PROXIMATE CHEMICAL COMPOSITION OF VARIOUS SPECIES OF PHILIPPINE MARKET FISHES

By JOSE I. SULIT, OLYMPIA B. NAVARRO, REGINA C. SAN JUAN, and ELISA B. CALDITO
Of the Bureau of Fisheries, Manila, Philippines

ONE TEXT FIGURE

INTRODUCTION

By knowing the proximate chemical composition according to species, sizes and different portions of the body of fishes, nutritionists are able to determine the approximate food value of various diets using fish as the main source of protein, fats, and minerals. This study also includes the determination of important minerals such as calcium, phosphorus, and potassium found in the ash.

The ravages of World War II destroyed the vast resources of protein food in many countries including the Philippines, making the prices of these foods beyond the buying capacity of an average family. Because of this condition, dietitians and nutritionists are searching for a substitute food rich in food value and yet cheap in price. It is hoped that the results of our studies may help solve some of these problems.

REVIEW OF LITERATURE

Investigations related to this study were conducted by Balagtas (1928), Santos and Ascalon (1931), and Hermano (1932) wherein the proximate chemical composition of a few species of Philippine fishes was included in their works. It has been found that the biological or nutritional quality of the protein, fats, minerals, and vitamins of various species of fish compares favorably with that of beef, veal, pork, lamb, and mutton. Le Cornu (1949) found that fish protein is rich in dietary essential amino acids, amongst them leucine, histidine, lysine, arginine, and tryptophane. Nilson (1946) revealed that fish protein is from 85 to 95 per cent digestible, and biological studies showed that all the dietary essential amino acids which are needed to give growth and maintenance to the body tissue are also present, and that an average serving of fish and shellfish will supply sufficient animal protein to satisfy the daily body requirements. Marks and Nilson (1946) proved in their studies

that baking, broiling, and simmering do not affect the protein food value of codfish. This claim was corroborated by Martinek and Goldbeck (1947) who studied the effect of baking on the protein food value of croaker fillet.

Le Cornu (1949) reported that the fats of some fishes have a high percentage of digestibility, determined as follows—mackerel, 95 per cent; butterfish, 86 per cent; and salmon, 94 per cent. According to Newell and McCollum (1931) the ash of fish fillet has relatively high amount of calcium, copper, iron, magnesium, phosphorus, potassium, sodium, and strontium, besides traces of aluminum and fluorine. In some samples analyzed by them, it was found that fish contains traces of barium, lead, chromium, silicon, tetanium, vanadium, and zinc, as well as traces of chlorine, sulfur, iodine, and bromine. According to Tarr et al. (1950), the vitamin B_{12} present in the fish soluble concentrate, spleen, liver, and fish meal, is one of the most important constituents commonly associated with the animal protein factor (APF). In the Menhaden Reductive Industry (1949), three important products were obtained, namely, the oil, the highly nutritive liquid mixture of proteins, soluble amino acids, and vitamin B_{12}, which, according to Dameshek (1949), is used in the cure of pernicious anemia.

Besides vitamins A and D found in the liver and body of fish, an average serving of fish meat supplies $\frac{1}{20}$ to $\frac{1}{15}$ of the daily allowance of B_1, $\frac{1}{25}$ to $\frac{1}{5}$ of B_2, and from $\frac{1}{10}$ to $\frac{1}{2}$ of niacine. The water soluble concentrates contain an appreciable amount of a newly discovered vitamin B_{12}. So much had been published about vitamin B_{12} that its use as growth-promoting compound is now beyond dispute. Exhaustive review of literature will reveal other more important aspects of fish as food.

MATERIALS AND METHODS

Preparation of the samples.—The different species of fish used in this study were obtained from market centers of Manila and from the catches of fishing boats of the Bureau of Fisheries. After determining the species, the fish was weighed, measured in standard length and depth, then scaled, finned and dressed. The edible portion or the fillet was removed and the rest of the flesh attached to the bones was added after softening by boiling, thereby obtaining the total edible portion. The percentage of non-edible portion is calculated by difference considering the whole fish as 100 per cent. After chopping, it is passed through

a meat grinder to produce a composite and homogenous mixture from which the different samples for analysis were taken.

Proximate chemical analysis.—The prepared samples obtained from different species of fish were analyzed for proximate chemical composition, namely, moisture, protein, fat, ash (minerals), and carbohydrates, calculated by difference. Also, the calories per one hundred grams of edible portion were calculated, based from the above analysis. Each gram of carbohydrates and proteins yields 4 calories, and each gram of fat, 9 calories (Table 1). Some species of fish were analyzed for proximate chemical composition with reference to sizes or weight, enumerated as large, medium, and small (Table 2). The different parts of the fish such as the head, belly, back and tail were also analyzed for proximate chemical composition (Table 3). These parts are shown in text fig. 1.

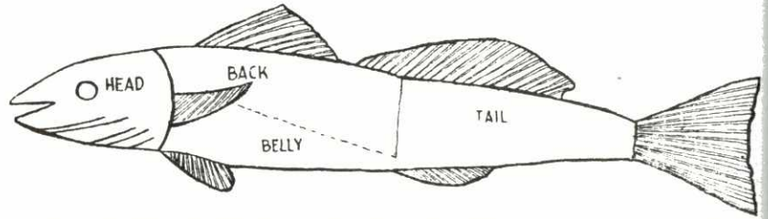

FIG. 1. Showing the different portions of the fish that were subjected to analysis.

Minerals of the ash of the edible portion.—In various species of fish commonly consumed in Filipino homes, the minerals of the ash of the edible portion were analyzed for calcium, phosphorus, and potassium. There has been no study conducted in this country where analysis for potassium is included in fish analysis. The samples used for the moisture determinations were ashed in the muffle furnace at 555°C., and the ashes obtained were utilized for the mineral determination (Table 4).

Methods used for chemical analysis.—For determining the proximate chemical composition of fish and calcium, the sixth edition of the Association of Official Agricultural Chemists (1945) was used as reference with little modification whenever necessary. For potassium and phosphorus, the diagnostic techniques for soil and crops (1948) and those of Fiske and Subbarrow (1925), and Lowry and Lopez (1946) were consulted, respectively.

RESULTS

Table 1 contains the proximate chemical composition and calorific food value of sixty-three species of Philippine market fishes commonly found in market centers. In some species, analysis for minerals of the ash is also included. The edible portion of the fish is determined and the none-edible part is calculated by difference. Table 2 gives the chemical composition of different portions of fish such as the head, belly, back and tail as enumerated in fig. 1.

Table 3 shows the proximate chemical composition with regards to sizes and weight and standard length of some species of fish, the purpose of which is to determine the extent of variations in the chemical composition according to sizes, weight, and standard length.

Table 4 gives the mineral composition of the ash of the fillet of certain species of fish. These minerals are calcium, phosphorus, and potassium.

DISCUSSION OF RESULTS

As shown in Table 1, it is very significant that practically all the species analyzed have less than 5 per cent fat, indicating that the majority of Philippine fishes have lesser fat than those found in temperate waters. Because of this property, practically all edible fishes in Philippine waters may be converted into fish meal without any trouble of any fatty acid rancidity in the final product. Comercial fish meal generally contains not more than 5 per cent fat and with a moisture content of not more than 10 per cent in order to insure from the attacks of molds and other food spoilage agents. The average percentage of fish protein in many of our fishes is generally high, and there are some that are extraordinarily rich in protein, namely, *apahap, dorado, dalagang bukid, lapu-lapu, labahita, maya-maya, talakitok, tulingan,* herring, and other fresh-water fishes, such as *bia, dalag,* and *kanduli.* The mineral ash is high in some species such as *asohos, bakokong moro, bambangin, buan-buan, dalagang bukid, dapang bilog, dilis, dorado, hasa-hasa,* herrings, and the tunas (Table 1). Dilis is one particular species which is quite high in food value, being rich in protein, fat, and minerals, especially calcium and phosphorus (Table 4). As food and as fish meal for poultry and stock feed, dilis serves as an ideal raw material. The work of Navarro (1950) revealed that dilis is as good as milk in protein and mineral contents. This is abundantly found in Philippine waters and commonly dried and utilized in the form of salted fish paste (*bagoong*).

TABLE 1.—*Proximate chemical composition and calorific food value of some Philippine market fishes.*

Local name	Scientific name	Edible portion	Non-edible portion	Moisture	Ash (minerals)	Protein (N x 6.25)	Fat (E. E.)	Carbohydrate by difference	Calories per 100 grams of edible portion
		Per cent	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	
Agoot	*Pomadasys hasta*	47.68	52.32	77.46	1.28	21.11	0.21		92
Alumahan (large)	*Rastrelliger chrysozonus*	63.59	36.41	79.01	1.09	17.15	1.62	1.77	105
Alumahan (medium)	do	56.90	43.10	78.73	1.52	17.06	0.65	2.04	96
Alumahan (small)	do	55.85	44.15	79.33	1.07	16.57	0.48	2.45	92
Apahap	*Lates calcarifer*	61.90	38.10	79.67	0.98	18.90	0.28	0.17	79
Asohos	*Sillago sihama*	57.77	43.23	74.48	2.12	20.41	1.17	1.82	100
Bakokong moro	*Sparus berda*	57.44	42.56	73.59	2.53	21.85	0.51	1.52	98
Balila	*Trichiurus haumela*	68.59	31.41	77.11	1.68	17.89	2.11	1.23	95
Bambangin	*Lutjanus fulvus*	65.96	34.04	78.38	1.14	19.65	0.41	0.42	84
Banak	*Mugil vaigiensis*			73.15	1.45	20.41	2.55	2.44	114
Bangos (large)	*Chanos chanos*	67.10	32.90	71.97	1.51	20.57	5.28	0.67	133
Bangos (medium)	do	61.64	38.36	71.15	1.05	20.73	5.67	1.40	144
Bia (large)	*Glossogobius giurus*			80.67	1.32	18.28	0.43		77
Bia (medium)	do			80.93	1.22	17.26	0.36	0.23	73
Bia (small)	do			81.49	1.14	17.54	0.29		73
Bidbid	*Elops hawaiensis*	56.99	43.01	77.10	1.32	19.25	1.59	.74	94
Bisugo	*Nemipterus taenipterus*	53.31	46.69	77.77	1.38	17.56	1.15	2.14	89
Buan-buan	*Megalops cyprinoides*	53.17	46.83	76.65	1.07	17.04	3.66	1.58	107
Buguing	*Hemiramphus far*	64.88	35.12	80.33	0.60	17.23	1.41	0.43	83
Butete	*Tetraodon* sp.	44.68	55.32	77.85	0.30	19.52	1.71	0.62	96
Butterfly fish	*Chaetodon* sp.	58.47	41.53	78.87	1.13	20.00	1.47		93
Dalag	*Ophicephalus striatus*	69.05	30.95	79.79	0.21	18.88	1.20		86
Dalagang bukid (large)	*Caesio cuning*	68.80	31.20	77.87	1.55	19.86	0.64	0.08	88
Dalagang bukid (medium)	do	70.74	29.26	78.11	1.27	18.93	0.27	1.42	84
Dalagang bukid (small)	do	71.71	28.29	78.00	1.42	20.42	0.47		86
Dalagang bukid	*Caesio lunaris*	70.71	29.29	77.69	1.26	19.35	0.57	0.13	83
Dalagang bukid	*Caesio caerulaureus*	74.27	25.73	80.01	1.45	17.37	0.91	.26	97
Damis	*Hynnis momsa*	70.77	29.23	76.10	1.35	20.99	1.66		99
Damis lawin (large)	*Alectis indicus*	65.90	34.10	77.80	1.44	17.63	0.30	2.83	85
Damis lawin (small)	do	43.18	56.82	80.35	0.43	18.17	1.18		83
Dapang bilog	*Pseudorhombus oligodon*	68.51	31.49	77.07	2.29	17.34	2.52	0.78	95

TABLE 1.—*Proximate chemical composition and calorific food value of some Philippine market fishes*—Continued

Local name	Scientific name	Edible portion	Non-edible portion	Moisture	Ash (minerals)	Protein (N x 6.25)	Fat (E. E.)	Carbohydrate by difference	Calories per 100 grams of edible portion
		Per cent	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	
Dapang sinilas (large)	*Cynoglossus puncticeps*	67.38	32.62	79.31	1.64	17.72	2.13		90
Dapang sinilas (small)	do	61.92	38.08	80.78	1.39	16.29	.24	1.30	81
Dilis (mature)	*Stolephorus commersonii*	100.00	None	74.44	3.57	20.74	1.40		96
Dilis (young)	do	100.00	None	77.61	2.42	16.93	1.30	1.74	94
Dilis (mature)	*Stolephorus indicus*	100.00	None	73.71	3.50	19.49	1.51	1.69	98
Dorado (large)	*Scomberoides lysan*	69.02	30.98	75.84	2.06	22.73	0.48		95
Dorado (small)	do	68.15	31.85	76.52	1.75	19.34	2.07	0.32	88
Duhay (large)	*Stromateus niger*	64.72	35.28	79.12	0.42	17.76	1.36	1.34	89
Duhay (small)	do	57.59	42.41	79.86	1.33	16.21	1.33	2.27	99
Galongong	*Decapterus macrosoma*	71.24	28.76	74.19	1.81	21.90	0.95	1.15	101
Gole	*Rachycentron canadus*	63.01	36.99	78.30	1.34	18.42	4.00		110
Hasa-hasa	*Rastrelliger brachysomus*	65.74	34.26	75.12	2.16	20.88	0.92	0.92	95
Hito	*Clarias batrachus*	54.35	45.65	79.90	2.12	16.45	1.27	0.26	78
Ilak	*Kyphosus lembus*	62.04	37.96	75.91	1.11	21.07	1.96		102
Kabasi (large)	*Anodontostoma chacunda*	53.09	46.91	77.35	2.88	18.20	1.53	0.04	87
Kalaso (large)	*Saurida tumbil*	64.30	35.70	77.29	1.48	19.54	0.79	0.90	89
Kalaso (small)	do	63.05	36.95	78.56	1.34	20.60	0.47		104
Kanduli	*Arius thalassinus*	79.00	21.00	79.27	1.20	18.18	0.75	0.60	82
Kanduling bongoan	*Arius leiotelocephalus*	51.31	48.69	78.07	1.34	21.21	0.52		90
Kitang	*Scatophagus argus*	39.43	60.57	77.00	0.90	18.83	1.30	1.97	95
Labahita	*Acanthurus bleekeri*	63.48	36.52	79.77	1.14	19.19	0.43		81
Lapu-lapu (large)	*Plectropomus* sp.	68.77	31.23	78.84	1.07	20.79	0.31		86
Lapu-lapu (medium)	do	67.54	32.46	79.65	1.03	19.25	0.38		80
Lapu-lapu (small)	do	64.11	35.89	79.24	0.91	19.05	0.27	0.53	81
Malakapas	*Gerres filamentosus*	58.25	41.73	78.85	2.24	17.70	1.28		82
Malaking mata (large)	*Monotaxis grandoculis*	49.37	50.63	78.37	0.80	19.04	1.75	0.04	92
Malaking mata (small)	do	43.35	56.75	79.22	1.43	17.11	0.63	1.61	89
Mamale	*Eleutheronema tetradactyla*	75.41	24.59	77.32	1.30	19.31	1.89	0.18	95
Maya-maya (large)	*Lutjanus malabaricus*	56.64	43.36	78.80	1.04	17.66	0.81	1.69	85
Maya-maya (small)	do	42.92	57.08	79.66	1.87	17.96	1.19		83
Mayang (large)	*Drepane punctata*	61.59	38.41	76.80	1.32	21.17	0.34	0.37	89
Mayang (small)	do	51.59	48.41	78.11	1.31	18.14	1.42	1.02	89

TABLE 1.—*Proximate chemical composition and calorific food value of some Philippine market fishes*—Continued

Local name	Scientific name	Edible portion	Non-edible portion	Moisture	Ash (minerals)	Protein (N x 6.25)	Fat (E. E.)	Carbohy-drate by difference	Calories per 100 grams of edible portion
		Per cent	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	
Oriles	*Megalaspis cordyla*	62.06	37.94	76.00	1.24	19.63	1.51	1.62	99
Palos	*Synbranchus bengalensis*	55.99	44.01	81.40	0.36	16.10	1.16	1.98	78
Parang-parang	*Chirocentrus dorab*	71.19	28.81	75.23	2.15	20.20	0.91	1.51	95
Pating	*Scoliodon palasorrah*	64.43	35.57	76.29	0.51	21.25	2.36	----	106
Pindanga	*Muraenesox cinereus*	94.73	5.27	78.04	0.63	18.97	1.53	0.83	93
Salay-salay aso	*Caranx kalla*	65.74	34.26	76.57	1.22	19.16	1.67	1.38	97
Samaral (large)	*Teuthis javis*	55.69	44.31	80.05	0.33	17.35	0.99	1.28	83
Samaral (medium)	do	50.66	49.34	79.18	1.10	20.90	0.58	----	89
Sap-sap (large)	*Leiognathus equulus*	44.76	55.24	79.50	1.46	17.32	1.12	.60	82
Sap-sap (medium)	do	42.99	57.01	79.36	1.88	17.70	1.38	.60	85
Sap-sap (small)	do	44.36	55.64	80.99	1.07	16.67	.50	.77	74
Spanish mackerel (large)	*Cybium commerson*	74.08	25.92	76.66	1.53	18.34	0.87	2.60	92
Spanish mackerel (medium)	do	68.47	31.53	78.12	1.49	17.09	0.35	2.95	83
Spanish mackerel (small)	do	64.99	35.01	78.80	1.59	16.44	0.34	2.83	80
Sunog	*Platycephalus indicus*	60.45	39.55	79.95	1.93	17.59	1.29	----	82
Talakitok (large)	*Caranx sexfasciatus*	69.97	30.03	77.49	1.35	22.04	0.43	----	92
Talakitok (medium)	do	66.05	33.95	77.77	1.08	20.46	0.45	0.24	87
Talakitok (small)	do	62.80	37.20	78.80	1.03	20.16	0.42	----	84
Talipa (small)	*Scomeroides lysan*	68.98	31.02	76.40	1.34	20.68	1.75	----	98
Talilong	*Mugil dussumieri*	53.86	46.14	72.25	1.83	20.49	3.55	1.88	121
Tamban (herring)	*Sardinella longiceps*	60.00	40.00	75.64	1.26	21.01	1.89	.10	91
Torcillo (large)	*Sphyraena jello*	62.36	37.64	77.69	1.78	18.79	0.22	1.52	77
Torcillo (medium)	do	61.30	38.70	75.62	1.68	19.15	1.35	2.20	98
Torcillo (small)	do	67.83	32.17	76.36	1.80	19.33	1.22	1.29	93
Tulingan (large)	*Auxis thazard*	71.22	28.78	72.32	1.38	22.86	1.96	1.48	105
Tulingan (medium)	do	64.07	35.93	72.10	1.65	24.47	0.62	1.16	108
Tulis (herring)	*Dussumieria acuta*	78.15	21.85	76.10	1.99	19.19	1.40	1.32	95
Tunsoy (herring)	*Sardinella fimbriata*	76.16	23.84	75.87	2.31	19.87	1.36	0.59	94

In Table 2 the proximate chemical composition of the different parts of fish reveals that there is little variation in the protein and ash contents; however, it is very significant that in most cases the fat is higher in the head and belly as shown in *apahap, banak, bisugo, buan-buan, iso, oriles,* and *salmon* The protein which is low in the head is equally distributed in the belly, back and tail. The percentage of ash does not vary so much in all portions of the fish except for a tendency of the amount decreasing in the head.

The result as shown in Table 3 reveals that the percentages of edible portion and food value in many cases are higher in bigger fishes.

Dalagang-bukid which is available in market centers throughout the year is cheap in price as compared with talakitok, lapu-lapu, oriles, and the tunas, yet it is comparatively high in food value.

The majority of Philippine market fishes have higher percentage of phosphorus than some common North American fishes (Table 4). In some species the percentage of calcium is also greater. The species that are high in both phosphorus and potassium are *alumahan, banak, biang puti, dalagang bukid, damis lawin,* dilis, and others (Table 4).

Phosphorus and potassium are two important elements found in the brain and cell tissues of organic living things and also responsible in the cure of arthritis and cancer.

SUMMARY AND CONCLUSION

In an attempt to determine the food value of various species of Philippine market fishes, their proximate chemical compositions were analyzed with reference to size, standard length, and different portions of the fish.

1. Sixty-three species of fish commonly found in market centers were analyzed for moisture, ash, protein, fats, minerals, and carbohydrates (calculated by difference), and their calorific food value;

2. In most cases, the edible portion and food value are higher in bigger fishes than in the smaller ones of the same species;

3. In many instances, the percentage of fat is higher in the belly and head, while the protein which is almost equally distributed in the belly, back and tail of the fish is quite low in the head;

TABLE 2.—*Showing the proximate chemical composition of different portions of the body of some large-sized market fishes.*

Local name	Scientific name	Parts of fish	Moisture	Protein (N x 6.25)		Fat (E. E.)		Ash (minerals)	
				Fresh basis	Dry basis	Fresh basis	Dry basis	Fresh basis	Dry basis
			Per cent	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*
Agoot	*Pomadasys hasta*	Back	77.46	21.11	93.66	0.21	0.93	1.28	5.68
		Belly	76.50	22.61	96.21	0.19	0.80	1.32	5.62
		Tail	77.28	21.86	96.21	0.28	1.23	1.23	5.41
		Head	75.55	17.65	72.19	5.93	24.25	1.33	5.44
Apahap	*Lates calcarifer*	Back	75.41	17.40	70.76	1.54	6.54	1.27	5.16
		Belly	75.13	18.56	75.54	1.97	8.39	0.98	3.99
		Tail	76.47	17.81	75.69	1.59	6.74	1.06	4.50
		Head	76.25	16.67	70.19	2.94	12.36	0.94	3.95
Banak	*Mugil vaigiensis*	Back	74.28	16.91	65.75	1.50	5.83	1.70	6.61
		Belly	70.71	21.94	74.91	4.63	15.81	1.41	4.81
		Tail	74.47	22.39	87.82	1.52	5.95	1.24	4.86
		Roe	55.53	25.20	56.67	13.94	31.35	2.35	9.14
Bangos	*Chanos chanos*	Back	71.34	22.91	79.94	3.82	13.34	1.57	5.48
		Belly	67.62	22.42	69.24	7.67	23.70	1.18	3.64
		Tail	71.93	23.20	82.65	3.04	10.84	1.28	4.56
		Head	79.80	13.58	69.23	6.18	30.59	1.17	5.79
Bid-bid	*Elops hawaiensis*	Back	72.90	19.53	72.07	1.66	6.14	1.32	4.87
		Belly	70.26	18.99	63.85	2.35	7.91	1.30	4.37
		Tail	72.66	19.70	72.06	0.90	3.29	1.26	4.61
		Head	75.64	16.27	66.79	0.62	2.55	1.02	4.19
Bisugo	*Nemipterus tacnipterus*	Back	79.65	15.26	74.99	0.61	2.99	1.23	6.04
		Belly	80.09	14.92	74.94	0.62	3.10	1.05	5.27
		Tail	79.07	15.66	74.82	0.48	2.99	1.11	5.30
		Head	80.25	14.32	72.51	0.80	4.03	1.14	5.77
Buan-buan	*Megalops cyprinoides*	Back	76.18	17.86	74.98	0.67	2.83	1.12	4.70
		Belly	76.71	17.05	73.21	0.78	3.35	1.04	4.38
		Tail	75.79	17.54	72.45	0.63	2.62	1.08	4.46
		Head	77.85	15.69	70.84	1.02	4.81	1.0›	4.79

TABLE 2.—*Showing the proximate chemical composition of different portions of the body of some large-sized market fishes*—Continued

Local name	Scientific name	Parts of fish	Moisture	Protein (N x 6.25)		Fat (E. E.)		Ash (Minerals)	
				Fresh basis	Dry basis	Fresh basis	Dry basis	Fresh basis	Dry basis
			Per cent	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*
Gele	*Rachycentron canadus*	Back	78.35	15.84	73.16	0.32	1.50	1 38	6.37
		Belly	78.71	15.45	72.57	0.36	1.71	1.08	5.07
		Tail	77.58	16.98	75.74	0.43	1.92	1.31	5.84
		Head	80.08	14.02	70.38	0.54	2.69	1.07	5.37
Iso	*Lutjanus* sp.	Back	78.38	16.73	77.38	0.92	4.26	1.06	4.90
		Belly	77.51	16.17	71.90	1.28	5.70	1.34	5.96
		Tail	77.83	15.85	71.47	0.75	3.37	1.06	4.78
		Head	74.22	16.98	65.87	8.52	33.03	0.90	3.49
Lapu-lapu	*Epinephelus corallicola*	Back	79.13	16.40	70.58	0.37	1.77	1.59	7.62
		Belly	77.38	15.59	68.92	0.37	1.64	1.28	5.66
		Tail	78.28	15.72	72.38	0.54	2.48	1.06	4.88
		Head	77.48	14.65	68.08	0.79	3.52	1.15	5.34
Oriles	*Megalaspis cordyla*	Back	73.34	17.00	64.74	1.42	5.42	1.18	4.49
		Belly	70.91	17.06	58.65	2.59	8.91	1.01	3.47
		Tail	74.82	18.05	71.68	0.97	3.87	1.19	4.73
		Head	75.11	14.55	58.53	1.99	7.99	0.96	. .86
Salmon	*Elagatis bipinnulatus*	Back	74.39	22.86	89.26	1.66	6.48	1.68	6.56
		Belly	72.90	22.87	84.39	2.99	11.03	1.63	6.01
		Tail	73.44	23.59	88.82	1.51	5.69	1.65	6.21
		Head	74.42	18.55	72.52	4.83	18.88	1.47	5.57
Talakitok	*Caranx malabaricus*	Back	76.55	16.32	69.34	1.11	4.75	1.45	6.18
		Belly	76.89	17.02	73.65	1.20	5.21	1.37	5.98
		Tail	76.33	17.06	72.07	1.32	5.57	1.24	5.04
		Head	75.41	15.58	64.58	2.21	9.00	1.08	4.39

TABLE 3.—*Proximate chemical composition of some Philippine market fishes at different sizes.*

Name of fish	Standard length	Depth	Weight	Edible portion	Non-edible portion	Moisture basis	Protein (N x 6.25)		Fat (E. E.)		Ash (minerals)	
							Fresh basis	Dry basis	Fresh basis	Dry basis	Fresh basis	Dry basis
	cm.	*cm.*	*gm.*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*
Rastrelliger chrysozonus:												
1. Alumahan	24	7	321.9	63.59	36.41	79.01	17.15	81.70	1.62	7.71	1.09	5.19
2. Alumahan	21	6	196.5	56.90	43.10	78.73	17.03	80.16	0.65	3.05	1.52	7.14
3. Alumahan	19.5	5	128.2	55.85	44.15	79.33	16.57	80.11	0.48	2.32	1.07	5.12
Chanos Chanos:												
1. Bangos	26.5	8	472.3	67.10	32.90	71.97	20.57	74.18	5.28	19.60	1.51	4.62
2. Bangos	23.5	6	238.5	61.64	38.36	71.15	20.73	71.85	5.67	19.64	1.05	3.64
Glossogobius giurus:												
1. Biang puti	23	5	219			80.67	18.28	94.57	0.43	2.22	1.32	6.82
2. Biang puti	18	3	95.5			80.93	17.26	90.51	0.36	1.89	1.22	6.40
3. Biang puti	14.5	2.5	93.5			81.49	17.54	94.76	0.29	1.57	1.14	6.16
Caesio cuning:												
1. Dalagang bukid	25	8	457.7	68.80	31.20	77.87	19.86	89.74	0.64	2.89	1.55	7.00
2. Dalagang bukid	24	8.5	428.2	70.27	29.73	77.78	20.60	92.71	0.57	2.57	1.47	6.62
3. Dalagang bukid	21.5	8.5	310.7	70.74	29.26	78.11	18.93	86.48	0.27	1.23	1.27	6.45
4. Dalagang bukid	20	7	271.8	71.71	28.28	78.00	20.42	92.22	0.47	2.13	1.42	6.45
Stolephorus commersonii:												
1. Dilis, young				100		75.61	16.93	69.41	1.30	5.33	2.42	9.91
2. Dilis, mature				100		74.44	20.74	81.14	1.40	5.48	3.57	13.97
tolephorus indicus:												
Dilis, mature				100		73.71	19.49	74.14	1.51	5.74	3.57	13.97
Therapon theraps:												
1. Gagaong	24	9	459.5	59.87	40.13	76.81	16.82	72.53	1.50	6.47	1.11	4.79
2. Gagaong	22	7.5	289.9	56.50	43.50	78.27	17.35	79.84	1.20	5.53	1.05	4.83
3. Gagaong	15.5	5	81.3	51.49	48.51	76.21	17.23	72.43	2.92	12.29	0.68	2.86
Plectropomus sp.:												
1. Lapu-lapu	32.0	9.5	758.5	68.77	31.23	78.84	20.79	98.25	0.31	1.47	1.07	5.06
2. Lapu-lapu	27.5	8	445.8	67.54	32.46	79.65	19.25	94.59	0.38	1.87	1.03	5.06
3. Lapu-lapu	22.5	6.5	254.1	64.11	35.89	79.24	19.05	91.76	0.27	1.30	0.91	4.37

TABLE 3.—*Proximate chemical composition of some Philippine market fishes at different sizes*—Continued

Name of fish	Standard length	Depth	Weight	Edible portion	Non-edible portion	Moisture basis	Protein (N x 6.25)		Fat (E. E.)		Ash (minerals)	
							Fresh basis	Dry basis	Fresh basis	Dry basis	Fresh basis	Dry basis
Leiognathus equulus:												
1. Sapsap	16	10	164	44.76	55.24	79.50	17.32	84.49	1.12	5.47	1.46	7.12
2. Sapsap	13.5	9.0	110.5	42.99	57.01	79.36	17.70	83.33	1.38	6.70	1.08	5.34
3. Sapsap	10.5	7.5	68.5	44.36	55.64	80.99	16.67	87.69	0.50	2.44	1.07	5.63
Cybium commerson:												
1. Spanish mackerel	32	6.5	337.9	74.08	25.92	76.66	18.34	78.58	0.87	3.72	1.53	6.56
2. Spanish mackerel	25.5	5.5	184.6	68.47	51.53	78.12	17.09	77.11	0.35	1.60	1.49	6.81
3. Spanish mackerel	24.3	4.3	90.4	64.99	35.01	78.80	16.44	77.55	0.34	1.62	1.59	7.50
Caranx sexfasciatus:												
1. Talakitok	26	12	624.4	69.97	30.03	77.49	22.04	97.91	0.43	1.91	1.35	6.00
2. Talakitok	23	9.5	335.5	66.05	33.95	77.77	20.46	92.04	0.45	2.02	1.08	4.86
3. Talakitok	13	8	186	62.80	37.20	78.80	20.16	95.55	0.42	1.98	1.03	4.88
Sphyraena jello:												
1. Torcillo	34.5	4	259.0	62.36	37.64	77.69	18.79	84.22	0.22	1.0	1.78	7.98
2. Torcillo	21.0	3.5	186.8	61.30	38.70	75.62	19.15	78.55	1.35	5.53	1.68	6.89
3. Torcillo	17	3	115.0	67.83	32.17	76.36	19.33	80.77	1.22	5.17	1.80	7.61

TABLE 4.—*Mineral components of various Philippine market fishes (estimated in milligrams per 100 grams of fresh sample).*

Local name	Scientific name	Ash	Ca	P	K
		Per cent			
Alumahan	*Rastrelliger chrysozonus*	1.09	42	622	176
Banak	*Mugil vaigiensis*	1.47	15	484	259
Bangos	*Chanos chanos*	1.05	16	264	94
Biang puti	*Glossogobius giurus*	1.35	50	537	272
Dalagang bukid	*Caesio cuning*	1.27	36	565	264
Damis lawin	*Alectis* sp.	1.44	26	658	274
Dilis	*Stolephorus commersonii*	3.57	178	1,690	511
Dapang sinelas	*Cynoglosus* sp.	1.39	32	436	283
Dorado	*Scomberoides lysan*	2.06	95	1,005	266
Duhay	*Stromateus niger*	1.33	17	506	208
Gagaong	*Therapon theraps*	1.11	41	435	216
Ilak	*Kyphosus lembus*	1.11	36	488	226
Kalaso	*Saurida tumbil*	1.34	16	303	266
Kanduling bongoan	*Arius leiotetocephalus*	1.34	14	440	224
Labahita	*Acanthurus bleekeri*	1.14	21	503	243
Lapu-lapu	*Plectropomus* sp.	1.07	27	195	138
Malaking mata	*Monotaxis grandoculis*	1.43	58	478	161
Maya-maya	*Lutjanus malabaricus*	1.87	65	778	293
Samaral	*Teuthis javus*	1.10	42	455	192
Sapsap	*Leiognathus equulus*	1.31	33	554	218
Spanish mackerel	*Cybium commerson*	1.53	149	462	305
Talakitok	*Caranx malabaricus*	1.26	27	501	260
Torcillo	*Sphyraena jello*	1.50	22	598	307
Foreign Fish					
Haddock		1.20	19	197	------
Halibut		1.00	13	234	540
Herring		1.30	101	272	------
White fish		1.60	150	263	------
Blue fish			23	235	------
Tuna, canned		2.10	8	224	480

4. The variations in the amount of ash in each species are rather insignificant irrespective of size, standard length and any portion of the fish;

5. The calcium and phosphorus contents in some are higher than those of the North American fishes, namely, the halibut, haddock, and herring;

6. The low fat content of practically all Philippine market fishes analyzed indicates that they may be suitable for fish meal manufacture without any danger of the free fatty acid rancidity which makes the product inferior in quality. A good commercial fish meal must contain not more than 5 per cent fat and 10 per cent moisture; and

7. Dilis is a good source of protein, calcium, and phosphorus. Because of its abundance in Philippine waters practically throughout the year, its greater utilization will undoubtedly help improve the Filipino diet.

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ILLUSTRATION

TEXT FIGURE

FIG. 1. Showing the different portions of the fish that were subjected to the analysis.