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Research Article

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Comparative Analysis of Total Lipid Content and Fatty Acid Composition of Head, Liver and Intestine from *Cyprinus carpio* (Linn.) and *Ctenopharyngodon idella* (Steindachner) of Different Weight Groups

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ABSTRACT

The present study was planned to find out the total lipid content and fatty acid composition of head, liver and intestine of Cyprinus carpio and Ctenopharyngodon idella under three different weight categories because processing waste is mainly disposed. The higest total lipid contents in head, liver and intestine from Cyprinus carpio and Ctenopharyngodon idella were recorded as 17.00 ± 0.57%,16.00± 0.57%,29.66± 1.20% and 22.73± 0.24%, 22.76± 0.23, 30.06± 0.16%, respectively in 751-1000g weight group when compared with 250-500g and 501-750g weight groups. Highest total PUFAs were recorded as 21.45±1.12% in head of Cyprinus carpio as compared to Ctenopharyngodon idella i.e. 12.69±0.17 in maximum weight group. However in liver these were highest 69.23 ± 0.27 % (250-500g) in C. carpio as compared to 36.59 ± 0.14% (501-750g) in C. idella, similar pattern was observed in case of intestine. Monounsaturated fatty acids and Saturated fatty acids were also observed in head, intestine and liver of all the three weight groups of both the species. Thus, it can be concluded that the processing waste of two Chinese carps is a rich source of total lipids and essential fatty acids, the polyunsaturated fatty acids, in particular.

Key words: *Cyprinus carpio, Ctenopharyngodon idella, Processing waste, Total lipids, Fatty acid composition.*

NTRODUCTION

Fish is an integral part of human diet. It is liked not only for taste but also for its high nutritional value. Fish is high in protein and some varities are also rich in good quality lipid containing essential fatty acids[2]. World food fish aquaculture production expanded at an average annual rate of 6.2 percent in the period 2000–2012 (9.5 percent in 1990–2000) from 32.4 million to 66.6 million tonnes (F.A.O., 2014).

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Fish has been shown to be the cheapest source of animal protein in Third World Countries[12]. Fish lipids are well known to be rich in long-chain (LC) n-3 polyunsaturated fatty acids (LC n-3 PUFA), especially eicosapentaenoic acid (EPA) and docosahexanoic acid (DHA)[9]. Fishes received increased attention as a potential source of animal protein and essential nutrients for human diets[7]. Fish and fish products are very important sources of income and high market value[13]. The consumption of fish is allied to health reimbursement because of a rich content in proteins of high dietary value; minerals, vitamins and distinguishing lipids. It should be considered that fish tissue presents elevated nutritional significance and therefore is a particularly optional dietary module. In addition, fish are a good source of micro and macro-elements such as calcium, phosphorus, selenium and manganese[10]. In the present course of study head, liver and intestine of *C. carpio* and *C. idella* were considered as waste material. This fish waste is also rich in valuable minerals, enzymes, pigments and flavours that are required by many industries including food, agriculture, aquaculture and pharmaceuticals. The objective of the present study is to collect waste material (head, liver and intestine of 250-500g, 501-750g and 751-1000g wt groups) samples of *C. carpio* and *C. idella* were collected, dissected and compared their waste material in order to find out their their total lipid content and fatty acid composition.

MATERIAL AND METHODS

Fresh specimens of the *Cyprinus carpio* (*Linn.*) and *Ctenopharyngodon idella* (Steindachner.) of different weight groups (250-500g, 501-750g and 751-1000g) were obtained from the local fish market in Ludhiana, transported to the laboratory in an ice box and stored in a quick freezer, at -30°C. Fish samples were thawed for 7 to 8 hours in refrigerator at 5°C and individual biometric data were recorded and wrapped in labeled clean air-tight ziplock polythene bags. The Whole head, its soft parts, and the visceral organs including liver and intestine were cleaned in fresh water, weighed on the top pan electronic weighing balance and calculated per 100g of the fish body weight. Each of these organs removed from different individuals of one weight group were thoroughly mixed to form a composite sample. The composite samples were then stored at -30°C in the quick freezer until analyzed.

The total lipid content of the soft parts of the head and various visceral organs was estimated by Soxhlet lipid extraction/solvent extraction method[1]. Fatty acid composition was determined by Gas Chromatography[3] and the esters were identified and quantified by injecting into GLC and comparing with a set of standard esters.

Statistical analysis

One way and Multifactor ANOVA were used to determine the inter-specific and weight group differences in the total lipids and fatty acid profiles of the waste from *Cyprinus carpio and Ctenopharyngodon idella*. The analyses were performed using Microsoft EXCEL and STATGRAPHICS statistical packages.

RESULTS AND DISCUSSION

Highest lipids contents were measured as 30.06 ± 0.16% in the intestine of 751-1000g weight group of *C. idella* .The total lipid content in *C. idella* under three different weight catageories and all the organs (head ,liver and intestine) performed the best than *C. carpio* as shown in table 1. The variation may be due to the diet or it may be related to environmental conditions, sex and age of the fish [14]. Lipid content in these fishes is comparatively lower than rohu and catla[15] and other marine fishes such as sardine and mackerel . The fatty acid composition as a percentage of eluted methyl esters of the head, intestine and liver from *Cyprinus carpio* and *Ctenopharyngodon idella* is summarized in Table 2. The predominant SFAs in all samples were palmitic, stearic and myristic acids. The highest saturated fatty acids (Table 2) were found to 49.29 % in the liver (751-1000g weight group) and 45.04% in the intestine (751-1000g) of *Cyprinus carpio* and

Ctenopharyngodon idella respectively when three weight groups of particular fish species were compared. It was reported that palmitic acid was the predominant in SFA group in freshwater channel catfish, *Ictalurus punctatus*[13], in freshwater rainbow trout, *Oncorhynchus mykiss*[8] and in the catfish *Pangasius hypophthalmus*[9]. Highest concentration of PUFAs (Table 3) were observed 69.23% in liver (250-500g) and 36.59% also in liver (501-750g) of *C. carpio* and *C. idella* respectively. Highest amount of n3/n6 ratio (1.38±0.02) and total MUFAs (40.19±11.92%) were found in the 501-750g of intestine and head of *C. carpio* (Table 3). However in case of *C. idella* highest amount was found 2.27% and 52.92 in the same weight groups of head. The ratio of n-3 and n-6 fatty acids is a useful index to evaluate the nutritional value of a lipid due to their beneficial effects of human health especially on coronary heart diseases, cancer and autoimmune diseases and 1:1 ratio has the best beneficial effects on health (Simopoulos, 2000). Both the species had good n-3/n-6 ratios making them suitable for human or aquaculture use (Table 3). The fatty acid composition of *C. carpio* occurring in the highest proportions were linolenic acid (C18: 3; 16.46%) 501-750g of intestine, stearic acid (C18: 0; 7.50%) 751-1000g of intestine, linoleic acid (C18:2; 32.0%) 751-1000g of liver, palmitic acid (C16: 0; 30.71%) 751-1000g of head, oleic acid (C18:1; 40.05%) 501-750g of head. The fatty acid compositions of *C. idella* occurring in the highest proportions were stearic acid (C18: 0; 4.16%) 751-1000g of intestine, oleic acid (C18:1; 52.59%) 501-750g of head, linolenic acid (C18: 3; 10.17%) 250-500g of liver, palmitic acid (C16: 0; 37.71%) 751-1000g of intestine, linoleic acid (C18:2; 18.37%) 751-1000g of intestine summarized in Table 2. high content of EPA, DHA, DPA and other fatty acids were was also detected . As the study indicates the presence of relatively high content of EPA and DHA in head and viscera, efforts should be made to recover the lipids from these tissues for commercial utilization. Thus, byproducts and wastes generated from marine fish processing can be used as sources of fish oil rich in unsaturated fatty acids. These can be used as valuable ingredients in specialty feed in aquaculture industry. With increasing demand for fish oil, recovery of fish oil from processing wastes should help augment the supply, apart from benefiting the industry by minimizing problems associated with disposal and environmental pollution[15].

Table 1. Total lipid content (%) of head and visceral organs *Cyprinus carpio* and *Ctenopharyngodon idella* of different weight groups

Body part/ organ	250-500g		501-750g		751-1000g	
	C. carpio	*C. idella*	*C. carpio*	*C. idella*	*C. carpio*	*C .idella*
Head	5.50±0.25[a]	16.0±0.52[b]	11.33±0.33[a]	19.80±0.34[b]	17.00±0.57[a]	22.73± 0.24[b]
Liver	10.8±0.29[a]	17.7±0.28[b]	13.13±0.82[a]	19.66± 0.39[b]	16.00±0.57[a]	22.76 ±0 .23[b]
Intestine	13.83±0.52[a]	18.16±0.49[b]	20.36± 0.48[a]	29.20 ±0.20[b]	29.66±1.20[a]	30.06± 0 .16[a]

Values are mean ± S.E., values with same superscript in a row with respect to the fish species do not differ significantly (p>0.05)

Table 2: Fatty acids (%of total lipids) in the head, liver and intestine of *Cyprinus carpio* (Linn.) and *Ctenopharyngodon idella* (Steindachner.) of different weight groups

Fatty Acid	*C. carpio*			*C. idella*		
	250-500g	501-750g	751-1000g	250-500g	501-750g	751-1000g
Palmitic acid (C16:0)						
Head	21.62±0.12[a]	23.45±2.92[a]	30.71±2.24[b]	32.09±0.95[ab]	28.68±2.65[a]	34.42±0.25[b]
Liver	2.16±0.32[a]	16.64±5.37[b]	26.74±3.48[c]	19.13±0.63[b]	13.37±1.02[a]	29.14±0.39[c]
intestine	11.45±0.15[a]	11.48±2.66[a]	28.11±0.23[b]	35.65±0.30[b]	33.15±0.36[a]	37.71±1.07[c]

Stearic acid (C18:0)						
Head	2.91±0.13^{c}	0.77±0.38^{a}	1.82±0.08^{b}	0.46±0.13^{a}	0.86±0.04^{b}	0.77±0.00^{b}
Liver	3.10±0.11^{a}	4.42±2.80^{a}	6.23±5.67^{a}	1.93±0.02^{a}	2.02±0.55^{a}	4.11±0.51^{b}
Intestine	5.52±0.18^{a}	4.94±2.51^{a}	7.50±0.48^{a}	0.38±0.01^{a}	0.19±0.18^{a}	4.16±0.45^{b}
Oleic acid (C18:1)						
Head	35.38±0.97^{a}	40.05±0.16^{a}	32.07±10.92^{a}	50.36±1.45^{b}	52.59±1.05^{b}	41.38±0.23^{a}
Liver	1.99±0.01^{b}	18.65±4.94^{c}	20.11±0.73^{c}	27.82±0.25^{b}	17.98±1.55^{a}	50.09±0.25^{c}
Intestine	8.15±0.16^{b}	4.05±0.37^{a}	20.61±0.83^{c}	47.33±0.62^{b}	46.38±0.38^{b}	28.98±0.80^{a}
Linolenic acid (C18:3 n-3)						
Head	0.24±0.15^{a}	6.27±0.07^{a}	6.91±1.55^{a}	3.17±0.29^{a}	0.63±0.36^{a}	0.57±0.01^{a}
Liver	3.58±1.09^{b}	5.60±1.66^{a}	5.23±0.49^{a}	10.97±0.40^{c}	8.43±0.12^{b}	2.79±0.34^{a}
Intestine	4.55±0.14^{b}	16.46±1.19^{b}	7.91±0.66^{a}	2.83±0.21^{a}	2.24±0.28^{a}	2.29±0.87^{a}
Linoleic acid (C18:2 n-6)						
Head	9.03±0.02^{a}	9.93±0.02^{a}	11.45±2.25^{b}	7.43±0.24^{b}	3.37±1.28^{a}	3.19±0.19^{a}
Liver	8.01±0.40^{a}	3.05±1.25^{a}	32.00±1.21^{b}	4.87±1.72^{a}	5.22±0.51^{a}	4.83±0.05^{a}
Intestine	5.91±0.04^{a}	5.61±0.68^{a}	11.25±0.09^{b}	.20±0.03^{a}	1.16±0.24^{b}	18.37±0.25^{c}

Only major SFAs have been included; Values are mean ± S.E.Values with same superscript in a row with respect to one fish speices do not differ significantly (p>0.05).

Table 3: Fatty acids (% age of total lipids) in the head, intestine and liver of *Cyprinus carpio* (Linn.) and *Ctenopharyngodon idella* (Steindachner.) of different weight groups

Head	**n-3/n-6 Ratio**	**0.73±0.00^{a}**	**0.51±0.02^{a}**	**0.62±0.25^{a}**	**0.40±0.04^{a}**	**2.27±0.84^{c}**	**1.21±0.03^{bc}**
Liver		**0.85±0.02^{c}**	**0.55±0.10^{b}**	**0.19±0.08^{a}**	**1.04±0.01^{b}**	**0.35±0.02^{a}**	**0.47±0.08^{a}**
Intestine		**1.24±0.03^{b}**	**1.38±0.02^{c}**	**0.44±0.54^{a}**	**0.56±0.01^{b}**	**0.19±0.02^{a}**	**0.12±0.04^{a}**
Head	**TOTAL PUFAs**	**20.56±0.19^{ab}**	**18.79±0.67^{a}**	**21.45±1.12^{b}**	**12.36±0.69^{a}**	**12.04±1.75^{a}**	**12.69±0.17^{a}**
Liver		**69.23±0.27^{b}**	**6.13±7.87^{a}**	**44.50±11.08^{a}**	**9.75±0.38^{b}**	**36.59±0.14^{c}**	**0.79±0.07^{a}**
Intestine		**37.61±0.73^{b}**	**39.76±1.45^{b}**	**31.58±0.83^{a}**	**3.86±0.26^{a}**	**4.81±0.50^{b}**	**3.25±1.21^{c}**
Head	**T TOTAL MUFAs**	**35.45±0.98^{a}**	**40.19±11.92^{a}**	**32.24±10.96^{a}**	**50.39±1.48^{b}**	**52.95±0.94^{c}**	**41.42±0.23^{a}**
Liver		**2.09±0.80^{b}**	**18.71±4.98^{c}**	**0.33±0.18^{a}**	**28.15±0.49^{b}**	**18.04±1.60^{a}**	**50.09±0.25^{c}**
Intestine		**8.17±0.18^{b}**	**4.05±0.37^{a}**	**20.61±0.83^{c}**	**47.42±0.64^{b}**	**46.44±0.39^{b}**	**28.98±0.80^{a}**
Head	**T TOTAL SFAs**	**31.09±0.34^{a}**	**30.01±2.58^{a}**	**37.30±2.57^{b}**	**36.38±1.50^{a}**	**34.11±2.27^{a}**	**43.66±0.35^{b}**
Liver		**18.34±1.26^{a}**	**45.12±0.96^{b}**	**49.29±13.24^{b}**	**35.95±0.23^{a}**	**40.83±1.87^{b}**	**36.18±0.42^{a}**
Intestine		**32.43±0.23^{a}**	**47.75±1.23^{b}**	**46.61±0.29^{b}**	**41.35±0.52^{b}**	**37.42±0.49^{a}**	**45.04±1.65^{c}**

Only major PUFAs have been included; Values are mean ± S.E.Values with same superscript in a row with respect to one fish speices do not differ significantly (p>0.05).

CONCLUSION

The *C. idella* was found to be best as compared to *C. carpio* having highest total lipid content in all the three weight groups. Palmitic acid and oleic acid was found to be maximum in head, liver and intestine of *C. idella* as compared to *C. carpio.* However, stearic acid, linoleic acid and linolenic acid pattern was found to be reverse in the species. So, it can be concluded that head,liver and intestine of *C. idella* and *C. carpio* are valuable sources of total lipid content with excellent amount of Polyunsatured fatty acids, Monounsaturated fatty acids and Saturated

fatty acids that can be used for human consumption instead of being treated as waste.

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