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Comparative organoleptic quality of Indian major carps collected from pond and reservoir

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Abstract

An attempt was made to distinguish the possible organoleptic differences between the pond reared and wild fish species of reservoirs and correlate these with the physicochemical characteristics of water bodies. The texture was found to firmer in wild varieties of fishes than pond reared fish, with best in *Catla catla* followed by *Labeo rohita* and *Cirrhinus mrigala*. All the cultured fishes had lighter colour than wild fish species which were darker in appearance. Comparatively, higher dissolved oxygen and transparency levels with low temperature and alkalinity levels were found in reservoirs. Hydrobiologically, the efficient ecosystem of reservoir was responsible for stronger texture and dark colouration in wild fish species. The fishes from reservoir exhibit tendency to lead active and agile life, comparatively the fishes from ponds are docile. Reservoirs have the potential of enhanced quality fish production.

Key words

Organoleptic quality, Major carp, Physico-chemical characterstics, Reservoirs, Texture

Introduction

In recent time there has been an ever increasing awareness about health food so that fish is finding more acceptances because of its special nutritional qualities. Fish is one of the most important sources of animal protein and has been widely accepted as an excellent source of high quality proteins, low in saturated fat, rich in vitamins, minerals and other elements for the maintenance of healthy body (Andrew, 2001).

Based on the consumer preferences by choice it is acclaimed that from culinary point of view the fish from natural wild stock are preferred over cultured fish (Verbeke *et al.,* 2007; Howaida and Ali, 2007). Capture from the open water bodies like reservoirs and culture in artificial ponds are the two major sources for getting fish. However, the productivity of wild fish from the reservoirs is very low in comparison to culture of fish in ponds and the average fish production from the reservoirs of Uttarakhand is estimated only about 25 kg ha^{-1} yr^{-1} (Gautam *et al*., 2004). Due to the superior quality of the wild fish, emphasis may be given to enhance the reservoir fishery.

However existing literature clearly indicates that significant organoleptic differences always occur when compare wild and cultured counterparts of the same species. Many studies in various species such as Australian snapper (Prescott and Bell, 1992), Channel cat fish, (Webster *et al.,* 1993), Chinook salmon (Sylvia *et al.,* 1995), Gilthead Sea bream (Grigorakis *et al.,* 2003), Red Sea bream (Mustafa *et al.,* 1995), Puffer fish (Saito and Kunisaki, 1998) has been done to compare the organoleptic differences between cultured and wild fish. Verbeke *et al.* (2007) and Howaida and Ali (2007) explored a strong organoleptic difference between wild and cultured fish.

The post mortem changes occurring in fish are very rapid due to aqueous habitat of fish. After the death fish undergoes many sensory, anatomical, physiological changes (Gopakumar, 2006). There are so many factors which influence the organoleptic characteristics of fish such as

chemical composition of the fish, environmental factors (temperature, salinity etc.) and feeding history (diet composition, feeding ratio etc.) (Huss, 1988; Grigorakis, 2007). There is a vast difference in the physicochemical characteristics of stagnant water body of pond and free flowing ecosystem of reservoir (Piska and Krishna, 2009).

However, there are so many references in the literature about the organoleptic difference between cultured and wild fish but no literature exists on the influence of physico-chemical parameters on the organoleptic properties particularly for the Indian major carps. Therefore, the objective of the study was to assess the differences in organoleptic properties of most preferred group of the consumer's liking, Indian major carps due to the differences in physicochemical characteristics of two types of water bodies ie. pond and reservoir.

Materials and Methods

Cultured Indian major carps were collected from the Instructional Fish Farm, College of Fisheries, Pantnagar (29^0N latitude, 79.3^0E longitude at an altitude of 243.8 meters) and wild fish of same species were procured from the Dhra reservoir ($28^0$53' N latitude and $79^0$40' E longitude) and Baigul reservoir ($28^0$56' N latitude and $79^0$40' E longitude) of Udhamsingh Nagar district in Uttarakhand state. The wild and cultured fish species viz. *Catla catla, Labeo rohita* and *Cirrhinus mrigala* were procured at same time and similar size having weight of 350-450g and length 28-32 cm were subjected to storing at room temperature of 35^0 C for the 6 hr duration (The time of setting in of rigor mortis). Sensory methods were used to assess the degree of freshness based on organoleptic characteristics such as body colour appearance (light/dark and shiny/dull), nature of skin (moist/dry, slime present/absent), texture (assessing by thumb impression), eye nature and position (protruded/ sunken, shiny/hemorrhage), colour of gills (red, light red, brown, pale, yellow) etc. (Kamal, 2000). The organoleptic characteristics were judged by a trained panel of expert members during the storage period. The grading of fish using score on the characteristics has been followed by multilingual Guide to EC Freshness Grades for Fishery Products (Howgate *et al.*, 1992) with slight modification to judge the quality of the fish. Observation was taken on monthly basis during June 2008 to March 2009 and each sample was analysed for the each hr (0-6 hr) up to six hr of storage period at room temperature. There was not any standard method for observing these parameters and was performed simply by apparent examinations.

Physico-chemical parameters of pond and reservoir water were analyzed throughout the study period from June 2008 to March 2009. Temperature was measured with the help of a mercury thermometer having range of 0–50°C, with mark up to 0.1°C. pH of the water sample was determined electrometrically with the help of pH meter. The dissolved oxygen, free carbon dioxide and Alkalinity were analyzed according to the APHA, (2005). The water transparency was measured by a Secchi disc of 20 cm diameter (Adoni *et al.,* 1985**)**.

Results and Discussion

The texture of freshly procured cultured and wild specimen were found firm during the initial 1st hr however there was impairment in quality of the texture as it became softer with the passage of storing time, in both the varieties of fishes. The texture of *Catla catla* was found to be firm and best followed by *Labeo rohita* and softer in case of *Cirrhinus mrigala* by the end of 6 hr duration among both cultured and wild varieties of fishes. Comparatively by the end of 6 hr all wild varieties of Indian Major Carps had firmer texture than their cultured counterparts. The obtained results most prominently indicate that the texture was found to be firmer in wild varieties of fishes than cultured, with best in *Catla catla* followed by *Labeo rohita* and *Cirrhinus mrigala*. The texture of wild fishes therefore was found to be better than cultured varieties and did not sustain any kind of impairment during the storage duration of 6 hr at room temperature (Table 1-3). Similar results of firm texture in wild fish than cultured ones were also observed in Australian snapper , Channel cat fish, Chinook Salmon and Gilthead bream by Prescott and Bell (1992), Webster *et al*. (1993) , Sylvia *et al*. (1995) and Grigorakis *et al*. (2003) respectively.

All the cultured fishes had lighter colour than wild fish species which were darker in appearance**.** Similar observation was also reported in other fish species by Mohr (1986), Karahadian and Fowler (1991), Howaida and Ali (2007). The colour in cultured fishes became dull during the 3rd hr of storage while the wild fishes appeared to be dull from the 2nd hr of storage itself. The moistness and slime (state of skin) in cultured specimen persisted upto 2nd hr before becoming dry during the 3rd hr while the skin of wild varieties started drying from 2nd hr and the persistence of complete dryness from 3rd to last 6 hr of storage. These observations are in the conformity of Meenakshi *et al.* (2010). The impression of darker colour in wild varieties of fishes might be related to the higher proportion of dark muscle in them comparatively to the cultured fishes which have shiny white appearance (Howaida and Ali, 2007).

The maintenance of red colour of gills is the indication of freshness and best quality (Gopakumar, 2006). In the initial 2 hr the colour of gills was red in both the varieties of fishes. However, the colour of gills started becoming light red to brown and light red at the beginning of 3rd hr and persisted with it till last in cultured varieties of fishes. The colour of gills remained red all through the duration of 6 hr for wild variety of fishes.

Table 1 : Organoleptic evaluation of *Labeo rohita* collected from pond and reservoir at room temperature

Organoleptic characters		Hours				
		1	2	3	4	5 and 6
Texture	Pond	Firm	Less firm flexible	Less firm and	Slight soft	Slight soft
	Reservoir	Very firm	Very firm	firm	Firm	Less firm
Colour	Pond	Light, shiny	Slight dull	Dull	Dull	Dull
	Reservoir	Dark, shiny	Dull	Dull	Dull	Dull
State of Skin	Pond	Moist, slime present	Slime present	Dry	Dry	Dry
	Reservoir	Moist, slime present	Dryness start	Dry more	Dry	Dry
Gill's Colour	Pond	Red	Red	Brown	Brown	Brown
	Reservoir	Red	Red	Red	Red	Red
Eye	Pond	Protruded, shiny	Protruded, shining with hemorrhage	Protruded with hemorrhage	Slightly sunken with hemorrhage	Slightly sunken with hemorrhage
	Reservoir	Sunken, shiny	Sunken, hemorrhage	Sunken with hemorrhage	Sunken with hemorrhage	Sunken into the cavity
Overall acceptibility	Pond	Good	Good	Not so good	Not good	Not good
	Reservoir	Excellent	Excellent	Good	Good	Good

*Values represented in the table are average value from month June 2008 to March 2009

Table 2 : Organoleptic evaluation of *Catla catla* collected from pond and reservoir at room temperature

Organoleptic characters		Hours				
		1	2	3	4	5 and 6
Texture	Pond	Very firm	Less firm	Less firm and flexible	Less firm	Less firm
	Reservoir	Very firm	Very firm	Very firm	Firm	Firm
Colour	Pond	Light, shiny	Slight dull	Dull	Dull	Dull
	Reservoir	Dark, shiny	Dull	Dull	Dull	Dull
State of Skin	Pond	Moist, slime present	slime present	Dry	Dry	Dry
	Reservoir	Moist, slime present	Dryness start	Dry more	Dry	Dry
Gill's Colour	Pond	Red	Red	Light red	Light red	Light red
	Reservoir	Red	Red	Red	Red	Red
Eye	Pond	Protruded, shiny	Protruded, shining with hemorrhage	Protruded with hemorrhage	Slightly sunken with hemorrhage	Slightly sunken with hemorrhage
	Reservoir	Sunken, shiny	Sunken, hemorrhage	Sunken with hemorrhage	Sunken with hemorrhage	Sunken into the cavity
Overall acceptibility	Pond	Excellent	Good	Not so good	Not so good	Not good
	Reservoir	Excellent	Excellent	Excellent	Good	Good

*Values represented in the table are average value from month June 2008 to March 2009

The eyes were found to be protruded (convex) and shiny in cultured fishes and sunken and shiny in wild varieties during the initial storage duration of 1 hr. The eyes remained protruded in cultured varieties till the end of 3rd hr but indicated blood hemorrhage from 2nd hr onwards. The eyes in wild fishes were completely sunken into the cavity from 1st hr onwards and the insistence of hemorrhage from 2nd hr itself. According to Gopakumar (2006) convex (bulging or protruded) eye is the measure of freshness of fish. In our observation, sunkenness in eyes in wild fishes right from the beginning might have been due to the stress condition they have sustained during their transit shift in live condition

Table 3 : Organoleptic evaluation of *Cirrhinus mrigala* collected from pond and reservoir at room temperature

Organoleptic characters		Hours				
		1	2	3	4	5 and 6
Texture	Pond	Firm	Less firm	Less firm and flexible	soft	Soft
	Reservoir	Firm	firm	firm	Less firm and flexible	Slight soft
Colour	Pond	Light, shiny	Slight dull	Dull	Dull	Dull
	Reservoir	Dark, shiny	Dull	Dull	Dull	Dull
State of Skin	Pond	Moist, slime present	Slime present	Dry	Dry	Dry
	Reservoir	Moist, slime present	Dryness start	Dry more	Dry	Dry
Gill's Colour	Pond	Red	Red	Light red	Light red	Light red
	Reservoir	Red	Red	Red	Red	Red
Eye	Pond	Protruded, shiny	Protruded, shining with hemorrhage	Protruded with hemorrhage	Slightly sunken with hemorrhage	Slightly sunken with hemorrhage
	Reservoir	Sunken, shiny	Sunken, hemorrhage	Sunken with hemorrhage	Sunken with hemorrhage	Sunken into the cavity
Overall acceptibility	Pond	Good	Not so good	Not so good	Bad	Bad
	Reservoir	Excellent	Good	Good	Not so good	Not so good

*Values represented in the table are average value from month June 2008 to March 2009

Table 4 : Comparative water quality parameters of pond and reservoir

Month	Temperature (°C)		pH		Dissolved O_2 (mgl^{-1})		Alkalinity (mgl^{-1})		Transparency (cm)	
	Pond	Reservoir	Pond	Reservoir	Pond	Reservoir	Pond	Reservoir	Pond	Reservoir
June'08	31.0±0.91	30.3±0.86	7.0±0.35	7.8±0.56	8.0±0.12	8.5±1.06	133±14.3	110±125	38±2.02	55±2.5
July'08	30.5±1.29	28.6±0.90	7.5±0.22	6.4±0.43	7.5±0.18	8.0±0.50	154±12.5	92±8.5	39±1.55	50±1.03
Aug'08	29.0±0.82	27.0±1.22	6.5±0.45	7.2±0.23	7.3±0.24	7.3±0.96	140±6.22	110±102	37.5±4.5	62±3.44
Sept'08	28.3±0.75	26.6±0.98	8.3±0.33	7.5±0.18	6.8±0.34	7.9±0.32	137±3.43	96±4.67	40±3.33	105±30.3
Oct'08	26.0±1.35	25.5±1.28	7.3±0.30	7.0±0.32	6.4±0.51	5.8±2.15	150±15.5	114±132	42±2.05	90±11.0
Nov'08	23.2±0.65	21.3±0.95	7.2±0.48	7.7±0.45	7.2±0.23	6.9±0.18	130±4.03	130±1.55	39±1.55	120±42.56
Dec'08	20.5±0.85	15.0±0.77	7.7±0.53	6.5±0.19	7.0±0.30	6.8±1.22	110±3.22	146±6.7	41±4.55	135±12.5
Jan'09	18.0±0.90	16.5±1.25	8.0±0.27	7.9±0.43	7.3±0.43	8.0±1.06	135±8.04	90±9.8	42±5.15	98±14.9
Feb'09	20.5±0.75	17.6±0.89	7.2±0.35	7.0±0.37	7.3±0.28	8.0±1.52	143±2.5	98±11.3	40±2.3	90±9.0
Mar'09	25.7±1.25	22.3±0.95	7.3±0.34	7.4±0.21	7.0±0.54	8.5±1.50	132±1.45	140±11.4	39±2.02	67±7.54
Average	25.3±1.22[a]	23.1±2.24[b]	7.4±0.50[a]	7.2±0.65[a]	7.2±1.34[b]	7.6±2.17[a]	136±.11.5[a]	113±13.6[b]	39.8±3.4[b]	87.2±13.4[a]

* Values are mean value of four observation of every month ±SD; *Average value of water quality with different superscript is significantly different at $p< 0.05$

from the site of reservoirs to the laboratory.

The fishes from reservoir exhibit tendency to lead active and agile life, whereas the fishes from ponds are docile. Comparatively lower water temperature (23.1±2.24ºC) and higher dissolved oxygen levels (7.6±2.17 mgl^{-1}) might be helpful to activate free and high swimming motion in fish in the reservoir. The stimulating active behaviour of fish in reservoir needs to have stronger texture of body muscles. The finding in this research fully agrees with the results of Venugopal and Shahidi (1996), who described that the stronger texture and darker body muscle help for continuous swimming action in wild fish species from reservoir and white muscles of pond cultured fishes help in rapid energy bursts. It is therefore that the fishes from the reservoir have firm body texture and darker body muscles as compared to pond cultured fishes which are white in appearance.

The measurements of physico-chemical parameters reveal that the average temperature in pond (25.3±1.22ºC) remains higher than the reservoirs (23.1±2.24ºC). Wellborn and Robinson (1996) found the temperature of reservoir

7.2ºC warmer than pond. Being a smaller and shallower water body the effect of temperature was more prominent in ponds than the reservoir. There was no evidence of seasonal difference in pH values of pond and reservoir. However the water from pond indicated slight inclination towards alkaline pH, owing to application of feed for fishes. The results of dissolved oxygen clearly indicated higher values for reservoir (7.6±2.17 mg l^{-1}) than ponds (7.2±1.34 mg l^{-1}) owing efficient flowing system, perfect upwelling and intensive mixing. The average value of alkalinity was found to be more in ponds (136±11.5 mgl^{-1}) than reservoir (113±13.6 mg l^{-1}). The higher values of alkalinity may have been due to application of feed, nutrients and fertilizers in ponds. The reservoir accounted for significantly higher values of transparency due to lesser rate of sedimentation than ponds. The periodic data of different physic-chemical parameters reflected the significant difference at 5% level on ANOVA analysis between the pond and reservoir water. (Table 4).

High dissolved oxygen level with lower limits of alkalinity and high rate of transparency make the reservoir to be the excellent buffer medium for the flourishing of planktonic biomass and nutrients responsible for rapid growth of fishes (Sugunan, 1995). Nemaki *et al.* (2008) also indicated the impact of water characteristics on the quality of Tilapia fish.

The overall findings of the study reveal that the wild fish from the reservoirs possess superior organoleptic quality due to more favourable physico-chemical water quality parameters than the culture fish of the pond.

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