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Studies on the Preparation of Fish Silage

III. Dried Silage Products

By

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Introduction

In parts one and two of this study the optimum conditions for the preparation of liquid silages from silver belly using hydrochloric and formic acids have been investigated (Jayawardena *et al.* 1980 ; Jayawardena and Poulter, 1980).

It has been shown experimentally by other workers that silages dried together with a filler material can be used to replace fish meal in compounded chicken feeds provided the levels do not exceed those for fish meal (Disney and Hoffman, 1976 ; Arufudin *et al*, 1978). However, few large-scale trials have been undertaken and the procedure is still at the experiment stage. In Sri Lanka imported fish meal is very expensive and the locally prepared product is often in short supply and of low quality. the potential in Sri Lanka for a high quality dried fish silage product suitable for incorporation into chicken feeds, is therefore very high.

In this, the third paper of the series, the preparation of dried products from silver belly silage mixed with cheap filler materials of plant origin, has been investigated. The Veterinary Research Institute, Peradeniya, is currently undertaking chicken feeding trials with various dried silage preparations and the results will be reported at a later date.

Materials and Methods

Fish Samples

Silver belly (6 kg.) (*Leiognathus splendens*) were purchased from St. John's Fish Market, Pettah, during April, 1978. The fish had been inadequately iced and their appearance indicated that they were not of good quality.

Preparation of Liquid Silages

Silages were produced using hydrochloric acid (10.2N) formic acid (90% w/v solution) and mixtures of both hydrochloric and formic acid. Table 1 gives the concentrations of acids used. The exact details of the procedure used for the preparation of the silages has been described previously (Jayawardena *et al.*, 1980.)

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Preparation of dried Silage/filler Material Mixtures

One month after preparation part of the silages produced by adding (*a*) hydrochloric acid to give a pH of 2.5, (*b*) 0.5% formic acid and hydrochloric acid to give a pH of 3.0 and (*c*) 2.5% formic acid were mixed with a filler material and dried. Table 2 gives details of the filler materials, the silages with which they were mixed and the concentration used. The mixing was done manually. Due to unfavourable climatic conditions sun drying was not possible and the silage/filler material mixtures were dried in a mechanical kiln at 40° to 45°C for 2 days.

Analytical Methods

Water, ash, fat, total nitrogen, crude protein, pH and total volatile nitrogen (TVN) were determined as described previously (Jayawardena *et al.*, 1980).

Results and Discussion

The TVN content of the silver belly used in this experiment was 167 mg/100g. This value is very high and indicates that the fish were spoilt. Nonetheless, all the silages produced had a pleasant malty odour and a normal appearance, ie. a grey/brown viscous liquid.

The pH of the silages made with hydrochloric acid were maintained at the desired level by periodic addition of further quantities of acid. No such pH adjustments were made for the sample produced with 2.5% formic acid. The pH of this sample rose slightly during the first few days after production, ie. pH 4.0 at day 0 and pH 4.3 at day 5. Small rises in pH of this nature do not affect the keeping quality of the silage (Jayawardena *et al.*, 1980 ; Jayawardena and Poulter, 1980).

Table 3 gives the proximate composition of the silage samples after one month of storage. Bearing in mind the difficulty of sampling a viscous liquid, the composition of the silages were quite similar to each other and to the mince from which they were derived (see also Table 3).

All 4 of the silage samples kept for one month without any signs of deterioration. After 4 months the silage prepared with 0.5% formic acid and hydrochloric acid to give a pH of 3·0 showed slight evidence of mould growth and the silage prepared with 2.5% formic acid had a putrid odour and small maggots were found on the walls of the container.

In practice, however, a storage life of one month would be sufficient time to allow the silage to be mixed with a filler material and dried to form an ingredient for compounded chicken food.

The appearance of the dried silage/filler material mixtures prepared in this experiment (after the silages had been stored in the liquid state for one month) varied according to the type of filler meterial used. The sample with rice bran I was a brown/black powder whereas the sample containing rice bran II was a lighter, yellowish powder. The sample containing maize meal was also yellowish in colour but had a much coarse texture. All three samples had a pleasant spicy/malty smell.

The proximate composition of the filler materials and the dried silage/filler material mixtures are given in Table 3. Rice bran I has a higher fat and protein but lower ash contents than rice bran II. Maize meal is very low in ash but protein content is similar to rice bran I. However, as shown in table 2, maize meal costs 2 to 3 times as much as either rice bran I or II. This is mainly because maize meal can be used as a human food while rice bran cannot. The differences in the composition of the dried silages/filler material mixtures shown in Table 3 reflects the difference in the composition of the filler materials and the proportions in which they were used.

For the dried silage product produced from silage made with 2.5% formic acid and rice bran I (3 : 1), and dried to 10.5% water contents, the yield (% w/w of raw fish) was 65.3%.

Conclusions

(1) Even though the silver belly samples were not of good quality, the liquid silages produced from them using (*a*) hydrochloric acid to give a pH of 2.5, (*b*) 0.5% formic acid and hydrochloric acid to give a pH of 3.0, (*c*) 1.0% formic acid and hydrochloric acid to give a pH of 3.5 or (*d*) 2.5% formic acid, kept in good condition for at least one month.

(2) Silages produced using hydrochloric acid and/or formic acid when mixed with rice bran or maize meal and dried, yielded powders having an acceptable appearance and a pleasant odour. Such powders are suitable for use in compounded chicken feeds.

(3) Although either rice bran or maize meal can be used as the filler material in the preparation of dried silage products, rice bran is to be preferred in Sri Lanka on economic grounds.

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TABLE 1

ACID CONCENTRATIONS USED TO PREPARE SILAGE SAMPLES

Formic Acid % *W/W*	*Hydrochloric Acid* % *W/W*	*PH* *
—	11·6	2·5
0·5	9·2	3·0
1·0	5·7	3·5
2·5	—	4·0

* For silages containing hydrochloric acid, the acid was added until the desired pH was obtained.

TABLE 2

DETAILS OF FILLER MATERIALS USED TO PREPARE DRIED SILAGES

Filler Material	*Price per cwt. (Rs.)*	*Appearance*	*Silage*	*Concentration (Filler : Silage)*
Rice Bran I	36·00	Red Powder	2·5% FA pH 4·0	1 : 3
Rice Bran II	25·00	Yellow Powder	0·0% FA pH 2·5	1 : 3
Maize meal	80·00	Yellow partially ground pieces	0·5% FA pH 3·0	1 : 1

FA = Formic Acid.

TABLE 3

PROXIMATE COMPOSITION OF WET MINCE, LIQUID SILAGES, FILLER MATERIALS AND DRIED SILAGE/FILLER MATERIAL MIXTURES

Sample	*Water* % *W/W*	*Ash* % *W/W*	*Fat* % *W/W*	*Crude Protein* % *W/W*
Silver belly mince	74·5	8·3	2·0	16·9
Silage pH 2·5	74·5	6·5	1·8	15·6
Silage 0·5% FA/pH 3·0	71·3	7·6	2·0	16.2
Silage 1·0%FA/pH 3·5	73·7	10·2	2·0	16·2
Silage 2·5% FA	74·3	7·3	2·1	16·7
Rice Bran I	9·8	20·3	13·0	11·6
Rice Bran II	8·8	26·0	10·2	8·7
Maize meal	12·2	1·8	4·7	10·1
Silage pH 2·5 + Rice Bran II	8.9	23·4	10·7	27·7
Silage 2·5% FA + Rice Bran I	10·5	16·0	14·1	32·3
Silage 0·5% FA/pH 3.0 + Maize meal	10·1	9·5	6·1	23·6

FA = Formic Acid.