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Nutritive Evaluation of four Commercially Important edible Fishes (*Caranx para, Cynoglossus dubius, Nemipterus Japonicus, Scomberoides commersonnianus*) of Karachi Fish Harbour, Pakistan

[1] Rashida Qari, [2] Moniba Shafaat
[1, 2] Institute of Marine Science, University of Karachi, Pakistan

Corresponding Author: **Rashida Qari**

Abstract
In present research four commercially important edible fish species *Caranx para, Cynoglossus dubius, Nemipterus Japonicus and Scomberoides commersonnianus* selected to determine carbohydrate, protein, ash, lipid etc. Protein content (20±3.4%) and ash content (33±3.6%) were high in the species of *Scomberoides commersonnianus* as compared to other species. which could make them more desirable from a nutritional standpoint. Both lipid content (16±2%) and carbohydrate content (40±4%) were high in *Nemipterus japonicus* as compared to other species. The finding indicates that there was little positive significant correlation found in between biochemical components of the fishes under investigation. The high ash percentage in all fish species under study indicated a significant mineral content and high protein and carbohydrate results indicates that all four studied species can utilize different food supplements, poultry feed and many byproduct (fish meal, manure and fish protein medicine). Enhancing knowledge of the nutritional profiles of the present fish species are aids in developing evidence-based dietary recommendations and promoting healthier eating habits. This research can inform dietary guidelines, particularly for communities reliant on local fisheries for food security and nutrition.

Keywords: Karachi Fish Harbour, Fish, Protein, Fat, Carbohydrate and Ash

Introduction

Fish biochemicals components are primarily consist into protein, lipid, carbohydrates, ash, moisture and water. Fish has valuable composition includes readily digestible protein, vitamins, polysaturated fatty acids, minerals including potassium and calcium (Suganthi, Venkatraman and Chezhian, 2015) [23]. Since fish farming is the first in the food pyramid and provides media for humans, it is a major target for bio-exaggerations of heavy metals (FAO, 1989) [8]. Ackman (1989) [2] reported that protein, omega-3- polyunsaturated fatty acid (PUFA) and minerals found in seafood particularly fish. The mineral composition of a few edible rubbish fishes of Karachi Fish Harbour was examined by Talat, Azmat and Akhtar (2005) [24]. Munshi, Ali, and Shakir (2005) [14] and Nisa and Abdullah. (2011) [17] studied biochemical composition in the fishes of coastal water of Pakistan. The FAO (1989) [8] reached a consensus regarding the regular arrangement of the edible portion of fish, allowing for the influence of distinct chemical composition among species that belong to the same family (Masood, Yasmeen, Hameed Ur Rehman, Azeem, Haseeb, Ahmad, Hassan, Sami Ullah, and Khan, 2014) [13]. In certain Asian nations such as Bangladesh and Cambodia peoples get up to 75% of their daily protein from fish (Koutrakis, 2011) [11]. Fish has a good amount of protein, ranged between 15-28% and all eight essential amino acids, such as sulfur-containing lysine, methionine, and cysteine on fresh-weight basis. Huss (1995) [10] split the muscle proteins of fish into three categories: i) structural proteins which make up 70-80% of the total protein content, such as actin, myosin, tropomyosins and actomyosin (ii) Sarcoplasmic proteins which make up 25-30% of the total protein such as myoalbumin, globulin and enzymes and (iii) connective tissue proteins such as collagen which make up roughly 3% of the total protein content in teleost fishes (Alp –Erbay and Yeşilsu, 2021) [3].

The fisheries sector indeed plays a fundamental role in advancing human development and ensuring food and nutrition security worldwide, providing essential sustenance to millions of people. Nazir, Yongtong, Kalhoro, Memon, Mohsin and Kartika (2015) [16] have conducted a thorough examination of the fisheries economy in Pakistan, focusing on the management strategies and economic dynamics of the fish market. Their research sheds light on the fishing efforts linked with economic efficiency and national income in Pakistan. It's notable that fish and fishery products valued at US $117 million were exported in 2002-

2003, highlighting the significant economic contribution of the fisheries sector to the country's trade balance and overall economy. This export revenue not only boosts national income but also supports livelihoods and economic development, particularly in coastal areas and fishing communities. Understanding the economic dynamics of the fisheries sector is crucial for devising effective policies and management strategies that promote sustainable fishing practices, equitable distribution of benefits, and resilience to environmental and market fluctuations. By supporting research and initiatives that enhance the productivity, profitability, and sustainability of fisheries, policymakers can ensure the continued contribution of the fisheries sector to food security, poverty alleviation, and economic growth in Pakistan and beyond.

The low utilization of fish in Pakistan can be attributed to socio-economic factors, including preferences for larger fish due to their perceived higher protein content (Qari, Munir and Aslam, 2017) [18]. Larger fish often command lower prices compared to smaller fish, making them more accessible to the general population. However, larger fish such as pomfret, croaker, and mackerel tend to be expensive and may not be affordable for poorer individuals. In recent years, there has been a growing awareness of the health benefits associated with small fish, which are rich in essential nutrients despite being commercially underutilized in nutrition. Recognizing these challenges, efforts are being made to promote the consumption of edible fish through the development of value-added products. These initiatives aim to increase the appeal and accessibility of fish products to a wider range of consumers. One approach involves the development of value-added products such as canned sardines and fish pickles, which offer convenient and affordable options for incorporating fish into the diet. These products not only extend the shelf life of fish but also enhance their palatability and versatility in culinary applications. Additionally, the production of fish protein concentrates or isolates as protein supplements presents another avenue for increasing fish utilization. These concentrated forms of fish protein can be incorporated into various food products to boost their nutritional value, particularly for individuals who may have limited access to fresh fish or other protein sources. By diversifying the range of fish products available and promoting their nutritional benefits, stakeholders can encourage greater consumption of fish in Pakistan, thereby improving food security, nutrition, and public health outcomes across socio-economic strata. Investigating the biochemical composition of local fish species is crucial for understanding their nutritional quality and potential benefits for human consumption. Since there's limited information available regarding the biochemical composition of these fishes. The present investigation holds significant value in filling this knowledge gap and providing valuable insights into the nutritional aspects of these species *Caranx para*, *Cynoglossus dubius*, *Nemipterus japonicus* and *Scomberoides commersonnianus*.

Materials and Methods

The Karachi Fish Harbour served as collection site for the present study. The harbour is run by the Sindh Provincial government and is situated at Ibrahim Hyderi port in Karachi. With a population of about 150,000, fishing is the main source of income for the majority of them. It's the greatest seafood store in Karachi. Approximately 90 % fish and sea food harvest and 95 % of country' exports are handled by Karachi Fish Harbour.

The fishes *Caranx para*, *Cynoglossus dubius*, *Nemipterus japonicus*, *Scomberoides commersonnianus* were initially identified using the FAO (1985) [7] field guide which is available online (Plate 1-4).

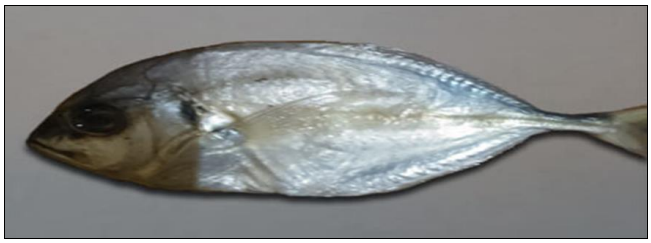

Plate 1: *Caranx para* (Cuvier, 1833)

Plate 2: *Cynoglossus dubius* (Day, 1873)

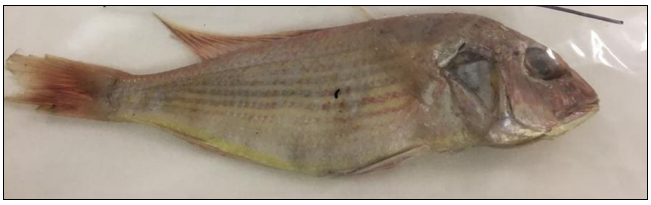

Plate 3: *Nemipterus japonicus* (Bloch, 1791)

Plate 4: *Scomberoides commersonnianus* (Lacepede, 1802)

For the preparation of biochemical analysis, a portion of the muscle of abdomen was taken then dried at 70° C. The samples were ground and then kept at room temperature and dry powder of samples used for biochemical parameters carbohydrate, protein, ash, lipid, moisture, and water determination. The phenol sulphuric acid method was used to measure the amount of carbohydrate (Dubios, Gilles, Hamilton, Rebers, and Smith, 1956) [6]. The proteins concentration was calculated using Lowry's technique (Lowry, Rosebrough, Farr, and Randall, 1951) [12]. The soxhlet extraction method was used to remove all the fat (Folch lees, and Sloane-Slanley, 1957) [9]. The standard method of Association of Official Agricultural Chemists (A.O.A.C) was used to determine the amount of ash, moisture and water (A.O.A.C., 1990) [4].

Results and Discussion

Total four fishes *Caranx para*, *Cynoglossus dubius*, *Nemipterus japonicus* and *Scomberoides commersonnianus*

belonging to class Actinopterygii were analyzed. Significant variations in biochemical composition were observed among the all studied species of fishes. The mean values of all biochemical parameters with standard deviation (±) for all species are presented in Table 1. The data points are grouped closely around the mean when the standard deviation is small and large when the standard deviation is large.

Table 1: Variation in biochemical composition of fishes collected from Karachi Fish Harbour

S.No	Name of Fishes	Parameters	Feb	May	Nov	Mean
1	*Caranx para*	carbohydrate	38.0	34.0	30.0	34±4
2	*Cynoglossus dubius*	carbohydrate	27.0	31.0	32.0	30±2.6
3	*Nemipterus japonicus*	carbohydrate	36.0	40.0	44.0	40±4
4	*Scomberoides commersonnianus*	carbohydrate	37.0	30.0	29.0	32±4.3
1	*Caranx para*	protein	18.0	15.0	18.0	17±1.7
2	*Cynoglossus dubius*	protein	14.0	19.0	15.0	16±2.6
3	*Nemipterus japonicus*	protein	17.0	15.0	19.0	17±2
4	*Scomberoides commersonnianus*	protein	22.0	16.0	22.0	20±3.4
1	*Caranx para*	Ash	25.0	24.0	29.0	26±2.6
2	*Cynoglossus dubius*	Ash	37.0	32.0	27.0	32±5
3	*Nemipterus japonicus*	Ash	23.0	25.0	21.0	23±2
4	*Scomberoides commersonnianus*	Ash	31.0	32.0	36.0	33±3.6
1	*Caranx para*	Lipid	8.0	14.0	14.0	12±3.4
2	*Cynoglossus dubius*	Lipid	13.0	16.0	16.0	15±1.7
3	*Nemipterus japonicus*	Lipid	18.0	16.0	14.0	16±2
4	*Scomberoides commersonnianus*	Lipid	8.0	9.0	13.0	10±2.6
1	*Caranx para*	Moisture	3.9	3.8	4.6	4.1±0.4
2	*Cynoglossus dubius*	Moisture	2.0	2.5	1.5	2±0.5
3	*Nemipterus japonicus*	Moisture	3.0	4.0	5.0	4±1
4	*Scomberoides commersonnianus*	Moisture	2.5	2.0	1.5	2±0.5
1	*Caranx para*	Water	37.15	38.33	36.78	37.42±0.8
2	*Cynoglossus dubius*	Water	19.27	19.04	24.05	20.73±2.8
3	*Nemipterus japonicus*	Water	44.82	48.63	41.80	45.08±3.4
4	*Scomberoides commersonnianus*	Water	34.21	35.71	34.54	34.82±0.7

Caranx para commonly known as Jacks is primarily depend on fish larvae and crustaceans [18]. The carbohydrate in muscles was ranging 30-38% with a mean value of 34±4% and protein range was 15-18% with a mean value of 17±1.7% whereas the ash range was 24-29% with a mean value of 26±2.6% (Table 1). The lipid range was 8-14% with a mean value of 12±3.4 % and moisture range was 3.8-4.6 % with a mean value of 4.1±0.4%. The water content range was 36.78-38.33 % with a mean value of 37.42±0.8% (Table 1).

Cynoglossus dubius also referred as Carrot tonguesole, member of Cynoglossidae family. It lives on the sandy and muddy continental shelf bottoms. It mostly consumes invertebrates that live on the bottom [18]. Table 1 show that the range of carbohydrate was 27-32 % with a mean value of 30±2.6%. Table 1 displays the protein range 14-19% with a mean value of 16±2.6% and the ash range of 27-37% with a mean value of 32±5%. The lipid range was 13-16 % with a mean value of 15±1.7% and the moisture range was 1.5-2.5% with a mean value of 2±0.5%. The range of water content was 19.04-24.05% with a mean value of 20.73±2.8% (Table 1).

Nemipterus japonicus member of Nemipteridae family, commonly known as the Thread fin bream is located in coastal water about at depth of 60m. Males eventually reach bigger size than female. Worms, crustaceans, mussels, cephalopods and fishes are the feed of *Nemipterus japonicus* [18]. Table 1 show that the carbohydrate range was 36-44% with a mean value of 40±4%. Protein range was 15-19% with a mean value of 17±2% and ash range was 21-25% with a mean value of 23±2%. The lipid range was 14-18% with a mean value of 16±2% and moisture range was 3-5% with a mean value of 4±1% whereas water content range was 41.08-48.63% with a mean value of 45.08±3.4% (Table 1).

Fish species *Scomberoides commersonnianus* commonly known as Talang queen fish. It is mostly coastal specie, occasionally forming tiny schools in estuaries. Its primary food source is fish, cephalopods and other pelagic fauna and flora whereas juvenile eat scale [18]. The carbohydrate range was 29-37% with a mean value of 32±4.3%. Protein range was 16-22% with a mean value of 20±3.4% and ash range was 31-36% with a mean value of 33±3.6% whereas lipid range was 8-13% with a mean value of 10±2.6% and moisture range was 1.5-2.5% with a mean value of 2±0.5% (Table 1). The range of water content was 34.21-35.71% with a mean value of 34.82±0.7% (Table 1).

There was significant correlation observed in between species composition such as *Caranx para* and *Cynoglossus dubius*, (r2 = 0.798), *Caranx para* and *Nemipterus japonicus* (r2 = 0.975), *Caranx para* and *Scomberoides commersonnianus* (r2 = 0.958), *Cynoglossus dubius* and *Nemipterus japonicus* (r2 = 0.690), *Cynoglossus dubius* and *Scomberoides commersonnianus* (r2 = 0.889) and *Nemipterus japonicus* and *Scomberoides commersonnianus* (r2 = 0.8373) (Figures1-6). A noteworthy positive association was noted in between carbohydrate and water content (r2 = 0.663), moisture and water content (r2 = 0.605) and moisture and carbohydrate (r2 = 0.663) whereas significant negative correlation observed in between ash and water content (r2 = -0.658), ash and carbohydrate (r2 = -0.811) and ash and moisture (r2 = -0.708) (Figures 7-12).

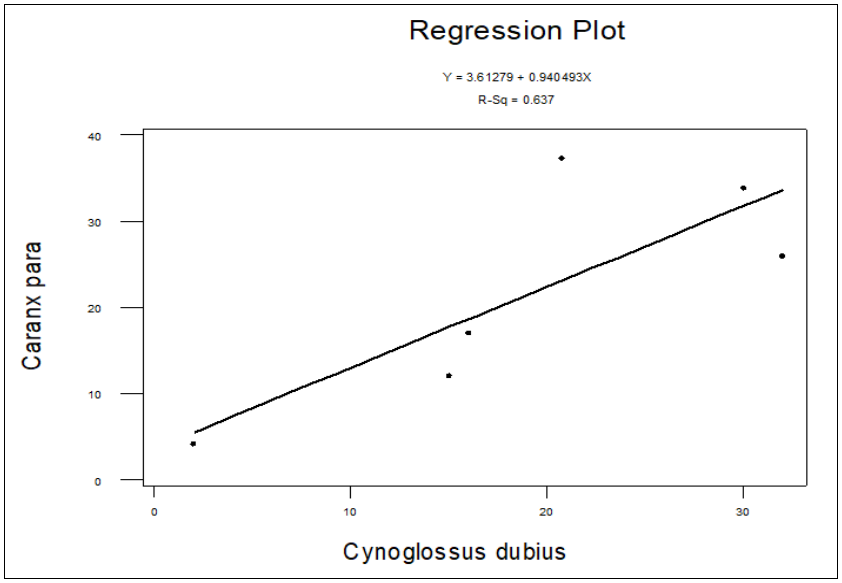

Fig 1: Correlation in between *Caranx para* and *Cynoglossus dubius* composition

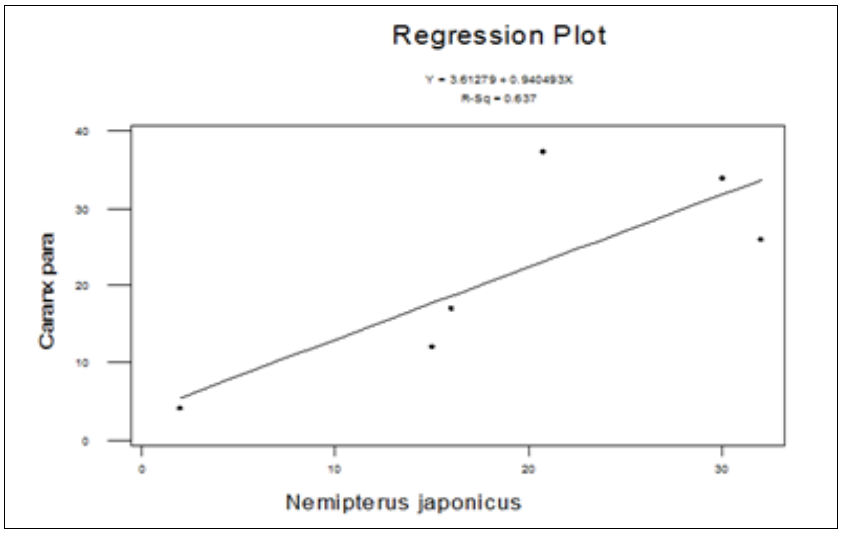

Fig 2: Correlation in between *Caranx para* and *Nemipterus japonicus* composition

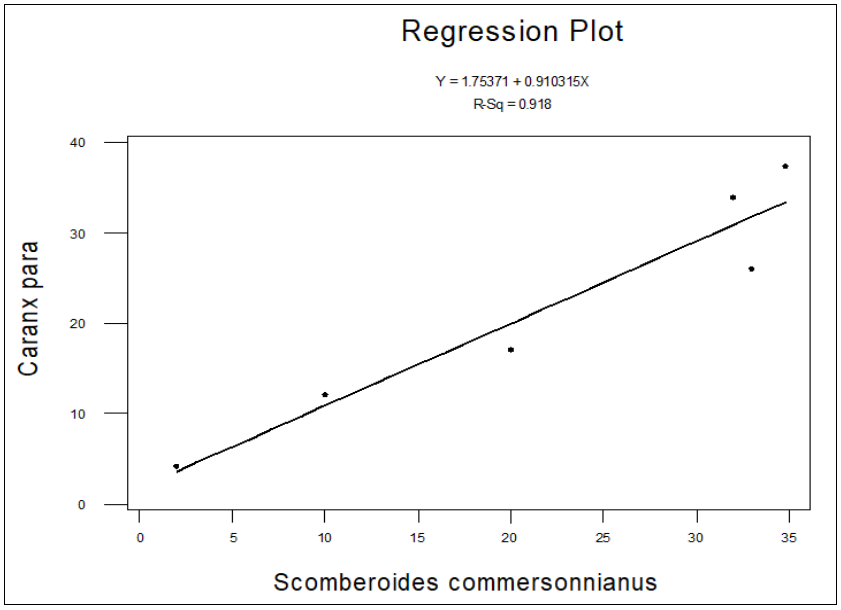

Fig 3: Correlation in between *Caranx para* and *Scomberoides commersonnianus* composition

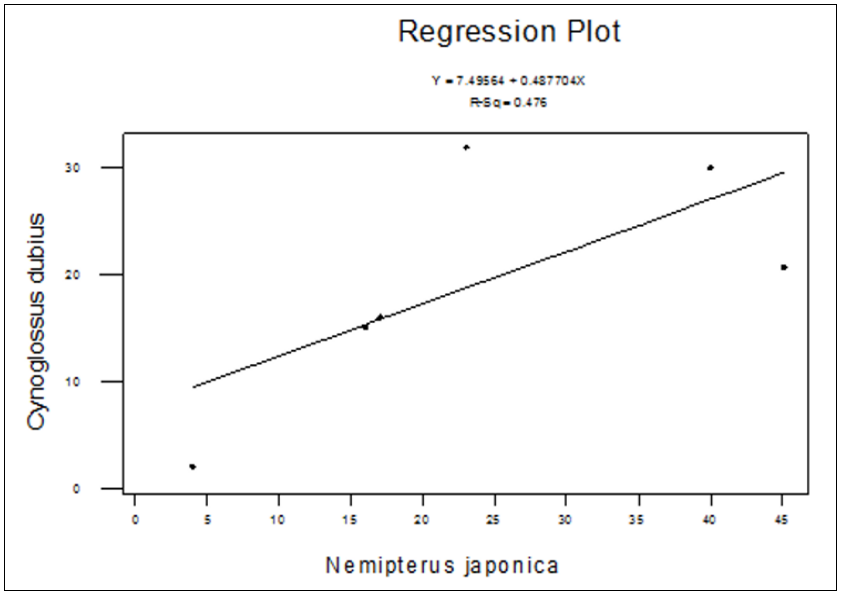

Fig 4: Correlation in between *Cynoglossus dubius and Nemipterus japonica* composition

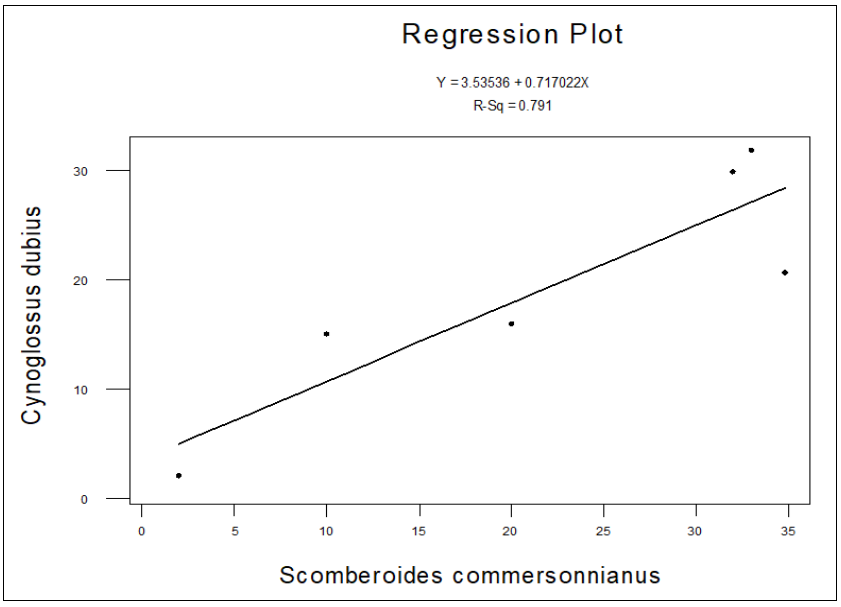

Fig 5: Correlation in between *Cynoglossus dubius* and *Scomberoides commersonnianus* composition

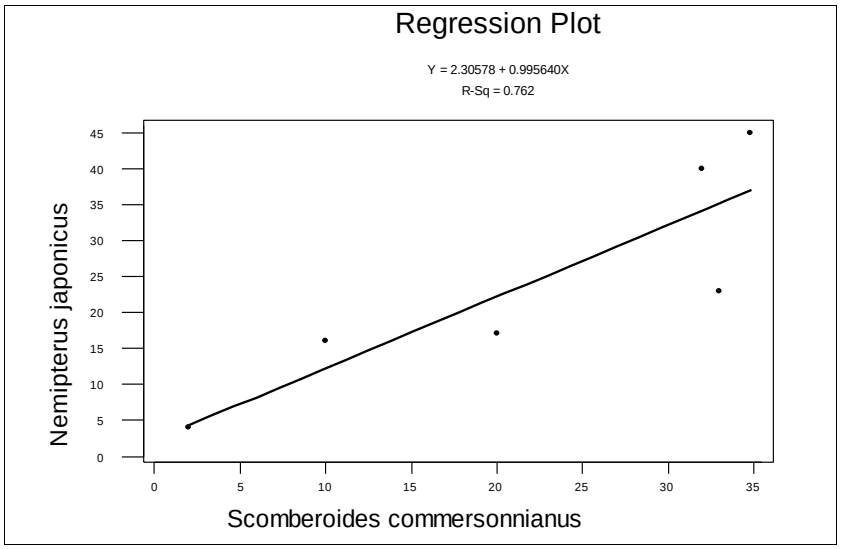

Fig 6: Correlation in between *Nemipterus japonicus* and *Scomberoides commersonnianus* composition.

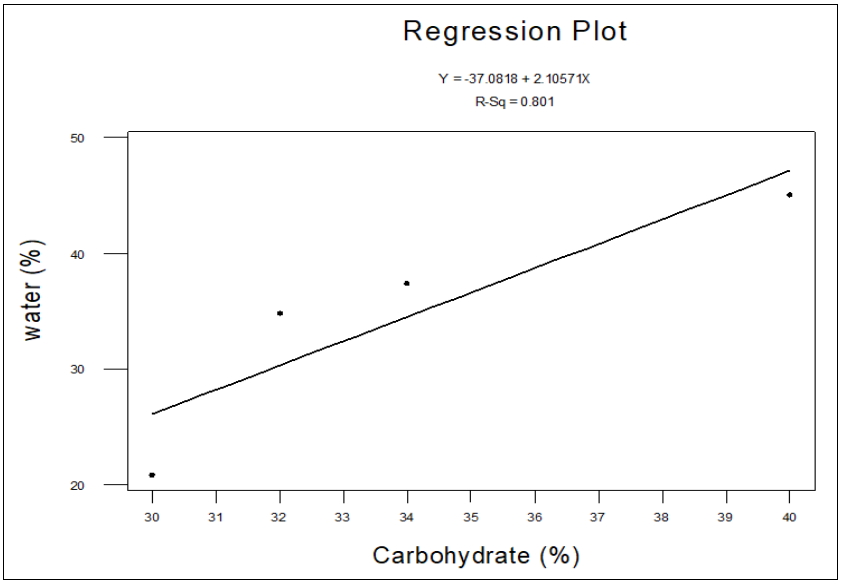

Fig 7: Correlation in between carbohydrate and water content

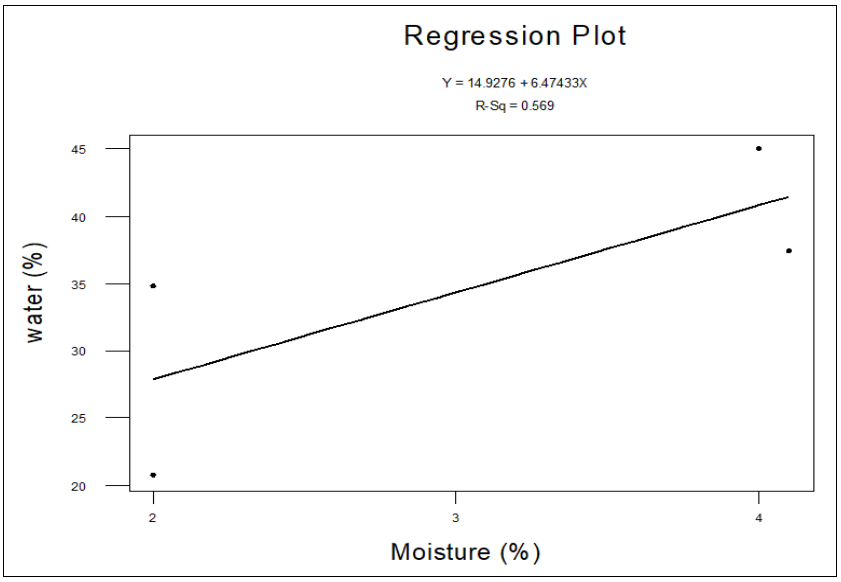

Fig 8: Correlation in between moisture and water content

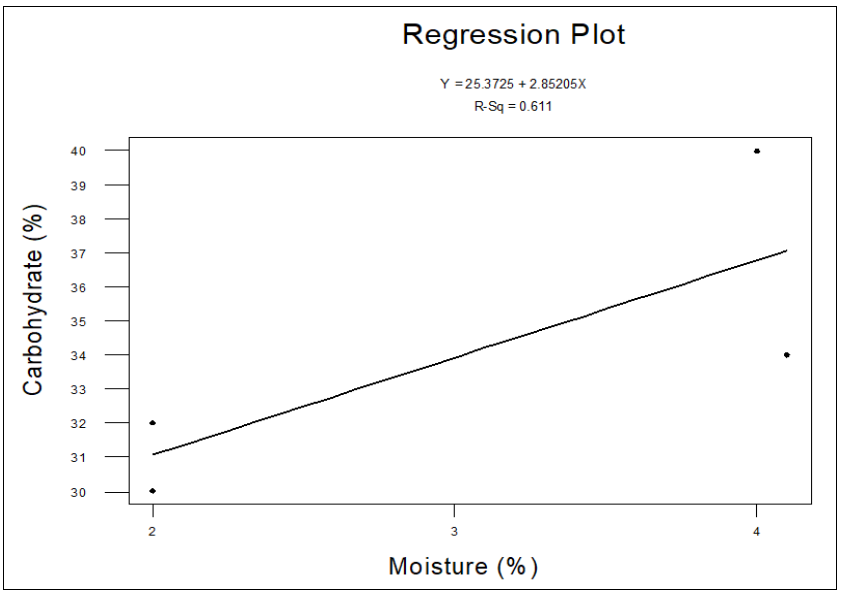

Fig 9: Correlation in between moisture and carbohydrate

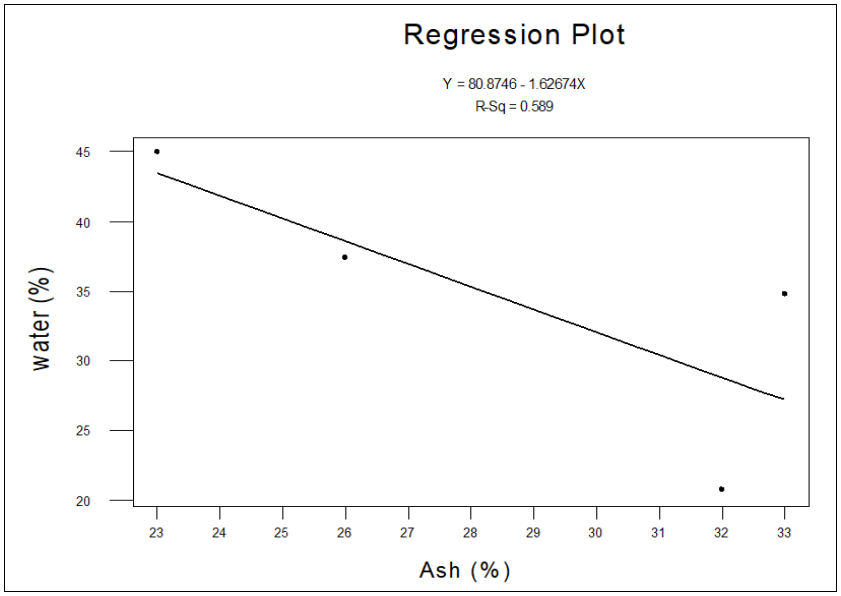

Fig 10: Correlation in between ash and water content

Fig 11: Correlation in between ash and carbohydrate

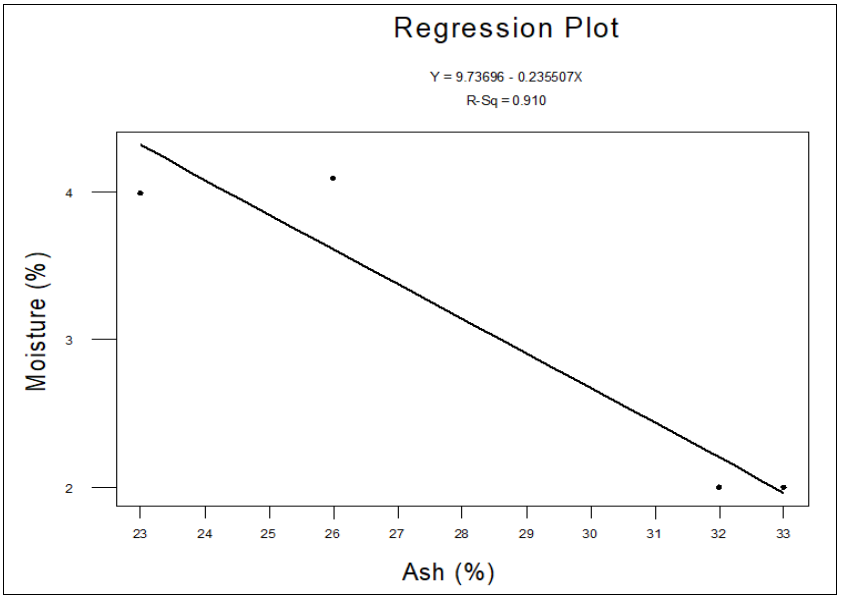

Fig 12: Correlation in between ash and moisture

The average compositions of the edible portions of the studied species according to FAO, (1989) [8] revealed that various species within the same family had distinct chemical composition. For instance, the flesh of common carp (*Caprinus caprio*, Cyprinidae) has the following composition: 17.5%, protein, 4.7% fats, 0% glycogen and 117 K cal of energy.

When compared to other studied species *Nemipterus japonicus* has the highest carbohydrate content (40±4%) out of the four studied fishes because *Nemipterus japonicus* mostly feed on crustaceans and other slow moving animals in the sea. *Cynoglossus dubius* has the lowest carbohydrate value (30±2.6%) feed mainly on bottom living invertebrates. Comparatively *Scomberoides commersonnianus* has the highest protein level (20±3.4%) and *Cynoglossus dubius* has the lowest protein level (16±2.6%). Whereas *Scomberoides commersonnianus* has the highest ash level (33±3.6%) and *Nemipterus japonicus* has the lowest ash level (23±2%). High ash content is indicating greater content of minerals (Porto, Castro, Filho, and Baptista, 2016; Shafaat, and Qari, 2023) [21, 22]. Highest lipid was found in *Nemipterus japonicus* (16±2%) and *Scomberoides commersonnianus* has the lowest lipid content (10±2.6%). *Caranx para* (4.1±0.4%) and *Nemipterus japonicus* (4±1%) has the highest moisture content (4.1±0.4%) whereas *Cynoglossus dubius* and *Scomberoides commersonnianus* has the lowest moisture content (2±0.5%) whereas the highest water content was found in *Nemipterus japonicus* (45.08±3.4%) and lowest was found in *Cynoglossus dubius* (20.73±2.8 in contrast to other fish under study.

Nemipterus japonicus has similar values of protein (17±2%) that was found in the same fish at South coast India's Tuticorin fishing Harbour (Kumar, Ruba Annathai, Jeya Shakila and Shanmugam, 2014) [19]. The present work showed the low percentage of water (19.04- 48.63) although average water content of fish is 70%. Its mean studied species of fishes have high lipid, protein and energy (Aberoumad and Pourshafi, 2010) [1]. Fish species-specific variations in the biochemical makeup of fish confirm by Naeem and Ishtiaq (Naeem and Ishtiaq, 2011) [15]. Whereas Deka, Mahanta and Goswami, (2012) [5] reported in his study variations in biochemical parameters, is caused by the fish habitat, season and feeding habits. Every fish under research was categorized as having a high quantity of protein with the exception of the Sillago sihama species, which has the highest protein content (21%). The current investigation showed that the protein content in the flesh of *Cyprinus caprio* was lower than that of another carp species (*Labeo rohita*, Cyprinidae), with the latter having a higher protein content 18.59% (Masood, Yasmeen, Hameed Ur Rehman, Azeem, Haseeb, Ahmad, Hassan, Sami Ullah and Khan, 2014) [13]. The current study's protein results indicate that the fish utilized as dietary supplement have an appropriate amount of protein similar to that of commercial fishes (Pawar and Sonawane, 2013) [20]. Talat, Azmat and Akhtar (2005) [24] reported in their study minerals have great physiological interest as they are the part of the structure of almost all important organic compounds. It is concluded after present research that all studied four species *Caranx para*, *Cynoglossus dubius*, *Nemipterus japonicus* and *Scomberoides commersonnianus* contain high ash or minerals concentration, can be utilize in many features like food supplements, poultry feed and many by product such as fish fertilizer, fish and chickens' meal as fish protein extract.

Conclusion

It is concluded based on the current findings, which examined four species (*Caranx para*, *Cynoglossus dubius*, *Nemipterus japonicus* and *Scomberoides commersonnianus*) are good source of protein (9-21%) and carbohydrate (28-40%) and they can be utilize for a variety of low-income people's food needs. Low-income individuals often look for inexpensive sources of protein to stretch their food budget, for example comparison shopping, sales, discounts, bulk buying etc. The biochemical constituent in all species varies largely in between species and between individual depend on time of year, place and feeding habit. High ash content was observed in all present species indicating high mineral content. Talat, Azmat and Akhtar (2005) [24] reported in their study minerals have great physiological interest as they are the part of the structure of almost all important organic compounds. It is concluded after present research that all studied four species *Caranx para*, *Cynoglossus dubius*, *Nemipterus japonicus* and *Scomberoides commersonnianus* contain high ash or minerals concentration, can be utilize in many features like food supplements, poultry feed and many byproduct such as fish protein extract, fish and chickens meal and fish fertilize. Significant correlation was noted among the biochemical constituents of every species under investigation.

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