A COMPARATIVE STUDY ON THE BIOCHEMICAL COMPOSITION OF THE COMMON CARP *Cyprinus carpio* L. COLLECTED FROM NATURAL WATERS, CULTIVATED AND IMPORTED IN BASRAH GOVERNORATE, IRAQ*

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ABSTRACT

The current study investigated the comparison of the biochemical composition of the common carp *Cyprinus carpio* L. which collected from four different sources in Basrah city; Shatt Al-Arab river at Abul- Khasib by using gill nets, earthen ponds at the University of Basrah campus, fish cages at Al-Hartha district and cooled fish imported from the Islamic Republic of Iran. Fifty specimens of each fish source were selected for analysis, half of which was stored with ice for up to ١٠ days.

The results indicated that higher moisture content 78.2% was in the muscular tissues of Shatt Al-Arab fish. Highest fat content 11.9% was recorded in imported fish, highest protein 18.17% and ash 2.29% were measured in fresh pond fish. Caloric value of the examined fish showed variations between fresh and iced fish where the highest value 165.62 Kcal/ 100 gm was recorded in fresh cage fish.

INTRODUCTION

Carp species are important fish in many parts of the world [1]. These fish are found in many different parts of the world for their ease of cultivation and ability to tolerate difficult environmental and life conditions. They are able to live in different freshwater and brakishwater environments. Their cultivation dates back in China to the 5th century BC and later it transferred into other continents[2]. It is characterized by resistance to harsh environmental conditions e.g. it has a wide thermal range and can withstand a reduction in oxygen levels of 4.5 mg / l. [3] Carp production is the main aquaculture production for many years in many countries in Asia, Africa,

Europe and Latin America representing the largest sector of global fish farming quantitatively [4]. The study of [5] indicated that the biochemical composition of fish is very similar to that of wild animals. The main components of fish are water (66-84), protein (15-24), fat (0.1-24) % and ash (0.8-2%). It was demonstrated by[6] that the differences in the biochemical composition of fish meat are closely related to food consumption, migrations and persistent sexual changes until egg laying. Fish that migrate long distances to reach breeding areas or specific rivers may use protein as an energy source in addition to fat and thus deprive reserves of protein and fat which leads to a general deterioration in the biological state of the fish. In addition, in most fish species, the food is not available during the egg laying migration, and therefore is not able to provide energy through nutrition as indicated by [7].

The present study aimed to investigate the differences in the biochemical composition of the wild common carp and carp cultured in pond and cages in addition to the imported carp in the markets of Basrah governorate.

MATERIALS AND METHODS

In this study, the common carp*Cyprinus carpio* fish were obtained from four different sites in Basrah governorate including 50 fish from the Shatt al-Arab waters in Abu Al-Khasib district by using gill nets, earthen culture ponds at Basra University and floating fish cages in Shatt al-Arab in addition to refrigerated carp fish imported from the Islamic Republic of Iran during the period from 1/12/2015 to 1/6/2016.

Fish were carefully selected applying the quality specifications set previously by [8]. Fish samples were collected and placed in styropor containers with crushed ice at 1:1 ratio. Upon the arrival to the laboratory, fish samples were thoroughly washed with tap water to exclude attached dirt and other materials. Then five fish from each sample were dorsally opened with very sharp knives, separating the meat part of each fish and mixing with each other to produce a homogenous representative sample for conducting biochemical tests. Half of specimens (25 fish) from each source was stored into styropor containers with crushed ice at 1:1 ratio for up to ١٠ days and then it was treated as described above to extract meat for further analysis.

Biochemical analysis

The biochemical tests were performed with 3 replicates and calculated on wet weight basis. Moisture was estimated by taking 5 g of each sample and oven dried at 105° C. Ash was calculated by burning 2 g of fish samples in amuffle furnace at 550° C for 24 hour., Soxhlet method was applied to estimate fat content using petroleum ether for 8 hours according to the method illustrated by [9]. As for protein determination, the semi-microkjeldahl methodwas followed [10]. After analysis, the resulting nitrogen value was multiplied by the protein conversion factor (N x 6.25) to calculate the protein content of the fish. The caloric value of fish meat was calculated by multiplying both protein and fat by factors of 4 and 9, respectively, adding both results which expressed by (kcal / 100 g meat) according to [11].

Statistical analysis

Data were analyzed using SPSS Version 20.0. package (SPSS, Inc., Chicago, IL, USA). Comparisons between means were performed with ANOVA and LSD *post hoc* test. The results were considered significant at $P \leq 0.05$.

RESULTS

Table (1) shows the range and average of the lengths and weights of fish under study. The length of the carp fish from the Shatt al-Arab (SA), earthen ponds (EP), floating cages (FC) and the import (FI) were 27.75, 28.25, 34.6 and 30.75 cm, respectively. Weight averages for SA, EP, FC and FI fish were 350.52, 747.75, 1227.4 and 1041.5 gm,respectively.

Table 1. Length and weight ranges and averages for the studied common carp *C. carpio*.

Fish source*	Length, cm		Weight, gm	
	Range	Average	Range	Average
SA	30.5 – 25	27.75	463 - 284.2	350.52
EP	36 – 20.5	28.25	847.69 – 622.6	747.75
FC	40. -29.2	34.6	2400.2-547	1227.4
FI	38 – 23.5	30.75	1321 – 762	1041.5

*SA, Shatt Al-Arab; EP, Earthen ponds; FC, Floating cages; FI, Import.

Table (2) demonstrates the biochemical composition of fresh and refrigerated common carp. The results showed differences in the percentage of moisture in the

muscular tissue of the studied fish. Thehighest moisture contentof fresh fishwas 78.2% in SA carp sample, while the lowest level was 70.8 % in FC carp. On the other hand, the highestmoisturelevel of iced fish was 79.4%in FI carp and the lowest moisture content was 74.1% in FC carp.The results of the statistical analysis showed no significant differences ($P > 0.05$) in the moisture contents between fresh and iced SA fish, , iced EP fish and iced FC fish, and there were no significant differences between fresh and iced EP and FC fish. However,statistical analysis showed significant differences ($P < 0.05$) between fresh Ep and FC fish with fresh and icedSA and FI fish.

Table 2. The biochemical composition of fresh and iced common carp *C. carpio* from different sources.

Fish source*	Sample	Biochemical composition (% wet weight)			
		Moisture	Fat	Protein	Ash
SA	Fresh	^{a}78.2	^{a}3.43	^{a}16.89	^{a}1.44
	Iced	^{a}79.21	^{a}3.17	^{a}16.35	^{a}1.30
EP	Fresh	^{b}71.7	^{b}7.31	^{a}18.71	^{b}2.29
	Iced	^{ab}75.5	^{b}6.20	^{a}16.96	^{a}1.45
FC	Fresh	^{b}70.8	^{c}11.30	^{a}15.98	^{ab}1.98
	Iced	^{ab}74.1	^{bc}9.60	^{a}15.49	^{a}1.39
FI	Fresh	^{a}77.7	^{c}11.90	^{b}10.05	^{c}0.98
	Iced	^{a}79.4	^{bc}9.99	^{b}9.98	^{c}0.78

*SA, Shatt Al-Arab; EP, Earthen ponds; FC, Floating cages; FI, Fresh import.
Values in the same column which carry different superscripts are significantly different at $P \leq 0.05$.

As indicated in table (2), there wereobvious differences in fat content of the muscular tissue of the studied fish. The fresh FI carp had the highest level among fresh samples at 11.9% while the lowest level was recorded in fresh SA carp with 3.43%. In iced samples, the highest level was measured in FI fish with 9.99% and the lowest level was 3.17%recorded in SA fish. The statistical analysis showed that the fat content in fresh and iced SA fish was significantly ($P \leq 0.05$) lower than that in the rest of fish samples. On the other hand, fat content in EP fish was in line with that in FC and iced FI carp, significantly different between FC and fresh FI while there were no significant differences between EP and fresh FI carp.

From the results in table (2) protein contents in the common carp from the various sources and the difference between them could be observed. The highest protein level in fresh fish was 18.71% in EP carp while the lowest level was recorded in FI carp at 10.05%. The statistical analysis showed that the percentage of protein in fresh fish from SA, EP and FC was significantly ($P \leq 0.05$) higher than it in FI carp. The statistical analysis indicated also that the protein contents in fresh and iced FI fish were significantly($P \leq 0.05$)lower than its counterparts in other fish samples

As for ash content, the results showed some minor differences in the muscular tissue of common carp from various sources. Ash contents of fresh fish was higher in EP fish which reached 2.29% while the lowest level was recorded in FI fish at 0.98%. In contrary, for iced samples, the highest content of ash was measured in EP fish at 1.45 and the lowest level was 0.78% in FI fish. The statistical analysis showed no significant (P 0.05) differences in the ash contents among the fresh and iced SA fish, iced FC fish and iced EP fish, but thelevelswas significantly higher than in the rest of fish samples. In addition, the statistical analysis showed significant differences in the contents of ash for fresh and iced FI fish with the rest of fish samples and significant differences also between fresh EP fish and the rest of the fish. However, the rest of examined fish samples showed no significant difference in ash contents as shown in table 2.

Table 3. The caloric value of fresh and iced common carp *C. carpio* fromdifferent sources.

Fish source*	Caloric value (Kcal/ 100 g meat)	
	Fresh	Iced
SA	^{a}98.5	^{a}93.9
EP	^{b}140.63	^{ab}123.65
FC	^{bc}165.62	^{b}148.36
FI	^{b}147.30	^{ab}129.83

*SA, Shatt Al-Arab; EP, Earthen ponds; FC, Floating cages; FI, Fresh import.
Values in the same column which carry different superscripts are significantly different at $P \leq 0.05$.

For the caloric value, Table 3 show evident differences between fresh and iced carp samples. The highest value was in fresh FC fish at 165.62 kcal / 100 g and the lowest in SA carp 98.5 kcal / 100 g. In iced fish the highest value was 148.4 kcal / 100 gin FC fish and the lowest value in SA carp 93.9 kcal / 100 g.The statistical analysis of

caloric values of fresh and iced SA sampleswere significantly lower than the rest of the samples except for iced EP and FI fish. However, no significant differences was detected between EP sample, iced FC sample and FI sample D. Additionally, the statistical analysis showed significant differences between fresh FC sample andSA sample and no significant differences with the rest of the samples.

DISCUSSION

The results of the current study showed some obvious variations in fish weights at approximate lengths. Thiscould be ascribed to the different composition and quantity of food available for feeding thecommon carp from the four studied environments with different locomotive activity of fish as well as natural food availability and composition in various culture systems which [12]. The natural food is a substantial part of fish food because it represent a cheap and healthy source for some vital nutrients like protein and vitamins[13]. The different protein sources in artificial fish feeds which is mostly depend on fish meal or soybean meal could participate in this variation because of the recognized differences in amino acid composition[14, 15]. For this reason, some feed additives or supplements contain free amino acid like methionine which has a direct impact on fish healthy growth and protein biosynthesis[16-18].

The biochemical composition of fish meat could be affected by many intrinsic and extrinsic factors. The first group include age, sex and size which related many to the different ratios of viscera, muscles and bones in fish body. The other group include the environmental factors mainly water temperature which regulate the rate of fish growth. Food composition is another factor which could governs the biochemical composition of fish meat especially under cultivation. This is reflected mainly on the compositional differences between wild-caught and cultured fish[19. 20].

The moisture content in fish meat varied slightly to widely between fish from the four different sources. The higher moisture contents in iced SA and FI fish in comparison with cultured EP and FC fish agree well with many previous studies on the common carp[25- 29] or other Iraqi freshwater fishes[30- 32].As indicated by [33], the lower moisture contents in culture fish may be related to the higher fat content in their bodies. Other studies[34, 35] confirmed the inverse relationship

between moisture and fat contents in fish and pointed out that deprivation of one volume of water could be compensated by three volumes of fat in fish body.

Fat contents demonstrated someobvious variation in the meat of fish from the four different studied sources. Wild SA fish showed a strongly clear decrease in fat content in comparison with cultured fish from the other three sources. It is well known that the high carbohydrate content in artificial fish feeds which is used widely in carp cultivation systems for economic reasons contribute primarily in elevating fat content of fish meat.The values of fat content which recorded in the current study is very close to those recorded previously in the common carp from different sources[21, 22, 24, 25, 28] as well as studies carried out on other wild or cultured freshwater fish[30-32]. However, it is noteworthy that some minor differences between the various studies in fat measurements could be ascribed to the different solvents used for fat extraction[41].

Protein is among the major nutrients which is essential for human feeding and it is more important than fat in determining the nutritional value of fish meat[42, 43]. The variation in protein content in studied fish from the four different sources is slight to clear and related also to moisture and fat contents in fish. The recorded values of protein content in the common carp from current study agree with many previous studies performed on the same species[21, 26-28] or other freshwater species some of which are from the same cyprinid family[30, 32]. Differences in protein content between wild and cultured fish relate mainly with feeding regimen and food composition in addition to some genetic factors. Storage conditions of fish meat could contribute to the variations in protein content after refrigeration because of the differences in protein degradation rates and nitrogen release due to fish meat decomposition especially with long storage periods[44-46].

Ash content, which reflects the mineral composition of fish meat, is relay on the general body metabolism and feeding [36]. Some internal factors like age, sex and nutritional status as well as external factors like environmental conditions especially mineral content of water, could play vital roles in determining body ash content and homeostasis in fish [19, 37]. The ash content in the current study varied significantly ($P \leq 0.05$) between the examined fish. In addition to the above mentioned factors, the physiological status of fish and storage conditions could have an indirect effect by altering moisture or fat content as indicated by [38, 39]. The results of the current

study agree with previous studies on the wild and cultured common carp [21-24, 26-29] and studies on other Iraqi freshwater fishes [31, 40].

The caloric values represents one of the most important parameter for the evaluation of the nutritional value of food. It reflects the caloric content of the three major energy-containing nutrients i.e. fat, protein and carbohydrates[46]. In the present study, fresh FC and FI fish showed the higher caloric value and this may be attributed to the higher levels of fat which is the major contributor with a caloric value of 0.09 Kcal for oxidation of one gram in comparison to 0.04 Kcal for protein oxidation[46, 47]. The current results agree well with previous studies on the caloric value of some cyprinid and non-cyprinid fish from Iraqi freshwaters[46-48].

In conclusion, wild common carp from Shatt Al-Arab river proved to be superior in the biochemical composition and caloric value in comparison with pond or cage cultured fish and imported carp.

دراسة مقارنه للتركيب الكيموحيوي لاسماك الكارب الشائع *Cyprinus carpio* L. من المياه الطبيعيه والمستزرعه والمستورده في محافظة البصره، العراق

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الخلاصة

بحثت الدراسة الحالية في مقارنة التركيب البايوكيميائي لأسماك الكارب الشائع *Cyprinus carpio* L. التي جمعت من أربع مصادر مختلفة في مدينة البصرة هي شط العرب في ابي الخصيب باستخدام الشباك الخيشومية والاحواض الترابية في موقع جامعة البصرة والاقفاص السمكية في منطقة الهارثة والاسماك المبردة المستوردة من جمهورية ايران الاسلامية. اختيرت ٥٠ سمكة من كل مصدر للتحليل، خزن نصفها في الثلج لمدة وصلت الى ١٠ ايام.

أوضحت النتائج ان اعلى محتوى للرطوبة كان ٧٨.٢% في النسيج العضلي لأسماك شط العرب. وسجل اعلى محتوى للدهن ١١.٩% في الاسماك المستوردة وقيس اعلى محتوى للبروتين ١٨.٧% واعلى محتوى للرماد ٢.٢٩% في اسماك الاحواض الطازجة. وظهر تفاوت في القيمة السعرية للأسماك المفحوصة بين الاسماك الطازجة والمبردة حيث بلغت اعلى قيمة ١٦٥.٦٢ كيلو سعرة/ ١٠٠ غرام والتي سجلت في اسماك الاقفاص الطازجة.

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