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ANALYSIS OF MINERAL COMPOSITION IN BYCATCH SPECIES FROM VISAKHAPATNAM FISHING HARBOUR

Zoology

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ABSTRACT

Three species of fishes (*Trichiurus lepturus,,Upeneus vittatus and Leiognathus equulus*) from bycatch were studied for their mineral compositions which were collected monthly from Visakhapatnam fishing harbour during August 2014 to July '16. Phosphorus, calcium, sodium, potassium and iron were analyzed quantitatively by atomic absorption spectrophotometer method. The result has been explained in relation to importance of minerals found in edible bycatch and their utilization as poultry feed and other useful byproducts.

KEYWORDS

bycatch, minerals, Visakhapatnam fishing harbour, sodium, potassium, calcium, iron.

INTRODUCTION

The commercial and industrial catch of marine fishes generally consists of edible and inedible species. Among inedible species the bulk catch of small size fishes were also included and were commonly referred to bycatch. As a part of the present study, a detailed estimation of mineral composition is estimated in muscle tissue of three selected by catch dominant species, *T.lepturus, L.equulus* and *U.vittatus* from Visakhapatnam fishing harbour. Marine foods are very rich sources of mineral components which are directly and indirectly involved in every bodily process. The total content of minerals in the flesh of marine fish and invertebrates is in the range of 0.6-1.5% wet weight [1]. Marine organisms have shown to accumulate minerals from the diet and deposit them in their skeletal tissues and organs, so as to be considered a good source of essential minerals [2].

Aquatic animals absorb minerals from the surrounding water in addition to the food ingested, and because of their variation in response to salt regulation or osmotic pressure, the mineral composition of the freshwater and marine fish differs with each other. Marine fish live in a hypertonic environment (i.e. in a medium containing an excess of salt) they tend to suffer from desiccation through water loss across the gills. To compensate for this loss marine fish, therefore have to continually drink small amounts of water; the excess salt contained within the intestinal seawater being pumped out of the gill to the exterior [3]. Consequently, since marine fish are reported to drink up to 50 percent of their total body weight per day, drinking may satisfy a substantial part of their mineral requirements [4].

A large number of minerals are present in fish. Most of these minerals present in sea water are also present in fish tissue. Fishes are capable of supplying part of the mineral requirement for water through gill tissue or skin. Diffusible ions include chloride, calcium, phosphorus, potassium and iodine [5]. Important minerals present in fish are sodium, potassium, calcium, phosphorous, magnesium, etc. These minerals are generally higher in marine fish than in fresh water fish [6]. There are, however, considerable variations in the content of individual elements in each organism due to various factors. The present authors also reported on diversity of bycatch, microbiological and organic components of 3 species of bycatch collected from Visakhapatnam fishing harbour [7], [8] & [9].

MATERIAL AND METHODS

T.lepturus, U.vittatus and *L.equulus* were purchased from the market at the Visakhapatnam fishing harbour regularly for the estimation of minerals in their muscle tissue. The present study was carried out to assess the macro-mineral elements such as calcium, phosphorus, sodium and potassium and micro-mineral element iron, and to understand the variations in the mineral content of the above two marine fishes during the two years of study period i.e., from August 2015 to July 2016.

The edible portion (muscle) was blended and aliquots weighed out for the various chemical analyses. The muscle was kept in hot air oven at 95^0- 100^0C for about 24 hours to dry the muscle to constant dry weight. The dry muscle was grained into a fine powder in a porcelain mortar. Weigh 2gm of sample taken into a small crucible and ignite in a muffle furnace at 500^0c to 550^0c. Dissolve ash in HCl (1+4) and transfer to 100ml beaker. 5ml HCl is added and evaporate to dry on the steam bath to dehydrate SiO_2. Moisture residue with 5ml HCl add about 50 ml water, heat few minutes on the steam bath, transfer to 100 ml volumetric flask. Cool quickly to room temperature, dilute to volume, shake and filter, and discard the first portion of the filtrate. This is used further for analysis of Calcium, Phosphorus, Sodium, Potassium and Iron. All of the chemicals used in this work were of the high purity GR Grade. The inorganic components i.e. calcium, phosphorus, sodium, potassium and iron in the above three fishes during August 2014 to July '16 were determined quantitatively by atomic absorption spectrophotometer method. Total Iron was estimated by the method of colorimetric.

RESULTS

Calcium

It was observed that the calcium content of *U.vittatus* higher than that of *T.lepturus* and *L.equulus.* The mean calcium value of *T.lepturus* was recorded 320.225mg/100g, and of *U.vittatus* 499.38mg/100g. and *L.equulus* recorded 360.75mg/100g. Considerable variations occurred in the quantity of calcium in the muscle tissue of both the fishes from season to season and these followed a fairly well defined cycle during the two consecutive years of the study period.

Phosphorus

The Phosphorus content of *T.lepturus* ranged between 1510.98, *Upeneus vitttus* 1520.96 and 1420.47mg/100g and in *L.equulus* it varied month wise data was presented in table No.2 and plotted in the graph. From the present analysis, it was concluded that the phosphorus content in the muscle tissue of *L.equulus* was higher (2086.45/100g) then that was observed in *T.lepturu, U.vitttus.*

Sodium

In the present investigation, the sodium content in the muscle tissue of recorded lower values than that of *U.vitttus* and *L.equulus.* At the lowest values of sodium content was observed in 3 selected species. (*T.leptures* 206mg/100g*, U.vittatus* 153mg/100g and *L.equulus* 248mg/100g and the highest values (*T.leptures* 485mg/100g*, U.vittatus* 786mg/100g and *L.equulus* 698*mg*/100g) were observed. The values represented in table no.3.

Potassium

In the first annual cycle, remarkable fluctuations in the potassium content of *T.lepturus* were observed throughout the year. Maximum value (2322mg/100g) was observed in December-2014 and the minimum value (1516mg/100g) was recorded in August-2014. In the second annual cycle, the highest potassium value was observed in January (2392mg/100g) and the lowest value (1456mg/100g) was

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recorded in September. In *U.vittatus*, the highest potassium value (2087mg/100g) in the muscle tissue was observed in July-2015 and the lowest value (1276mg/100g) was noticed in October -2015 with the mean monthly value of 2938mg/100g for the first annual cycle. In *L.equulus* the highest potassium value (2385mg/100g) in the muscle tissue was observed in Jul-2015 and the lowest value (1764mg/100g) was noticed in Mar -2015 In the second annual cycle, the highest value (2208mg/100g) was noticed in May-2016 and the lowest value (1804mg/100g) in Mar-2015.

Iron

In the *T.lepturus*, for the first annual cycle, the highest Iron content was observed in Jun-2015 with (4.48mg/100g) and the lowest value (2.42mg/100g) was observed in January-2015. In the second annual cycle, the highest Iron value was noticed in Aug-2015 with (4.10mg/100g) and the lowest value (2.30mg/100g) was recorded in Dec-2015. in the *U.vittatus*, for the first annual cycle, the highest Iron content was observed in Jun-2015 with (3.32mg/100g) and the lowest value (1.01mg/100g) was observed in May-2015. In the second annual cycle, the highest Iron value was noticed in Jun-2016 with (3.65mg/100g) and the lowest value (1.22mg/100g) was recorded in May-2016. As shown in the above table, in the *L.equulus*, for the first annual cycle, the highest Iron content was observed in Jun-2015 with 3.32mg/100g and the lowest value 1.02mg/100g was observed in May-2015. In the second annual cycle, the highest Iron value was noticed in Jun-2016 with 3.65mg/100g and the lowest value 1.22mg/100g was recorded in May-2016.

Table-1 Calcium (mg/100g) in *T.lepturus, U.vittatus* and *L.equulus* during 2014-'15 and 2015-'16

	2014-'15			2015-'16		
Month	*T.lepturus*	*U.vittatus*	*L.equulus*	*T.lepturus*	*U.vittatus*	*L.equulus*
AUG	275.37	617.04	232.02	320.86	567.23	320.32
SEP	356.53	398.60	207.25	237.40	476.43	230.43
OCT	239.16	432.32	182.47	250.73	345.65	220.34
NOV	222.36	476.87	481.56	424.52	376.65	399.89
DEC	540.45	876.34	318.37	633.10	943.10	820.10
JAN	214.36	546.23	267.08	418.12	617.04	254.54
FEB	220.58	345.65	386.68	222.08	543.34	345.87
MAR	313.74	320.12	348.54	215.28	212.23	356.65
APR	230.44	399.43	234.76	210.12	440.12	289.98
MAY	440.57	520.2	543.53	221.44	567.43	550.54
JUN	541.36	654.76	435.43	416.58	498.67	543.67
JUL	270.55	324.98	343.65	238.19	476.67	375.54
MEAN	322.1225	492.7117	331.7783	317.3683	505.38	392.3225
STDEV	121.7397	163.3494	114.0109	130.9008	177.6543	171.9226

Table-2 Phosphorus (mg/100g) in *T.lepturus, U.vittatus* and *L.equulus* during 2014-'15 and 2015-'16

	2014-'15			2015-'16		
Month	*T.lepturus*	*U.vittatus*	*L.equulus*	*T.lepturus*	*U.vittatus*	*L.equulus*
AUG	1812.28	1754.32	1249.65	1889.73	1723	1179.67
SEP	1798.50	2065.06	1457.87	1827.47	1865	1169.21
OCT	1654.14	1432.09	2012.12	1742.42	1332.43	2086.45
NOV	1556.68	1643.01	1077.03	1621.34	1432.43	1286.34
DEC	699.76	976.76	1185.65	310.30	248.20	710.80
JAN	1348.86	1060.01	1347.23	1214.23	1376.90	1243.09
FEB	1288.34	1178.87	1273.05	1126.56	1298.32	1674.11
MAR	1168.28	1324.23	1487.29	1088.73	1543.65	1043.29
APR	1648.86	1501.32	1672.43	1672.34	998.32	2012.98
MAY	1676.70	1765.32	1185.38	1696.49	1609.56	1290.76
JUN	1752.36	1785.08	1428.64	1748.18	1701.03	1632.80
JUL	1762.94	1921.04	1188.87	1766.28	2012.54	1543.45
MEAN	1513.975	1533.926	1380.434	1475.339	1428.448	1469.286
STDEV	332.4181	347.1385	259.1074	460.4126	461.7848	349.6549

Table-3 Sodium (mg/100g) in *T.lepturus, U.vittatus* and *L.equulus* during 2014-'15 and 2015-'16

	2014-'15			2015-'16		
Month	*T.lepturus*	*U.vittatus*	*L.equulus*	*T.lepturus*	*U.vittatus*	*L.equulus*
AUG	248	486	654	330	387	687
SEP	296	617	698	276	679	679
OCT	220	698	543	206	786	599
NOV	320	542	486	247	488	532
DEC	332	289	320	352	153	345
JAN	386	381	399	219	435	521
FEB	311	564	478	309	574	465
MAR	416	685	386	366	598	421
APR	318	345	298	376	432	298
MAY	397	498	476	450	532	398
JUN	485	323	567	476	365	554
JUL	412	432	676	414	534	634
MEAN	345.0833	488.3333	498.4167	335.0833	496.9167	511.0833
STDEV	76.05555	138.2372	134.1169	87.54267	162.7544	128.0529

Table-4 Potassium (mg/100g) in *T.lepturus, U.vittatus* and *L.equulus* during 2014-'15 and 2015-'16

	2014-'15			2015-'16		
Month	*T.lepturus*	*U.vittatus*	*L.equulus*	*T.lepturus*	*U.vittatus*	*L.equulus*
AUG	1516	2010	1854	1652	2301	1856
SEP	1740	2003	1787	1456	2011	1863
OCT	1958	1276	1979	1871	1573	2187
NOV	2140	1873	2043	2086	1987	2065
DEC	2322	2022	2022	2322	1965	2198
JAN	2162	2056	2065	2392	2098	2101
FEB	2022	1934	1989	2116	1923	1972
MAR	2080	1987	1764	2049	1876	1804
APR	1969	2032	2093	1986	2065	2097
MAY	1864	1987	2187	2076	2024	2208
JUN	1772	1992	1987	1885	1976	1974
JUL	1 639	2087	2385	1742	1988	2032
MEAN	1932	1938.25	2012.917	1969.417	1982.25	2029.75
STDEV	2029.75	215.6656	170.4302	267.7887	167.0858	138.5169

Table-5 Iron (mg/100g) in *T.lepturus, U.vittatus* and *L.equulus* during 2014-'15 and 2015-'16

	2014-'15			2015-'16		
Month	*T.lepturus*	*U.vittatus*	*L.equulus*	*T.lepturus*	*U.vittatus*	*L.equulus*
AUG	3.96	2.66	2.45	4.10	2.88	2.56
SEP	4.24	3.23	2.10	3.88	3.21	2.01
OCT	3.78	2.66	2.54	2.62	2.76	2.73
NOV	3.32	2.98	2.66	3.88	2.76	2.36
DEC	2.43	2.36	2.65	2.30	2.14	2.55
JAN	2.42	2.10	2.01	2.76	3.18	2.36
FEB	2.86	1.88	2.31	2.42	1.98	1.37
MAR	2.96	1.78	2.99	2.46	1.21	2.32
APR	3.36	2.08	1.12	3.45	2.76	1.89
MAY	3.74	1.01	1.02	3.89	3.54	1.22
JUN	4.48	3.32	3.32	4.02	3.87	3.65
JUL	3.52	2.86	2.43	3.59	4.32	2.98
MEAN	3.4225	2.41	2.3	3.280833	2.884167	2.333333
STDEV	0.663902	0.674078	0.675587	0.708102	0.846259	0.665901

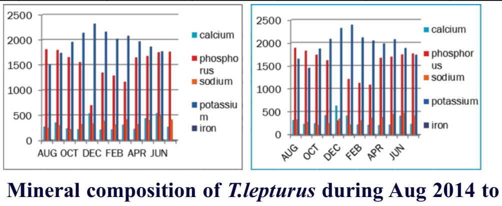

Fig-1: Mineral composition of *T.lepturus* during Aug 2014 to Jul '15 & Aug 2015 to Jul'16

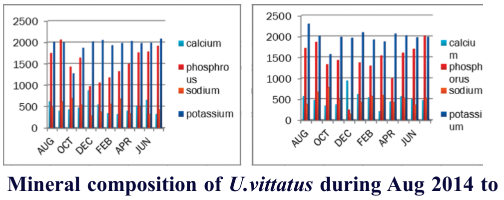

Fig-2: Mineral composition of *U.vittatus* during Aug 2014 to Jul '15& Aug 2015 to Jul '16

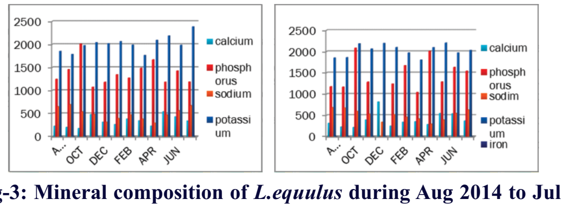

Fig-3: Mineral composition of *L.equulus* during Aug 2014 to Jul '15 & Aug 2015 to Jul '16

DISCUSSION

Marine bycatch species were having very rich sources of mineral components. Minerals are a very important component of a diet, because they cannot be synthesized by the human body and therefore should be provided with food in the right amounts and proportions. Fish is an excellent source of mineral elements. With respect to the mineral content, some fishes are superior to other types of food. [10] & [11] reported that the mineral content of fish makes fish unavoidable in the diet as it is a source of different minerals that contribute greatly to good health. Marine foods are very rich sources of various mineral components. The feeding habits and the influence of the environment on *T.lepturus*, *U.vittatus* and *L.equulus* made them a good source of minerals which are of nutritional importance.

Calcium

Seafood is one of the useful sources of calcium. In the present study, *T.lepturus* recorded the calcium content of 322.12mg/100g in during the year 2014-2015 and 317.36 mg/100g in during the year 2015-16 in their muscle tissue. *U.vittatus* recorded the calcium content of 492.71mg/100g in during the year 2014-2015 and 505.38mg/100g in during the year 2015-16 in their muscle tissue. *L.equulus* recorded the calcium content of 331.77mg/100g in during the year 2014-2015 and 392.32mg/100g in during the year 2015-16 in their muscle tissue. The similar results were reported by [12] in *Sardinella brachysoma* (240.56mg/100 g). These values are in the moderate range. But in some marine fishes, fairly high calcium content was reported.

Phosphorus

Stated [13] that the phosphorus content in fishes ranged between 1520 mg/100g and 2600 mg/100g. In the present study, the average phosphorus content of *T.lepturus* recorded 1513.97mg/100g in during the year 2014-2015 and 1475.33mg/100g in during the year 2015-16 in their muscle tissue. *U.vittatus* recorded 1533.92mg/100g in during the year 2014-2015 and 1428.44mg/100g in during the year 2015-16 in their muscle tissue. *L.equulus* recorded 1380.43mg/100g in during the year 2014-2015 and 1469.28mg/100g in during the year 2015-16 in their muscle tissue. The value of *T.lepturus* falls within the above stated range. Phosphorus levels in some commercial fish species were ranged as 1077.27-3184.77 mg/kg. [14], reported concentrations of phosphorus in the muscles of roach and bream were 1914.60-2387.0 and 1429.8-2268.3mg/100g dry weight. The richness in phosphorus level attributed to the fact that phosphorous is a component of protein [15].

Sodium

Marine fishes contain higher sodium content than freshwater fishes. In the present study, *T.lepturus* recorded 345.08mg/100g in during year 2014-2015 and 335.08mg/100g in during the year 2015-16 in their muscle tissue. *U.vittatus* recorded 488.33mg/100g in during the year 2014-2015 and 496.91mg/100g in during the year 2015-16 in their muscle tissue. *L.equulus* recorded 498.41mg/100g in during the year 2014-2015 and 511.18mg/100g in during the year 2015-16 in their muscle tissue. Similar sodium value was studied by [16] in *Sardinella brachysoma* (323.24 mg/100g).

Potassium

Potassium is an essential element in the body system that plays a vital role in protein synthesis, nerve conduction; control of heart beat, muscle contraction and synthesis of nucleic acids [17]. In the present investigation, *T.lepturus, U.vittatus and L.equulus* reported 2080mg/100g, 2087mg/100g and 2385mg/100g of potassium in their muscle tissue during 2014-15. And the period of 2015-16, *T.lepturus, U.vittatus and L.equulus* contain 2392 mg/100g, 2301 mg/100g and 2208 mg/100g of potassium in their muscle tissue. Potassium is also reported to vary in concentration in salt water fishes. The levels of potassium in some commercially important fish species from the south Caspian Sea samples ranged from 1809.06-2678.36mg/kg by [18]. [19] reported the average potassium value of commercial fish as 300 mg%.

Iron

The levels of iron found in sea foods can range between 0.3-7.0 mg/100g [20]. In the present investigation, the iron content of *T.lepturus, U.vittatus and L.equulus* were recorded within the above said range. Marine fishes contain higher iron content than freshwater fishes; however, the iron content of fish is very low compared to that of mammals [21].

T.lepturus contains slightly higher iron content than*, U.vittatus and L.equulus. T.lepturus* contains 4.48mg/100g, *U.vittatus* 3.23mg/100g and *L.equulus* contain 3.32 mg/100g during the year 2014 to 2015; *T.lepturus* contains 4.02mg/100g, *U.vittatus* 4.32 mg/100g and *L.equulus* contain 3.65 mg/100g during the year 2015 to 2016; The iron concentration obtained in the present study is found close to the value that was reported by [22] & [23]. [24] reported the iron content in traditionally cured marine fish which ranged from 15 to 28 mg%.

CONCLUSION

The present study reveals that these fishes are very good source of iron and other mineral elements. In the diet can prevent or cure diseases that are associated with nutritional elements. The major mineral composition of the bycatch along the Visakhapatnam fishing harbour provides information on the mineral constituents. It can be concluded that the bycatch, especially the three selected species available in the post monsoon season in the months of November and December are more nutritious with respect to the calcium content.

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