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Organic composition of three edible bycatch species from Visakhapatnam fishing Harbour

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Abstract
The non-commercial fishes called bycatch form a significant quantity of the total marine fish landings particularly in the landing area of Visakhapatnam fishing harbour (VFH). The inedible fishes, bulk catches of juvenile fishes, low value fishes and fishes unacceptable for human consumption are commonly referred to as bycatch. The present study was conducted to investigate the organic components (total protein, carbohydrate and lipid) and moisture in 3 species of finfish (*Leiognathus equulus*, *Upeneus vittatus* and *Trichiurus lepturus*) from bycatch of VFH during Aug 2014 to Jul'16. The total protein estimation was done by Micro Kjeldahl method, carbohydrate by Dubois method and lipid by Franz von Soxhlet method. The results showed that these fishes are good source of proteins, carbohydrates and lipids. The result of the current study explained that the overall nutritional composition of each bycatch categories were above 15% in inedible bycatch which proves that the bycatch were of good nutritional value and it is acceptable for development of value added products. This investigation may be beneficial in utilization of bycatch.

Keywords: Bycatch, organic composition, moisture, protein, carbohydrate, lipid, VFH, nutritional status

Introduction
Fish is one of the essential foods necessary for growth and tissue repairs in animals and humans in particular. As a part of the present study, a detailed estimation of organic composition in muscle tissue of three selected bycath dominant species, *T.lepturus, L.equulus* and *U. vittatus* have made. Biochemical assays and nutrients play a vital role on physical growth and development, maintenance of normal body function, physical activity and health. The knowledge of the biochemical composition of any edible organisms is extremely important since the nutritive value is reflected in its biochemical contents.

Biochemical composition generally means percentage composition of basic food constituents such as moisture, proteins, lipids and carbohydrates and. The chief components of a fish are water, protein and lipid which account for 98% of the total weight of fish muscle. These components play a vital role in the functional property and nutritional value of the fish. The remaining 2% constitutes carbohydrates, vitamins and minerals. The assessment of the organic composition of the fish is not only important to know its nutritive value, but also for its better processing and preservations and to ensure that they meet the requirements of food regulations and commercial specifications. According to principal composition of fish is 16-21% protein, 0.2 to 5% Fat, 0.5 to 5.0% of Ash, 0 to 0.55% carbohydrates and 66 to 81% of water. The protein percentage is more in fish than in any other animal foods. The percentage of proteins in fishes is drastically higher than that of milk and cheese which is carried out by and as well as higher than poultry feed with protein content of 11.34%. Fish are abundantly available at a cheaper rate, thus being within the reach of low-income group of people. Dependence on fish is usually higher in coastal than in inland areas and some small island states depend almost exclusively on fish. Above 60% of population gets 40% of animal protein from fish in third world countries. It has been calculated that fish provide about 55% of all the animal protein consumed in Asia. The contribution of food fish to the total global animal protein in 1993 was 15.6%, 16% in 1996 and 14.7% in 2005 estimated total lipid content in six commercially important fishes of Tuticorin, south east coast of India. Reported the derivatives of marine fish and their role in the human therapeutics. Estimated the proximate composition of six marine fish species from Tamil Nadu coastal region, India. More recently, studied the organic composition of some marine fishes from the east coast of India.

Fish is the vital source of animal protein with other nutritional elements which is required for

supplementing both infant and adult diets for the maintenance of healthy body. Fatty fish species are generally rich in fat soluble vitamins such as vitamins D and A. Among water soluble vitamins, the content of vitamin B_{12} is particularly high. Vitamin D improves the uptake of calcium and phosphates in the bowel, and contributes to regulating the calcium level in the blood. Marine fish is a major source of high-quality protein, lipids, and a wide variety of vitamins and minerals. These macromolecules and their derivatives show different pharmacological activities, which make the fish as a therapeutic diet. Hence, the consumption of fish has been linked to health benefits such as reduced risk of coronary heart disease. A preventive and curative effect has also been reported for arterial hypertension, human breast cancer colon and prostate cancer, inflammatory diseases asthma and disorders of the immune system. In addition, fish oil helps to prevent brain aging and Alzheimer's disease.

It is with such available background related to the importance of fish as a good source of essential nutrients, the present chapter deals with the composition of muscle tissue in *T.lepturus, L.equulus* and *U.vittatus*. Their monthly as well as seasonal variations for a period of two years study. These biochemical laboratory tests assist and encourage the use of biochemical investigations in relation to diseases, which reveals the cause and suggests rational and effective treatment. It also helps to make available screening tests for early diagnosis assist in monitoring progress and also helps in assessing response to therapy. These fish are very popular and delicious items of diet and because of their nutritive value and more consumption, they form very important species. The present authors also reported on diversity of bycatch, microbiological and inorganic components of 3 species of bycatch collected from Visakhapatnam fishing harbor.

Material and Methods

For the present study the selected species were purchased from the local fish markets at the Visakhapatnam fishing harbour. These fishes were brought to the laboratory at regular intervals for two years of the study period, i.e., 2014-15 and 2015-16. And three species of bycatch were identified with the help of "F.A.O" (Food and agriculture organization) Species identification sheets.

To prepare the sample for determination of organic composition, the fish were washed thoroughly and transferred into plastic buckets, containing ice. They were thoroughly cleaned with the tap water by keeping the fish in slanting position in a tray and the excess water was removed with blotting paper. The non-edible portions (Offal, Bones and Scales) were removed immediately to avoid decomposition. The edible portion (Muscle) was blended and aliquots weighed out for the various analyses. The muscle was kept in hot air oven at 95^0 -100^0c for about 24 hours to dry the material to the constant dry weight. The dry muscle was ground into a fine powder in a porcelain mortar. The samples thus obtained were used for the determination of proximate composition (Moisture, Protein, carbohydrate and Fat). Moisture, Fat and Ash content were determined according to the [33] and Protein by the method of Micro Kjeldahl by.All of the chemicals used in this work are of high purity GR grade.

Moisture

Moisture is the material lost by food on heating to ~100^0c or allowing standing over a dehydrating agent or by heating in vacuum. It is generally considered to be water, but actually it is the total volatile matter lost or driven off at this temperature.

Direct heating method (oven method)

A definite amount of the material is weighed into a weighing bottle or porcelain dish or glass dishes with cover (petri dishes). The bottle is placed with the lid open, in an air oven thermostatically controlled at 100^0c for 6 hours. The bottle is cooled in a desiccator and weighed. The process of heating, cooling and weighing are repeated until successive weighing show a difference of not more than 1 mg.

Protein

Total protein was estimated by the method of Micro Kjeldahl.

Procedure 50 to 200 mg of dry sample or about 1gm of wet sample is weighed into a Kjeldahl's digestion flask. 10 ml of concentrated H_2SO_4 and a pinch of the digestion mixture are added to the flask and the flask is heated on a Kjeldahl digestion rack. A glass bead is added to the reaction mixture to prevent bumping. The mixture is digested for 4-6 hrs, or until a clear solution is obtained (greenish yellow in colour) to ensure complete conversion of the nitrogen in the sample into ammonium sulphate. A blank is carried out using sulphuric acid. The digested sample is transferred to a 100 ml volumetric flask and made up to the mark.

5 ml of the made up sample is pipetted and transferred into the chamber of the Kjeldahl distillation apparatus which has been cleaned out by steaming. 10 ml of 40% NaOH is added to the inner chamber and the liberated ammonia is steam distilled into a receiver flask containing 10 ml of 2% boric acid solution to which 2-3 drops of mixed indicator are added. The indicator is red in boric acid and turns green when ammonia is absorbed. The distillation is carried out for (2-5) minutes and the contents of the receiver flask (ammonia absorbed in boric acid) is titrated against standard N/70 HCL until the colour changes to purple. The nitrogen present in the sample is calculated using the nitrogen equivalence *viz*., 1 ml of 0.05 N/70 HCL = 0.007g of nitrogen. The protein value is obtained by multiplying the N content by 6.25.

Carbohydrates

Carbohydrates were estimated by the Dubois method

Procedure

Anthrone in sulphuric acid can be used for colorimetric determination of sugars, methylated sugars and polysaccharides). The assay is very simple, rapid, inexpensive and highly sensitive. The colour produced is very stable and the assay is largely unaffected the presence of proteins.

To estimate the amount of carbohydrate, 10 mg of a weighed amount of fine dried powder was taken in a test tube. To which 5 ml of 1N sodium hydroxide was added and homogenized the content and centrifuged for about 15 min at 2500 RPM. The supernatant was taken separately and kept for further analysis.

To estimate the amount of carbohydrates 0.5 ml of the solution was taken in a test tube and to this 0.5 ml of distilled water was added to get 1 ml of solution. To this 5 ml of anthrone in sulphuric acid (50 mg of anthrone in 100 ml of the Con. Sulphuric acid) was added. Then shake the contents well and kept for incubation for about 15 min. after completion of process of incubation the test tubes were boiled in water bath about 15 min. colors were developed when the samples

cooled to normal room temperature. The optical density of the samples was measured by using a U.V. spectrophotometer (Bio Aquarius CECIL CE 7250 7000 series make) and noted down the readings of absorption at the wave length of 600 NM. All the samples were taken in triplicates.

LIPIDS

Lipids were estimated by Franz Van Soxhlet's method

The extraction of fat from substances is often tedious and requires thorough contact and heating with solvent. This is done in a special apparatus known as Soxhlet Extractor (Franz von soxhlet, 1879). In this procedure, the apparatus is designed so that a fresh portion of solvent comes in contact with the materials to be extracted over a relatively long period of time.

Description of the apparatus

The apparatus consists of a flask, containing a volatile solvent and resting on some type of heating device. The flask is connected by means of interchangeable ground joints with a tube having a siphon arrangement and a side arm (Soxhlet Extractor). Again the extraction tube is connected by interchangeable ground joints with a water cooled condenser.

Reagent - Ethyl ether or Petroleum ether.

Procedure

2 to 3g of the ground moisture free material is accurately weighed into a thimble. The mouth of the thimble is packed with absorbent cotton so as to keep the sample in. The thimble is placed in the Soxhlet Extractor and it then connects with the pre-weighed flask (receiver) and also the condenser.

The receiver containing suitable solvent *viz*., ethyl ether or petroleum ether (B.P 40^0 - 60^0c) is heated at such a rate that the ether will drop from the condenser on to the center of the thimble at the rate of 5 to 6 drops per second. When sufficient solvent has been thus transferred to the extracting tube to fill the siphon it siphons back into the receiver. Thus the process is continued until the extraction is complete, varying at times from 8 to 24 hours.

Then the flask is removed and the volatile solvent is evaporated in (60^0 -80^0c) on a water bath. The residue is dried in an oven maintained at 60^0 - 70^0 c, cooled in a desiccator and weighed with evaporation of the ether; the weight is on the decrease and becomes constant at last. Any further heating results in an increase in weight gradually caused by the oxidation of the fat. The least weight of the residue gives the weight of the fat in the sample.

Results

The finding on the three species of marine fishes i.e., *T.lepturus, U.vittatus* and *L.equulus* from the study area, Visakhapatnam fishing harbour clearly indicate that there are some notable differences in the bio-chemical constituents of the three species, these species were among the noncommercial the coastal waters of India by means of by catch consider as waste. The tissues of the fish specimen were analyzed in order to determine the composition of water, protein, carbohydrate, and lipid. In the present study to evaluate the nutrient composition of the 3 species of bycatch landed at the fishing harbour of Visakhapatnam. The nutrient composition of selected fish species collected from the landing centre was as follows.

The biochemical composition of these three fishes was analyzed and the results are furnished with table - 1, 2, 3 and 4. The results revealed the dominance of moisture content in all the three bycatch species followed by total protein. The variations were clearly observed in the concentrations of different chemical constituents like moisture, protein, carbohydrate, fat in the muscle tissue of study fish species during the study period of two successive years and these changes were attributed to factors like feeding, spawning periodicity and environmental conditions.

Moisture

The percentage of water in the composition of the fish body is a good indicator of the relative energy, protein and lipid content. The average moisture content of *T.lepturus, U.vittatus and L.equulus* in the present study was recorded 74.67%, 76.26 and 80.21. Variations in the moisture content of the body muscle of these species were recorded highest values in June, December and November, December. As these fishes breed twice in a year, two peak levels in the moisture content were noticed during those months. The moisture content was lower in rainy season in the present study. The results of the present study revealed that changes in moisture content in the muscles of these selected species were could be attributed to changes in lipid level directly and to feeding intensity indirectly.

Protein

The present study, the lowest protein value (*T. lectures* 17.68mg/100g, *U. vittatus* 16.10mg/100g and *L.equulus*.0mg/100g and the highest values (*T. lepturus* 22.10mg/100g, *U. vittatus* 21.10mg/100g and *L. equulus* 21.98mg/100g) were observed. The values represented in table no.5. content of protein in the muscle of these fishes were recorded more or less similar in both the study areas and in both the years. The highest percentage of protein in the muscle was noted in fishes. The protein cycle shows a strong position in total organic composition. The majority of the fishes had the average protein content between 16 -21%.

Carbohydrate

The low value of carbohydrate (*T. lepturus* 0.27mg/100g, *U. vittatus* 0.23mg/100g and *L. equulus* 0.14mg/100g and the highest values (*T. lepturus* 0.87mg/100g, *U. vittatus* 1.22mg/100g and *L. equulus* 1.96mg/100g) were observed. Carbohydrates are commonly employed for providing energy in the cells. The energy metabolism happens through glycolytic process involving oxidative, citric acid cycle. The energy liberated is stored in the form of ATPs. Each gram of carbohydrates is capable of yielding the energy equivalent of 4.1 calories. The values represented in table no.7.

Lipid

Fat is one of the essential constituents of the fish muscle. It is the basic source of energy like proteins. The lowest value of lipid (*T.lepturus* 0.89mg/100g, *U.vittatus* 1.02mg/100g and *L.equulus* 1.43mg/100g and the highest values (*T.lepturus* 2.86mg/100g, *U.vittatus* 3.12mg/100g and *L.equulus* 3.07mg/100g) were observed. The values represented in table no.6. It seems to be more or less equal and negligible difference in fat content in both the fish species were recognized. But considerable variations in fat content were observed in different months as well as different seasons. Least fat content in the body muscle was observed during (May, June & October, November). The high fat content was observed during (March, October, & January).

Table 1: Percentage composition of Protein in *T. lepturus*, *U. vittatus* and *L. equulus* during 2014-'15 and 2015-'16.

Month	2014-2015			2015-2016		
	T. lepturus	*U. vittatus*	*L. equulus*	*T. lepturus*	*U. vittatus*	*L. equulus*
Aug	19.2	21.0	14.0	20.06	20.08	16.23
Sep	21.45	17.50	16.16	20.86	18.0	19.18
Oct	20.54	17.98	17.56	19.03	17.76	19.98
Nov	18.12	20.03	19.04	17.86	21.0	19.94
Dec	19.96	17.98	20.96	22.10	16.10	21.60
Jan	19.12	16.43	16.16	19.18	17.03	17.54
Feb	19.10	19.89	19.01	18.20	19.77	18.98
Mar	20.64	20.34	20.96	19.42	20.87	20.65
Apr	20.01	19.56	21.45	21.32	20.34	21.98
May	18.07	20.76	20.34	17.68	19.98	20.87
Jun	17.86	17.99	19.76	18.00	18.12	21.06
Jul	18.62	19.16	20.02	19.83	19.98	19.87
Mean	19.39083	19.05167	18.785	19.46167	19.08583	19.82333
STDEV	1.140976	1.446286	2.330648	1.433323	1.609266	1.662612

Table 2: Percentage composition of Lipid in *T. lepturus*, *U. vittatus* and *L. equulus* during 2014–'15 and 2015-'16.

Month	2014-2015			2015-2016		
	T. lepturus	*U. vittatus*	*L. equulus*	*T. lepturus*	*U. vittatus*	*L. equulus*
Aug	1.86	1.44	2.00	1.80	1.64	2.56
Sep	2.05	1.39	2.04	1.16	1.89	2.60
Oct	0.96	2.03	2.87	0.89	1.98	3.07
Nov	1.22	2.56	2.05	1.21	3.12	2.23
Dec	2.85	3.05	2.14	1.82	2.22	2.09
Jan	2.16	2.65	2.55	2.20	2.09	2.76
Feb	2.32	1.02	1.43	2.50	1.02	1.94
Mar	1.02	2.60	3.04	2.14	2.64	2.14
Apr	2.71	2.10	2.14	2.76	2.09	2.18
May	1.96	1.90	2.16	1.80	2.13	2.56
Jun	2.86	2.03	2.01	2.66	2.89	2.13
Jul	2.09	2.23	1.97	2.20	1.98	3.05
Mean	1.997273	2.083333	2.220909	1.928333	2.140833	2.4425
STDEV	0.690523	0.590536	0.447	0.601163	0.556163	0.380911

Table 3: Percentage composition of carbohydrate in *T. lepturus*, *U. vittatus* and *L. equulus* during 2014-'15 & 2015-'16.

Month	2014-2015			2015-2016		
	T. lepturus	*U. vittatus*	*L. equulus*	*T. lepturus*	*U. vittatus*	*L. equulus*
Aug	0.28	0.46	0.19	0.32	0.76	0.14
Sep	0.35	0.54	1.32	0.29	1.05	1.94
Oct	0.27	0.57	0.64	0.43	0.86	0.48
Nov	0.28	0.63	1.54	0.46	0.43	1.24
Dec	0.46	1.01	1.54	0.43	0.55	1.09
Jan	0.58	0.88	1.00	0.65	1.14	1.43
Feb	0.52	0.23	1.07	0.74	0.39	0.87
Mar	0.63	1.22	0.65	0.55	0.97	0.32
Apr	0.59	0.87	0.99	0.49	1.02	1.34
May	0.87	0.34	1.87	0.77	0.98	1.32
Jun	0.34	0.59	1.96	0.48	0.23	0.98
Jul	0.56	0.89	1.34	0.64	0.54	1.05
Mean	0.4775	0.4775	1.175833	0.520833	0.743333	1.016667
STDEV	0.182315	0.290625	0.524135	0.153235	0.303684	0.508211

Table 4: Percentage composition of Moisture in *T. lepturus*, *U. vittatus* and *L. equulus* during 2014–'15 and 2015–'16.

Month	2014-2015			2015-2016		
	T. lepturus	*U. vittatus*	*L. equulus*	*T. lepturus*	*U. vittatus*	*L. equulus*
Aug	73.10	78.12	80.16	72.90	79.21	79.76
Sep	75.72	76.04	78.94	75.80	76.32	79.56
Oct	74.82	79.45	77.90	74.56	80.14	80.12
Nov	73.88	72.98	81.23	73.98	75.43	79.23
Dec	73.37	76.04	82.70	89.0	76.20	85.70
Jan	73.02	74.47	78.93	72.56	75.67	79.21
Feb	72.62	70.28	80.09	72.76	70.00	83.59
Mar	74.16	77.98	81.00	74.24	83.15	79.45
Apr	75.16	76.09	85.70	75.56	75.27	82.10
May	73.68	79.43	77.08	73.82	78.98	78.09
Jun	72.10	80	79.65	72.29	80.02	79.43
Jul	72.52	78.94	78.98	72.94	77.83	77.98
Mean	73.67917	76.65167	80.19667	75.03417	77.35167	80.35167
STDEV	1.118265	2.951437	2.300796	4.543852	3.332225	2.299062

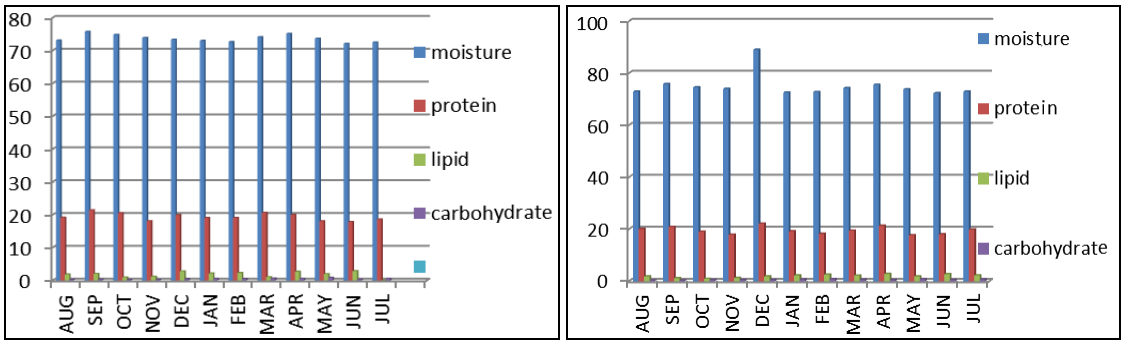

Fig 1 & 2: Moisture and organic composition of *T. lepturus* during 2014-'15 & 2015-'16

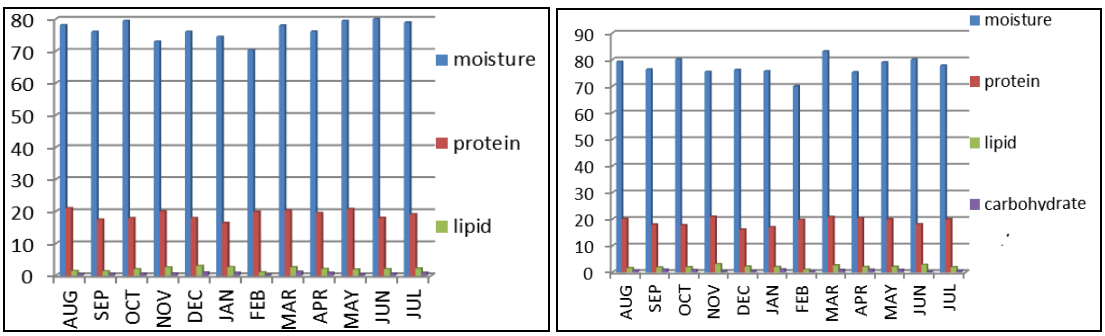

Fig 3 & 4: Moisture and Organic composition of *U. vittatus* during 2014-'15 & 2015-'16

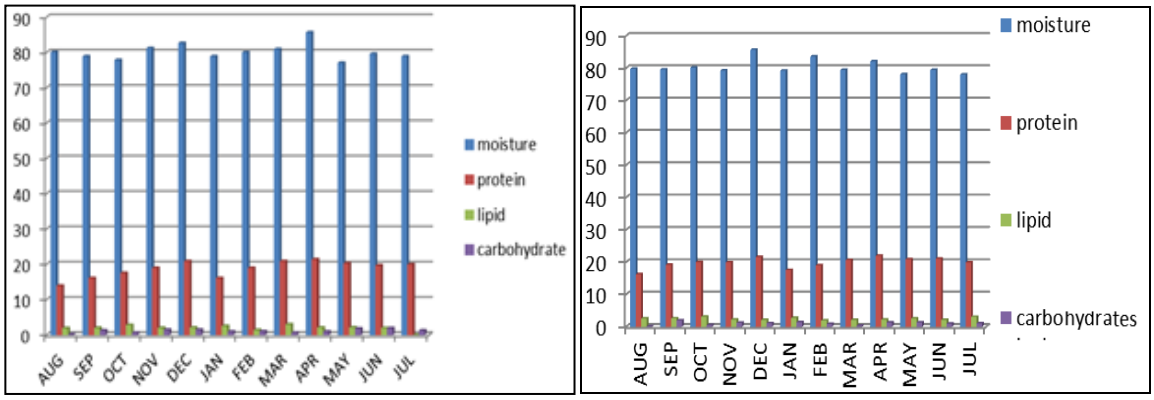

Fig 5 & 6: Moisture and organic composition of *L. equulus* during 2014-'15 & 2015-'16

Discussion

A number of investigators have attempted to relate changes in whole body composition or the composition of specific organs or muscle tissues to seasonal variables [35, 36]. Under natural conditions, numerous fish species endure long periods of starvation associated mainly with seasonal changes in food availability, spawning migrations, preparation for spawning or seasonal changes in water temperature [37].

Bycatch contain sufficient amount of proteins, lipids, carbohydrates and minerals. The species like *T. lepturus, U. vittatus* and *L. equulus* were the best source of well-balanced proteins with high- biological value. Seafood is one of the most important foods in human nutrition because of its high nutritional quality [38]. Marine fish is an important source of quality protein and cheaper in cost compared to other source of animal protein. The nutritional properties of fish and fish products render them valuable foodstuffs that are beneficial for human health. A balanced diet is necessary to get all the nutrients in the correct amounts for maintaining a sound health. About 35% of the Indian population is fish eaters and the per capita consumption is 9.8 kg, whereas the recommended intake is 13 kg [39].

Variations in the moisture content of the body muscle of *T.lepturus, U.vittatus* and *L.equulus* were recorded highest values in Dec, June (late pre-monsoon season) and in November, December (early post-monsoon season) i.e. at spawning time. [40] Explained the raising of moisture in fish muscles during the spawning period to be from endocrine source.

The moisture content was found to be more or less similar in the fish species. The findings are almost similar to other related fishes as well as in other vertebrates. The moisture content was lower in monsoon season in the present study. Similar moisture content in *Sardinella longiceps* (73.79%) and *Lutjanus decussates* (73.52%) was observed by [41].

Protein

As far as the estimation of the organic composition of the selected species *viz*., *T.lepturus, U.vittatus and L. equulus* is concerned, the composition of protein content for *T.lepturus* ranges from 17.86 percent to 21.45, for *U.vittatus* it ranges from 16.43 to 21.00 per cent and for *L.equulus* from 14.00 to 21.45 for the year 2014-15, these values varied in between 17.68 and 22.10 for *T.lepturus*, 16.10 and 20.87 for *U.vittatus* and 16.23 and 21.60 for *L.equulus* for the year 2015-16. The values of the Standard deviation also show lesser deviation from their respective mean values. Hence, that there are no significant variations in the protein content in selected species throughout the study period.

Like moisture content, content of protein in the muscle of these fishes were recorded more or less similar in both the study areas and in both the years. The highest percentage of protein in the muscle was noted in bycatch species, as we observed that these protein values, May-June and November - December the maximum values were observed during these months. The minimum values were observed immediately after spawning time. The protein content of these species found in the study was more or less similar to the result of [42].

Majority of fishes had the average protein content between 16 - 21%. The average protein content of *T.lepturus* (19.32%) *U.vittatus* (19.05) and *L.equulus* (19.82%) were in line with the findings of [43]. [44] reported 21.75% of the protein content in the muscle tissue of *T.lepturus* from Mombasa, Kenya [45]. Reported the protein values of highly demanded tabling fishes. The diet of these fishes consists of crayfish, small fishes, zoo planktonic and benthic crustaceans and cephalopods [46]. These are high protein prey and could be the reason for the high protein levels in the muscle tissue of these fishes found. They also reported that the rise or fall of the biochemical constituents in different seasons appeared to coincide with high flow feeding activity of the fish.

Carbohydrate

With regard to the composition of carbohydrates, it can be observed that the percentage composition varies in between 0.27 and 0.87 for *T.lepturus*, 0.23 and 1.01 for *U.vittatus* and 0.19 and 1.96 for *L.equulus* for the year 2014-15. These values are 0.29 and 0.77 for *T.lepturus*, 0.23 and 1.14 for *U.vittatus* and 0.14 and 1.43 for *L.equulus* for the year 2015-16. The standard deviation values show less variation in composition of carbohydrates throughout the study period.

The study thus supports the view that carbohydrate plays an insignificant role as an energy reserve in aquatic animals [47], since it is in very low concentration in the muscle, liver and gonad, and that its role in the mobilization of energy during maturation and spawning. Carbohydrates formed a minor percentage of the total composition of the muscle. A critical appraisal of the observations indicates that the carbohydrates as energy reserves are comparatively insignificant in aquatic animals as mentioned by [48]. Very low values of carbohydrates recorded in the present study could be because of glycogen in many marine animals does not contribute much to the reserves in the body. Carbohydrates are considered to be the first degraded under the stress condition of animals.

Lipid

As far as the percentage composition of the Lipid is concerned, it varied in between 0.96 and 2.86 for *T.lepturus*, 1.02 and 2.65 for *U.vittatus* and 1.43 and 3.04 for *L.equulus* for the year 2014 – 15. These values varied in between 0.89 and 2.76 for *T.lepturus* 1.02 and 3.12 for *U.vittatus* and 1.94 and 3.07 for *L.equulus* for the year 2015-16. The Standard Deviation values also show that there is no significant variation in the Lipid composition of the three species throughout the study period.

The low fat content values obtained from the organic analysis as shown in Table No-6, agreed with other analysis carried out by earlier researchers such as [49]. 2.08% of fat in *Lepturacanthus savala* was reported by [50]. [51] Reported lower muscle, fat content in sea bream (*Sparues aurata*) and sea brass (*Dicentrarchus cabrax*). Similarly, low fat in fish muscle was reported by [52].

According to generally fish can be grouped into 4 categories according to their fat content; lean (< 2%), low fat (2-4%), medium fat (4-8%) and high fat (> 8%) In the present study, the fat content of *T.lepturus, U.vittatus and L.equulus* was recorded less than 2%. Hence, these fishes are grouped under the lean category of fishes. Categorized fish as lean or fatty species depending on how they store fat for energy. Lean fish use the liver as their energy deposit, while fatty species store fat in adipose cells throughout the body.

The overall objective of the present study is to determine the nutritive value of low value bycatch species found dominant in Visakhapatnam fishing harbour, the major landing area Visakhapatnam, in order to assess the variability of the biochemical composition of protein, lipids carbohydrates, moisture and mineral composition. The information on the biochemical composition of these dominant trashes is considered to be very essential for the product development from those low valued non-commercial by catches.

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