NOTES

NUTRITIVE VALUES OF SHARKS, SKATES AND RAYS FROM PORTONOVO COAST

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ABSTRACT

Proximate composition of sharks, skates and rays varies in the different seasons of year and from specimen to specimen and even in the same specimen from part to part of the body. Lipid is the most variable component, from 0.4 to 6.2% in the body and from 12.5 to 48.4% in the liver in fresh condition. Moisture content is found varying between 71.0 and 84.0%. There is an inverse relationship between the quantum of water and lipid in the tissue. Protein content is found to increase with age. Carbohydrate and mineral contents were estimated and discussed in detail.

Lovern (1930) studied the liver oil of thresher shark, *Alopoecia valpes*. Setna et al (1944) and Joshi et al (1953) have studied nutritive value of elasmobranches of Bombay, while Masheklar and Sohonie (1959) have delt with the proteins in sharks and skates. The present study, employing the recent and modified methods of analysis, gives the nutritive values of some Indian elasmobranchs from Portonovo.

The tissue samples kept in aluminium foils in ice were brought to the laboratory from the Portonovo fish landing place. Biurette method, as adopted by Raymont et al (1964), was followed for estimating the protein, and phenol sulphuric acid method of Dubois et al (1956) was adopted for determining carbohydrates. Solutions made from tissues were read in Spectronic-20 using 540 μ against blank reading in the case of protein and 490 μ in the case of carbohydrates.

The standard chloroform methenol extraction procedure of Folch et al (1956) was adopted for extracting lipids. Samples were dried in an oven at 80°C, and were then ground to powder form. The ash content was determined by igniting the pre-weighed samples in a muffle furnace at 400°C for 2 h. The results presented are the mean of 5 determinations in each case.

The ranges and mean of proximate composition of sharks, skates and rays are as follows:

	Moisture	Lipids	Protein	Ash
Mean	65.4	14.7	16.0	3.5
Range	34.1-84.2	0.4-48.4	5.7-24.7	1.9-5.3
Ratio				
High to low	2.4	121.0	4.3	2.8

Results are summarised in Table 1, from which it can be seen that while protein, moisture and ash contents showed less variations, lipids showed while protein, moisture and ash contens showed less variations, lipids showed a wide variation, more than 100-fold. The proximate composition of fishes varied in the different seasons of the year, and from specimen to specimen, and even in the same specimen from region to region of the body.

Moisture content of the body tissue varied between 71.0% in Mako shark and 84.2% in the whale shark, which is in agreement with the previous findings of Setna et al (1944) and Master and Magar (1954). The moisture content varied also with the growth of the fish. In *Carcharhinus limbatus, C. sorrah* and *Dasyatis jenkinsii* the moisture content, as observed in the present study, was reduced from the juveniles to adults from 78.0% to 72%, 77.4% to 74.8% and 76.1% to 74.2%, respectively. It is further noticed that there was difference between moisture content of the body tissue and the liver tissue in the same specimen.

Lipid content was more variable from fish to fish and in the same fish from region to region. The lipid content of the body tissue was always low, from 0.4 to 6.2% in fresh samples and between 6.0 and 15.8% in the dried samples, while the liver was rich in lipid content, between 12.5 and 48.4% in fresh materials and between 31.9 and 62.2% in dried samples. The fatness of the liver was above 80% in certain sharks which could only arbitrarily be classed as 'lean' (Shul'man 1972) as fatness or leanness is judged from the amount of fat present in the body muscle.

It was noted during the present study that females in the pregnant stages have extremely thin and dark livers with less oil content (Table 1). This finding confirms the observations of Springer (1967) who described fatty livers as indication of metabolic well being in sharks and noted that small livers with little oil content were frequently related to starvation of males during mating season or females during pregnancy.

The upward trend in fat content with increase in the age of fish was also observed in the present study. The amount of water in the tissue was reduced with increase in the fat content, thus establishing an inverse relationship with fat content. The oil content of the liver of shark is supposed to be a device for controlling buoyancy (Baldrige 1972).

TABLE 1. *Mean values of proximate composition of sharks.*

Name of shark	Length range in cm	Kind of tissue	% of wet weight				% of dry weight				
			Moisture	Lipid	Carbo-hydrate	Protein	Dry matter	Lipid	Carbo-hydrate	Protein	Ash
C. limbatus	80-119	body	78.0	0.8	0.2	19.7	22.0	8.8	0.5	84.2	2.0
		liver	45.6	38.5	1.5	10.5	54.4	49.6	0.8	41.4	2.2
	120-180	body	74.0	1.0	0.3	21.7	28.0	12.7	0.6	81.2	2.4
		liver	34.1	48.4	2.5	10.8	65.9	54.8	2.2	36.8	2.8
(Adv. preg.)	150-180	body	78.2	0.5	0.3	20.4	20.8	8.6	0.8	84.4	2.4
		liver	56.8	26.3	0.8	13.2	43.2	48.4	1.8	40.6	2.7
C. sorrah	57-100	body	77.4	0.5	0.3	18.9	22.6	9.5	0.2	81.6	1.9
		liver	52.5	32.5	0.8	10.4	49.5	48.5	1.5	41.3	2.3
	101-150	body	74.8	0.8	0.4	21.5	25.2	9.0	0.4	82.6	3.2
		liver	48.2	36.4	1.9	10.8	51.8	62.2	0.8	32.8	2.5
(Adv. preg.)	130-150	body	76.2	0.5	0.4	20.5	19.8	8.5	0.8	82.5	3.0
		liver	53.9	25.4	1.0	14.1	46.1	50.8	1.5	42.5	2.8
S. laticaudus	30-45	body	75.2	0.6	0.2	21.8	24.8	10.7	0.2	85.1	2.1
		liver	64.0	24.8	0.8	8.8	36.0	48.0	1.5	46.4	2.4
S. lewini	120-240	body	71.6	2.1	0.2	24.3	28.4	10.3	1.2	81.5	2.1
		liver	48.1	36.2	2.2	11.0	41.9	51.7	3.3	37.8	3.9
S. blochii	110-150	body	71.8	1.0	0.4	24.7	28.2	7.5	0.8	80.8	5.8
		liver	48.4	36.8	1.0	10.2	51.6	50.6	2.1	41.2	4.2
(Adv. preg.)	120-150	body	75.0	1.0	0.8	18.2	25.0	6.0	0.7	84.8	5.6
		liver	60.1	23.4	1.0	12.8	39.0	44.4	1.2	45.4	4.3
R. typus	538-562	body	84.2	2.1	0.1	9.9	15.8	9.4	0.4	81.4	6.5
		liver	68.1	19.2	1.6	5.7	31.9	31.9	2.0	60.4	2.3
I. glaucus	140-160	body	71.0	6.2	0.4	19.3	29.0	12.6	1.5	78.4	4.9

R. granulatus	112-148	body	79.1	0.6	0.2	18.1	20.9	10.1	2.2	80.2	4.5
		liver	66.7	16.4	1.8	11.6	33.3	44.5	4.5	39.9	4.4
R. obtusus	35-58	body	79.5	0.5	0.2	17.5	20.5	10.2	2.2	79.5	3.8
		liver	65.5	15.4	2.2	10.4	34.5	38.5	2.0	48.9	5.3
D. imbricatus	10-19	body	75.5	0.4	0.1	21.4	24.5	7.5	2.1	81.5	4.5
		liver	65.3	12.5	1.8	14.5	34.7	46.4	3.2	41.7	4.2
D. sephen	74-138	body	73.4	1.3	0.5	22.5	26.6	12.7	1.2	81.1	2.5
		liver	36.8	45.4	2.5	8.5	63.2	53.8	3.0	36.5	4.1
D. jenkinsii	21-40	body	76.1	0.9	0.3	18.0	23.9	8.1	1.1	81.5	2.2
		liver	66.5	15.2	2.1	11.5	33.5	40.4	2.2	48.5	4.1
	41-80	body	74.2	1.1	0.2	20.6	25.8	15.8	1.4	75.4	2.8
		liver	52.4	28.7	2.2	13.2	47.6	50.2	2.2	40.1	4.7
D. uarnak	30-120	body	77.5	0.5	0.3	20.1	22.5	9.5	1.5	81.4	3.2
		liver	50.5	30.5	2.4	14.4	49.5	58.4	2.1	32.6	3.1
A. narinari	60-110	body	75.8	0.6	0.3	21.5	24.2	13.3	0.2	80.5	2.1
		liver	60.9	25.4	1.8	10.8	39.1	56.1	1.8	33.8	3.8

It is evident from Table 1 that the protein content of sharks, skates and rays increased with age. Shul'man (1972) also observed a similar increase in the protein content which even doubled as the fish advanced in age and length.

Based on the important biochemical components like oil and protein studied in the present case, 5 categories in elasmobranchs are recognised (Table 2) on the model of Stansby (1962), as below:

Category A	Low oil — high protein	
	(<5 %)	(15-20%)
Category B	Medium oil — high protein	
	(5-15%)	(15-20%)
Category C	High oil — low protein	
	(>5%)	(< 15%)
Category D	low oil — very high protein	
	(< 5%)	(< 20%)
Category E	low oil — low protein	
	(<5%)	(<15%)

TABLE 2. *Categories of fish based on proximate composition.*

Name of species	Category	Remarks
Carcharhinus limbatus	D	Young ones may fall in category C
C. sorrah	D	—do—
Scoliodon laticadus	D	———
Sphyrna blochii	D	———
S. lewini	D	———
Rhiniodon typus	E	———
Isurus glaucus	B	———
Rhinobatus granulatus	A	———
R. obtusus	A	———
Dasyatis imbricatus	D	Some caught in certain season may fall in A
D. sephen	D	———
D. jenkinsii	A	———
D. uarnak	A	———
A. narinari	D	———

Carbohydrates also play an important role in the accumulation of energy in the body of fish. Its content does not exceed 1% in the body tissue in fresh condition and is up to 2.9% in the fresh liver, which is often referred to as glycogen 'depot,' in all the elasmobranchs studied here, as excess carbohydrate is stored in it. The reduction in the liver glycogen in the female sharks and rays during advanced pregnancy indicates that the glycogen from the liver is used up in feeding the young.

Ash content ranged from 1.9-6.5% (Table 1) in the case of sharks and 2.1 to 5.3% in the case skates and rays. The mineral content of elasmobranchs studied here also increased with age. The young ones of *C. sorrah*, 57-100 cm in total length, accumulated minerals up to 1.9%, while the adults with range of 101-150 cm total length accounted for 3.2%. The large-sized whale sharks, 538-562 cm, contained 6.5% of mineral residue in the tissue.

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