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DIGESTIBILITY OF FISH SILAGE AND FISH MEAL BY NILE TILAPIA (OREOCHROMIS NIIOTICUS)

By

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SUMMARY

Two digestibility trials were conducted. The first, to determine the digestibility coefficients of the local fish meal (low quality), fish meal (medium quality), fish silage made from fish processing waste and fish silage made from unusable fish for human consumption which were fed as a single ingredients for 5 days the apparent digestibility coefficient protein, lipid, calcium and phosphorus were higher for the fish silage (which was made from unusable fish for human consumption) followed by the other fish products. The second trial was to determine the digestibility coefficient of four diets, whereas, each diet contained one source of fish products. The higher values of digestibility coefficients were obtained from diet contained fish silage made from unusable fish for human consumption and fish silage made from fish processing waste. The present data also indicated that the nutritional value of fish silage was improved by storing the ingredients at -5 °C prior to insilling, and the diets made using these silages contained more intact protein and less free amino acids than diets made using conventional fish products.

INTRODUCTION

Finding an economical way for converting the waste products of fish industry into acceptable protein supplements for fish feeding is very important.

Ensiling of fish wastes as a method of preservation was developed in Northern Europe and has been used commercially since 1948 (Tatterson and Windsor, 1974). Fish silage is a liquid product made from whole fish, containing of whole fish and fish wastes, or fish waste alone. It is liquified by the action of endogenous enzymes in the presence of added mineral and / or organic acids such as sulfuric, phosphoric, formic or propionic acids.

Heating may or may not be used during the process, as heating facilitates fat recovery (Johnesen and Skrede, 1981) and inhibits lipolysis of triglycerides during storage (Tatterson and Windsor, 1974). In unheated silage, hydrolysis proceeds until the nitrogenous components become a mixture of short-chained peptides and monoenoic acids (Raa and Gildberg, (1976)

Fish silage can be dried either by adding a small percentage of other dry commodities or by co-drying the mixture in conventional fish meal drying equipment. This practice prevents foaming and facilitates drying by providing particles on which the silage can be absorbed (Hardy et al., 1984).

Diets based on fish silage have been successfully used for trout in Norway (Asgard, 1981; Rao and Absjorn, 1982) although no similar data appeared to exist for tilapia diets.

This study was therefore conducted to determine the nutrients digestibility coefficients of local commercial fish meal (Low quality), fish meal (medium quality), fish silage made from fish processing wastes and fish silage made from whole fish which is not usable for human consumption. Also this study was conducted to determine the nutrients digestibility coefficients of diets containing the four fish products.

MATERIAL AND METHODS

Experimental procedure

Trial I

Tilapia (average weight, 9.0 gm) were separated into 16 groups of 12 and placed in 16 glass aquaria (2.7 gm / L), each was supplied dehlorinated tap water. Each experimental diet was randomly assiggned to two tank of fish. Eight groups fed pelleted food as local commercial fish meal (Low quality), fish meal (meium quality), fish silage (made from fish processing wastes) and fish silage (made from whole fish which not usable for human feeding) for 5 days.

Trial II

The other eight groups were fed for ten days on diets containing 28 % CP. Each diet contained one source of fish, the product mentioned above (table 2).

The fish were fed every day at a rate of 3 % of the live fish weight, the faeces were removed every day using a siphon tube and fine mesh (20 u) and transferred to petridishes for drying. In add the faeces were removed from the small inte at the end of each feeding trial.

Preparation of fish silage

The fish silage was prepared (after storing ingredients at - 5 C° prior to ensiling) by addi % sulfuric acid and 0.75 % propionic acid to fish processing wastes or whole fish not u for human feeding. The silage was stored covered plastic container at labora temperature and mixed periodically by hand a paddle. After 30 days, batches of silage w neutralized with 1.6 % Ca (OH)2 to PH 6.2 - mixed with wheat bran 6 % and dried in ove 80 C°. After drying, the material was ground.

Chemical analysis

Determination of dry matter, crude protein, e extract, Ca and P contents in feed and faeces carried out using the procedures of Associatio Official Analytical Chemists (1975) and prese in tables 1, 3 and 4. The concentration of chro oxide was measured spectophotometrically by method of Furukawa and Tsukahara (1966).

Amino acid profiles of ingredients and fae were obtained following their acid hydrolysis h in 6 Hcl at 110 C) under nitro

Table (1): Chemical composition of (FML), (FMM), (FSW) and (FSU).

Fish products	Dry matter %	Crude Protein %	Ether extract %	Ash %	Ca %	P %
Local commercial fishmeal (low quality)	92.0	21.87	12.38	42.70	3.20	1.54
Fishmeal (medium quality)	93.0	41.86	18.20	17.90	6.50	1.44
Fish silage (made from fish processing vaste)	33.1	31.80	23.24	14.34	4.50	1.35
Fish silage (made from unusable fish for Human consumption).	38.7	40.6	29.02	15.57	5.10	1.40

Table (2): Composition of the experimental diets.

Raw materials	(FML)	(FMM)	(FSW)	(FSU)
Yallo corn (8.12 % CP)	15	25	25	28
Wheat bran (8.01 % CP)	10	10	10	10
Soy bean meal (44.0 % CP)	30.5	30.5	30.5	30.5
Cotton seed meal (41.0 % CP)	20	20	20	20
Fish meal (low quality) (21.87 % CP)	20	--	--	--
Fish meal (medium quality) (41.86 % c?)	--	10	--	--
Fish silage (made from fish processing (31.86 % Cp)	--	--	15	--
Fish silago (made from unusable fish) (40.6 % CP).	--	--	--	7
Cotton seed oil.	3	3	3	3
Vita. Min. remix.	1	1	1	1
Chromic oxide (Cr_2O_3)	0.5	0.5	0.5	0.5
Dry matter (%)	86.49	86.29	77.51	82.37
Crude protein (%)	28..01	28..64	28.81	27.54
Ether extract (%)	7.90	8.67	11.33	9.70
Ash (%)	13.73	7.31	7.51	6.71
Ca (%)	0.14	0.15	0.15	0.14
P (%)	0.56	0.58	0.57	0.59
Cross energy (Kvsl / kg)	4418.76	4735	4870.96	4798.74
Chronic oxid (Cr_2o_3)	0.27	0.20	0.17	0.08

Table (3) Chemical composition of faeces of tilapia fed single fish products (Trial I).

Item		Dry matter %	Crudeprotein %	Ether extract %	Ash %	Ca %	P %
Fish meal (low quality)		31.58	1.9	5.34	62.85	1.5	0.6
	SE±	1.32	0.10	0.05	0.37	0.01	0.03
Fish meal (medium quality)		18.47	4.9	9.87	37.88	1.0	0.5
	SE±	0.28	0.09	0.06	0.29	0.02	0.04
Fish silage (made from fish processing waste)		11.78	3.0	15.05	37.36	0.7	0.4
	SE±	0.43	0.07	0.42	0.32	0.05	0.03
Fish silage (made from unusable fish)		10.74	2.2	10.61	20.18	0.8	0.4
	SE±	0.98	0.05	0.31	0.14	0.06	0.03

Table (4) Chemical comosition of faeces of tilapia fed diets contained varies fish products (trial II).

Items		Dry matter %	Crude protein %	Ether extract %	Ash %	Ca %	P %
Fish meal (low quality)		20.27	1.9	4.54	38.98	0.9	0.5
	SE±	1.63	0.12	0.09	0.59	0.07	0.04
Fish meal (medium quality)		17.26	2.5	4.75	16.48	0.7	0.5
	SE±	2.15	0.07	0.07	0.45	0.04	0.03
Fish silago (made from fish processing waste).		15.68	1.5	5.92	16.13	0.6	0.5
	SE±	1.66	0.04	0.04	0.55	0.05	0.03
Fish silage (made from unusable fish)		14.77	2.3	6.48	17.84	0.7	0.5
	SE±	1.76	0.06	0.05	0.42	0.06	0.03

Table (5) Essential amino acid content of fish products, faeces and digestibility coefficients of the same essential amino acids

Essential Amino Acid	Amino acid content								Digestibility coefficient			
	(FML)		(FMM)		(FSW)		(FSU)		(FML)	(FMM)	(FSW)	(FSU)
	Feed	faeces	Feed	faeces	Feed	faeces	Feed	faeces				
Aminine	1.61	0.5	3.48	1.2	2.51	0.85	2.6	0.88	91.64	90.36	89.38	[illegible]
Methionine	0.5	0.19	1.93	0.73	0.37	0.15	0.53	0.19	97.24	89.43	87.28	[illegible]
Histidine	1.56	0.50	1.53	0.56	1.19	0.40	1.28	0.43	91.37	89.77	89.38	[illegible]
Phenylalamine	0.93	0.32	2.7	1.10	2.25	0.79	2.39	0.81	90.74	88.62	88.91	[illegible]
Isoloucine	1.06	0.34	3.01	1.10	1.5	0.61	2.21	0.75	91.36	89.79	87.16	[illegible]
Tryptophan	0.31	0.10	0.74	0.27	0.30	0.12	0.41	0.15	91.31	89.80	87.37	[illegible]
Loucine	1.86	0.45	4.83	1.25	0.38	0.77	4.12	0.65	93.49	92.77	93.73	[illegible]
Threonine	0.86	0.23	2.68	0.55	2.17	0.74	2.00	0.53	92.80	94.26	89.23	[illegible]
Lysine	1.73	0.46	4.9	1.05	4.08	0.88	4.23	1.08	92.84	94.01	93.19	[illegible]
Valime	1.16	0.26	3.38	0.83	2.24	0.53	2.69	9.68	93.96	93.14	92.53	[illegible]

chromatographic seperation on an amino acid analyser. Tryptophan was measured separately according to Matheson (1974), Table (5).

At the end of each feeding trial, the apparent digestibility coefficients for the local fish meal (low quality), (FML), fish meal (medium quality), (FMM), fish silage (made from fish processing waste, (FSW), and fish silage made from whole unusable fish), (FSU) were determined using chromic oxide as an indicator.

The apparent digestibility coefficients were estimated using the formula suggested by Maynard and Loosli (1962):

$$\text{Digestibility coefficient (\%)} = 100 - \left[100 \left(\frac{Ii}{If} \times \frac{Nf}{Ni} \right) \right]$$

Where:-

I = concentration of chromic oxide. i = ingesta.

N = concentration of nutrient (%DM) f = faeces.

Statistical analysis was adopted after Steel and Torrie (1980) using Complete Randomiz Design. Duncan, test was also applied in ea experiment whenever possible to test m differences, Duncan (1955).

RESULTS AND DISCUSSION

Table (6): Apparent digestibility coeficients of fish products which tilapia fed for 5 days.

Diets	Dry matter %	Crude protein %	Ether extract %	Ca %	P %
Fish meal (low quality)	90.76 [bc]	97.66 [b]	88.39 [a]	26.20 [b]	70.08 [a]
Fish meal (medium quality)	94.45 [a]	96.73 [c]	84.85 [b]	57.01 [a]	68.25 [b]
Fish silage (made from fish prcessing waste)	88.76 [c]	97.02 [c]	79.55 [c]	50.88 [a]	63.91 [c]
Fish silage (made from unusable fish)	91.99 [b]	98.44 [a]	89.45 [a]	54.75 [a]	71.15 [a]
SE±	1.19	0.38	2.23	7.12	1.59

SE±, standard error.

A, b,... etc. means in same column with different superscripts are different ($p < 0.05$)

Table (6) illustrated the digestibility coefficients of local fish meal (low quality), fish meal (medium quality), fish silage made from fish processing wastes and fish silage made from unusable fish for human consumption which fed as a single ingredient for 5 days. (Trial I).

The apparent digestibility coefficients for protein, lipid, Ca and P were highere for the fish silage diets than for the other fish products. This confirmed the results of Stone et al., (1989) who reported that fish protein was readily digested and absorbed from silage made form ingredient not stored at - 5 C° prior to ensiling, but was utilized less efficiently for growth than protein from fish meal, the reason of these data may be due to the nutritional value of fish silage which made from whole fish was imporved by storing the ingredients at - 5 C° prior to ensiling as a results of Stone et al., (1989). Short-term storage of fish at temperatures slightly below freezing could be an alternative method for reducing the free amino acid content of fish silage rather than fish processing wastes. Although silage made from whole fish is somewhat more digestible than silage made from fish processing wastes, Hardy et al., (1984) found that neutralization of added sulfuric acid restored the weight gains of trout to fish meal control diet.

Table (7) illustrates the digestibility for four diets (Trial II), whereas, each diet contained one source of fish products. The higher values of digestibility coefficients were obtained from diet contained fish silage made from unusable fish for human consumption or fish silage made from fish processing wastes. Several studies reported that the silage diets, however, were inferior to those containing intact protein (Yamada et al., 1981) or fish meal (Hardy et al., 1984) in supporting fish growth in part because they contained a higher proportion of essential amino acids in free form.

The present data indicated that as the nutritional value of fish silage was improved by storing the ingredients at - 5 C° prior to ensiling. Also, the diets made with these silages contained more intact protein and les free amino acids than diets made with convenional fish products. These diets may have been utilized more efficiently because of prolonged absorption time of peptides and free amino acids as digestion progressed in the gastrointestinal tract, resulting in better conversion of dietary protein to fish. It is clear from these results that the autolysis of fish silage should be restricted to preserve nutritional value.

It is clear from these results that the autolysis of fish silage should be restricted to preserve nutritional value.

Table (7): Digestibility coefficients of diets which contained vaies fish products

Diets	Dry matter %	Crude protein %	Ether extract %	Ca %	P %
Fish meal (low quality).	68.36^{c}	90.84^{b}	22.42^{b}	13.21^{b}	87.95^{c}
Fish meal (meduim quality).	62.49^{c}	83.63^{c}	17.82^{b}	12.50^{b}	83.84^{d}
Fish silage (made from fish processing waste).	84.37^{b}	95.98^{a}	59.62^{a}	69.09^{a}	93.22^{b}
Fish silage (made from unusable fish).	92.45^{a}	96.48^{a}	71.87^{a}	78.95^{a}	96.43^{a}
SE±	6.94	2.99	13.44	17.77	2.79

SE, standard error.
A, b,.. etc. means in same column with different superscripts are different ($P < 0.05$)

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