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Source, Production and Chemical Composition of Fish Meal in Pakistan

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ABSTRACT

Fish meal is considered a major source of protein commonly used in domestic animal feeds as well as in commercial aqua feeds. The present study documents the different species used for the production of fish meal in Pakistan and to determine the proximate composition of fish meal samples obtained from these units. Samples of fish meal were collected from nine different commercial fish meal processing units and were processed for proximate analysis. Results of the proximate analysis revealed more than 60% crude protein (CP) in the fish meal samples obtained from Abdul Baqi, Shamim, Abdul Rasheed and Liaqat fish meal processing units while samples collected from rest of the processing units contained less than 60% CP. Crude fat ranged from 9.9% to 29.5%, ash content 12.7 to 28.2% and gross energy 4,118 to 4,883cal/g. The present study is a preliminary step to identify the source of fish meal production and its chemical evaluation determining the quality and its possible utilization in aqua feed production.

Key words: Fish meal; proximate composition; production; Pakistan

INTRODUCTION

Fishmeal is a generic term produced from a nutrient-rich feed ingredient commonly used for poultry and other domestic animals diet. It can be made from almost any type of seafood but is generally manufactured from wild-caught, small marine fish that contain a high percentage of bones and oil which are not suitable for direct human consumption. A small percentage of fish meal is rendered from the by-catch of other fisheries, and by-products or trimmings created during processing of various seafood products destined for direct human consumption (Miles and Chapman, 2006).

The nutritive value of fish meal varies depending on sources of input, place of harvest and addition of salt for preservation. Understanding the chemical composition of various fish meals used in animal or aqua feed are essential for formulating artificial diets (Kinh et al., 2011). The increasing demand for high quality artificial feed for various farming such as aquaculture, poultry, pig, etc. can be satisfied with fish meal production; a source of good quality protein (Hardy and Masumoto, 1990). Inclusion of fish meal to artificial diets increases feed efficiency and growth through better food palatability, and enhances nutrient uptake, digestion, and absorption. The balanced amino acid profile and high palatability of fish meal provides synergistic effects with other animal and vegetable proteins in the diet to promote fast growth and reduce feeding cost (Hardy, 2000; Oliva and Goncalves, 2001; Miles and Chapman, 2006). Fish meal provides a balanced amount of all essential nutrients including amino acids, phospholipids, and fatty acids (DHA or docosahexaenoic acid and EPA or eicosapentaenoic acid), mineral content, for optimum development, growth, and

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reproduction, especially of larvae and brood stock (Zaldivar, 2002). The incorporation of fish meal in artificial feed imparts a natural characteristic to the final product (Miles and Chapman, 2006).

More cost and limited availability of fish meal has affected the overall feeding and production costs in aquaculture industry. Protein is the most expensive source mainly comes from fish meal, accounting for more than 50% total feed cost in intensive aquaculture (Thompson et al., 2005). Fish meal and fish oil are known as the principal ingredients in feeds of commercially important species of farmed fish and shrimp. Fish oil is also used as a supplementary source which increases the energy value and essential fatty acid profiles in aqua feed (Aberoumand, 2010). In semi-intensive aquaculture system, feed and fertilizers account for about 40 to 60% of the total operational cost but feed accounts for 60 to 80 % and fish meal makes up a substantial part of the total cost (FAO, 2007).

A variety of fish meal commercially available worldwide, mostly depends on temperature, processing technique and fish species that are differed from country to country (Hardy, 1990). Global fish meal production averages between 6.5 mmt per year, out of which 23% is being utilized in aqua feeds (Hardy, 2000). According to Miles and Chapman (2006), the top fish meal producing countries and fish species used for fish meal are Peru (Anchovy), Chile (Anchovy and Horse mackerel), China (Various species), Thailand (Various species), U.S.A. (Menhaden, Pollock) European Union (Various species) Iceland and Norway (Capelin, Herrings, Blue whiting), Denmark (Pout, Sandeel, Sprat), Japan (Sardine/Pilchard) and South Africa (Pilchard). One third of the world fish harvest that is not used for direct human consumption is converted into fish meal or fish oil. According to recent estimates worldwide about 25% of fish meal comes from the usage of waste from the fish processing sectors. Regarding consumption of fish meal, about 3.06 million tonnes of fish meal is consumed by aquaculture sector (Tacon, 2007). Another 5 to 6 million tones of low-value/trash fish are used as direct feed in aquaculture worldwide (Tacon et al., 2006).

In South Asia, fish meal is usually prepared from low quality trash fish that contains low nutritive value and high ash contents (Giri, 2010). All this is due to the use of the low quality fishes and processing techniques in the preparation of fish meal. Studies regarding fish meal production, species used and its quality are not available in Pakistan. Therefore, the present study is planned to investigate the source, production and chemical composition of commercial fish meal production in Pakistan.

MATERIALS AND METHODS

The study area

Fish meal samples were collected directly from fish meal processing units at Korangi and Ibrahim Haidery, Karachi, Pakistan. Detailed information regarding raw/trash fish and material used in fishmeal processing were gathered using a proforma (Table 1). The production processes of traditional and mechanical plants were as follows. Traditional units in Pakistan commonly process the fish meal either by dry or wet processing. Major steps recorded in dry processing were fish collection followed by sun drying, cooking, again sun drying, grinding and finally packing. On the other hand, major steps involved in wet processing were; fish collection followed by cooking, sun drying, grinding and finally packing. Mechanized fishmeal processing was observed with different steps such as pitting of fresh fish followed by cooking under pressure, drying, grinding, weighing and packing.

Proximate analysis

The collected fish meal samples from different processing plants were brought to the Department of Fisheries and Aquaculture, University of Veterinary and Animal Sciences, Pattoki, Pakistan and analyzed for proximate composition (AOAC, 2006). Briefly, dry matter was determined by oven drying for 24 hours and ash contents by burning 1.0 g sample in muffle furnace at 600 °C overnight. Ether extract by Soxtherm apparatus using diethyl ether as a solvent. Crude protein (%) was determined by microkjeldhal apparatus using copper sulphate and magnesium sulphate digestion mixture. Gross energy was determined by a bomb calorimeter using benzoic acid as standard.

RESULTS AND DISCUSSION

The most common fish species used for fish meal production in Pakistan are shown in Table 2. The chemical analysis of fish meal samples revealed that average gross energy, fat, dry matter, crude protein, fiber and ash contents were 4,417 cal/g, 21.88%, 91.03%, 55.79%, 7.26% and 20.75%, respectively. The range of the value of gross energy, fat, dry matter contents, protein, fiber contents, ash, and phosphorous varied from 4,118 to 4,883 cal/g, 9.9 to 29.52%, 88.43 to 93.29%, 37.49 to 66.57%, 2.23 to 12.67%, 12.74 to 28.22% and 0.1 to 1.0%, respectively (Table 3). Aberoumand (2010) reported that chemical composition and quality of fish meal are determined by various factors including raw material, freshness and drying methods of fish. He worked on Blue whiting, herring and capelin meals and categorized the samples on the basis of freshness of the raw fish and processing techniques into three grades that were low temperature (LT), Norsea Mink (NSM) and standard. Aberoumand also suggested that the usage of fresh raw materials, low temperature and low retention time (during drying) for fish meal processing retains quality to a greater extent which is useful in the fish feed industry. Khatoon et al. (2006) investigated fish meal availibility for poultry rations in Pakistan and reported variation among 184 samples of fish meal for their proximate nutrient composition, pepsin, digestibility, salt, acid insoluble ash and chromium. An inverse relationship was observed between fat, ash, pepsin digestibility, chromium and crude protein contents of the fish meal. Kinh et al. (2011) studied the chemical composition of the various fishes used for fish meal production in Vietnam and found that nutritive value of various fish samples varied greatly from less than 30% up to more than 65% crude protein. There was an inverse relationship between crude protein and total ash content of samples. Amino acid concentration was directly proportional to crude protein content, but this relation was not consistent among samples. Ariyawansa (2000) studied raw material freshness and drying methods to determine various factors of fish meal quality. The results revealed that the usage of fresh raw materials, low temperature and low retention time (during drying) for fish meal processing retains functional properties to a greater extent which is useful in the fish feed industry. Jun-ichi et al. (1991) studied the quality and chemical aspect of fishmeal and fish oil of five different kind of fish meal produced from Sadinops, saga, Engeraulis, ringens, trachurus, murphy, Ethmidium maxulatum, srapt of meruccius. In most of the meal except Merluccius meal the component of non-protein was 6 to12%. The percentage of

Table 1 Performa used for fish meal information/data collection

Unit Name	Species used	Production (Tonnes/ month)	Distri-bution	Processing Techniques Traditional/ Mechanical
Mateen	Mushka, Chaku, Anchovies, Mullets (Boi), Schinids	100-200	Local	Traditional (Dry Processing)
Liaquat		150-200	Local	Traditional (Dry Processing)
Gulam Husain		300-500	Local	Traditional (Dry Processing)
Abdul Baqi		300-500	Local	Traditional (Wet Processing)
Hameed	Liver, Doma, Chaku, Kasa(Small Fishes)	100-150	Local	Traditional (Dry or Wet Processing)
Shameem	Doma, Kichaka, Chaku, Karroy, Paddan, Mithu, Khansa, Looer, Kolgar	30 tonnes at one time	Export Germany	Mechanical
Abdul Rashid		100-300	Local	Traditional (Dry/Wet processed)
Kampa Industry Unit 1		100 metric tonnes in 24 hours	Export	Traditional (Wet processes)
Kampa Industry Unit 2		300-500	Local	Traditional Dry/Wet Processed

Table 2 Juvenile finfish species found in trash fish being used in fishmeal preparation

Common Name	Scientific Name	Common Name	Scientific Name
Silver Pomfret	*Pampus argenteus*	Hilsa	*Tenualosa illisha*
Elongated sole	*Solea elongate*	Sting Rays	*Himantura uarnak*
Silver Sillago	*Sillago sihama*	Indian Threadfin	*Polynemus indicus*
Mullet	*Liza subviridis*	Cobia	*Rachycentron canadum*
Mullet	*Liza carinata*	Indian Scads	*Decapterus russellii*
Long-rayed Silver	*Gerres filamentosus*	Indian Mackerels	*Rastrelliger kanagurta*
Black Sea bream	*Acanthopagrus berda*	Oil Sardine	*Sardinella longiceps*
Sea Perch	*Lates calcarifer*	Croaker	*Otolithus ruber*
Grunter	*Pomadasys kaakan*	Jaw fish	*Johnius goma*
Mangrove Red snapper	*Lutjanus argentimaculatus*	Grunts	*Pomadasys hasta*
Sardine	*Dussumieria acuta*	Catfish	*Arius maculates*
Herring	*Chirocentrus dorab*	Elasmobranches	Sharks, Rays, Skates

Table 3 Proximate composition of fish meal samples collected from different plants

Source	Type of Processing	Dry Matter (%)	Protein (%)	Fat (%)	Gross energy (cal/g)	Ash (%)	Fiber (%)	Phosphorus (%)
Hameed	Traditional dry	91.41	58.85	29.22	4405	21.26	11.60	1.95
Abdul Rasheed	Traditional dry	88.43	60.35	17.89	4043	20.71	7.26	-0.27
Abdul	Cooked	89.03	60.26	27.23	43.25	17.25	11.27	0.88
Baqi	Wet Processed	89.65	66.57	12.21	4130	13.63	3.67	0.52
Shameem	Mechanical dry	90.55	61.78	14.84	4118	22.42	2.88	0.65
Liaquat	Traditional dry	93.12	65.49	16.51	4212	17.65	6.24	0.44
Ghulam Husain	Traditional dry	93.29	55.59	29.52	4271	21.23	12.67	1.30
	Balochistan coast							
	Mixed	92.20	53.53	25.98	4776	19.32	8.73	-0.21
	Sindh Coast	94.33	37.49	18.30	4217	26.80	0.12	-1.82
Kampa Unit 1	Traditional wet	89.01	53.38	22.50	4529	12.74	9.77	-1.02
Kampa Unit 2	Traditional dry/wet	88.70	55.06	22.50	4613	21.23	5.94	-0.44
	Fish Dry	90.09	57.48	20.59	4320	20.37	6.86	-0.48
	Viscera mixed	92.99	50.71	16.29	4345	26.28	5.12	0.21
Mateen	Traditional Sample1	92.13	49.73	9.90	4012	28.23	2.32	-0.83
	Sample 2	88.88	58.19	28.70	4519	15.88	10.21	1.85
	Sample 3	89.89	53.11	29.45	4432	19.77	8.55	1.56
	Sample 4	90.14	57.90	22.94	4883	20.43	7.43	-0.10
	Sample 5	94.25	49.76	26.84	4632	26.20	10.26	0.07
	Sample 6	91.41	54.88	21.38	4510	22.87	7.16	1.00

crude fat was 6-11%. Crude protein content in factory ship meal was highest and was 72%. There was no appreciable difference observed in analytical values account for the difference in drying method of fish meal processing. Moghaddam et al. (2007) studied the chemical composition, mineral contents and protein quality of Iranian Kilka fish meal, 6 samples of Kilka fish meal were provided from three commercial rendering plants. The results of proximate analysis showed that the PER and NPR values for the Kilka fish meal samples were lower ($p < 0.05$) than that of Peruvian fish meal and Chilian fish meal.

In conclusion, the fish meal processing in Pakistan is mostly based on traditional methodology (sun drying) where low quality boney trash fish species are used which contain an average 50-55% crude protein, 20% fat and 15-20% ash contents and are comparable to Vietnam, Iran and India that also use low quality fish and traditional methods of sun drying. The results of proximate composition are poor with respect to Chilean and Peru fish meal that contains higher crude protein and using high quality fish. A few plants that have high tech equipments are using good quality fish and producing high quality fish meal containing >70% protein and export their product to the European countries.

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