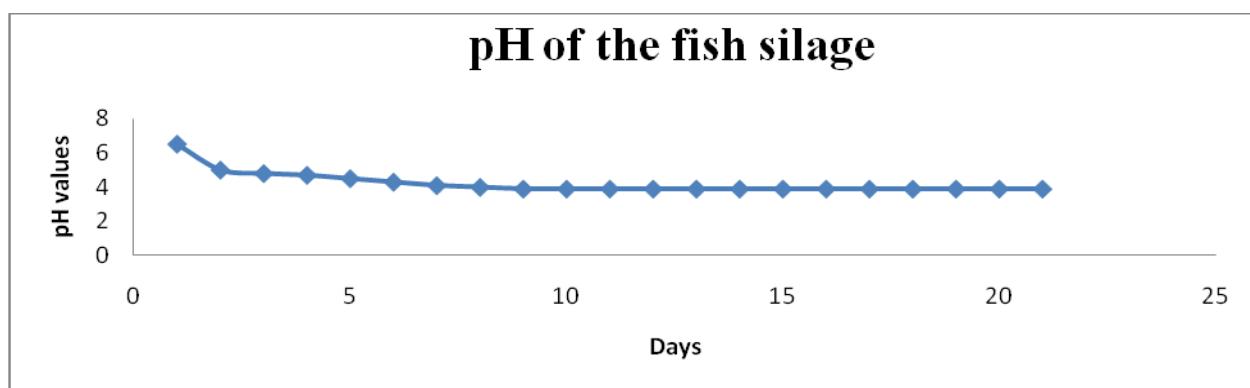
**Determination of TBA**

The TBA of the sample was analyzed which gave an initial value of  $4.06 \pm 0.02$  mgN/100g and which exhibited a value of  $4.25 \pm 0.06$  mgN/100 by 14<sup>th</sup> day and which remained stable throughout the period of hydrolysis.

The product of TMA is dependent on the bacterial activity as well as from endogenous enzymes (Mohd'Yusuf *et al.*, 2010).

The recommended level of TMA value for human consumption is 10 to 15 mg N/100 g (Connell, 1995).

**Determination of pH of the fish silage**



**Table.1** Proximate composition of the samples analyzed

Ingredients	Moisture	Protein	Fat	Ash
Raw fish waste	74.61	19.05	3.38	5.21
Liquid fish silage	80.825	15.3	5.78	3.3

### **Determination of TMA**

The acceptable limit of TMA values ranged from 1.4mg% to 9mg%. There was a constant reduction in the values of TMA which indicated the reduction in the spoilage bacterial counts. As there is reduction in pH it is difficult for the putrefying bacteria to survive which led to the reduction of TMA values. The TMA value for the initial lot was  $2.29 \pm 0.16$ mg% for the initial lot of the raw wastes and which gradually showed a slight increase to  $3.72 \pm 0.13$  mg% for the fish silage at the end of 28 days. As proteolysis increases, it may also lead to the increase in TMA levels.

### **Determination of TVBN**

TVBN values represent the amount of volatile nitrogen compound released by the degradation of nitrogenous compounds on action with acid as well as enzymes present in the fishes. As nitrogenous compounds break down more and more liquefaction occurs. It has been reported that liquefaction of protein is more in acid silages than in fermented silages. The initial TVBN value of the fishery wastes was  $19.01 \pm 0.12$ mgN/100g and it was finally increased upto  $26.33 \pm 0.19$ mgN/100g until 28 days.

Almost similar values was obtained for the silage prepared from fishery wastes by Palkar *et al.*, 2017 which came to around 27.16mgN/100g for 2.5% formic acid and 25.25mgN/100g for 3.5% formic acid silages after 24 days. TVBN levels were well below acceptable limit for the silage with and without antioxidant even after 90 days (Tanuja *et al.*, 2014). Tissues degrading enzymes, digestive enzymes or proteolytic enzymes present in the fish can be cause of release of high amount of nitrogenous compounds leading to the increase in TVBN values (Hammoumi *et al.*, 1998).

### **Determination of TPC**

TPC of the silage samples were analyzed to indicate the microbial load in silage. The initial TPC value of the pink perch waste was  $6.4 \times 10^6$  cfu/g which finally showed a gradual reduction. Palekar (2009) ( $5.1 \times 10^6$  cfu/g) and Palkar *et al.*, 2017 ( $6.7 \times 10^6$  cfu/g) has demonstrated similar results in the case of pink perch wastes and also in market fishery wastes.

Fish silage is a cheap and environment friendly alternative method for waste-fish utilization and prevents dumping in environment which leads to pollution in many coastal fishing communities. It is also a better and cheap alternative to be added in animal feed as a good protein supplement. In this study it was observed that the proximate and the biochemical composition of the silage remained acceptable throughout. Even though there was an increase in TVBN, TMA, TBA and PV values it was within the limit. pH of the reached stable within 7<sup>th</sup> day and remained constant at 4. This pH value aided in liquefying the wastes and also controlled the growth of microorganisms. However, liquefaction due to the proteolytic enzymes may produce a good product which would contain available ingredients that could be used by the digestive system of the animal fed on the product. Hence silage is a highly beneficial product as a protein supplement in animal feed by replacing soybean at certain levels. It is very cheap and easy to prepare and is a beneficiary product for small scale backyard poultry farmers.

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