ISSN: 0975-833X

Available online at http://www.journalcra.com

INTERNATIONAL JOURNAL OF CURRENT RESEARCH

International Journal of Current Research
Vol. 5, pp.001-005, June, 2010

RESEARCH ARTICLE

COMPARATIVE STUDIES ON BIOCHEMICAL COMPOSITION AND ORGANOLEPTIC QUALITY OF INDIAN MAJOR CARPS REARED IN NEWLY DEVELOPED CHINA CLAY MINES: A BREAKTHROUGH

Basudev Mandal, Bidhan Chandra Patra and Bimal Kinkar Chand*

Department of Aquaculture Management and Technology, Vidyasagar University, Midnapore – 721 102, West Bengal, India

*Directorate of Research, Extension & Farm , West Bengal University of Animal & Fishery Sciences , 68, K.B. Sarani, Kolkata – 700 037, West Bengal, India

ARTICLE INFO

Article History:
Received 12th April, 2010
Received in revised from
17th May, 2010
Accepted 26th May, 2010
Published online 1st, June, 2010

Key words:
Protein,
Lipid,
Indian Major Carps,
Taste,
Organoleptic appearance.

ABSTRACT

The present studies have emphasizes on the correction of soil and water quality of china clay mines with the help of organic and inorganic fertilizer and become transfer to like a productive pond. After successful transformation of china clay mines like a productive one, fingerling stages of Indian major carps were released to the mine water and the growth performance was observed with minute care. At the initial stage, mortality rate was high and after acclimation it slowed down. Monthly variation of growth, biochemical composition and nutritional quality were estimated and recorded. After one year culture period the remaining experimental fishes were harvested by cast net and distributed among the local people for tasting the organoleptic quality. They could not find any deviation of taste in between fish reared in china clay mines and in general Indian major carps. Protein and lipid content of experimental fishes (Protein percentage of *Catla catla, Labeo rohita* and *Cirrhinus mrigala* was 11.55, 13.04 and 11.02 respectively and the lipid percentage was 4.59, 3.94 and 4.34 respectively) were slightly lower than the fish culture in highly productive pond (Protein percentage of *Catla catla, Labeo rohita* and *Cirrhinus mrigala* was 12.83, 14.47 and 11.86 respectively and the lipid percentage was 4.71, 4.23 and 4.52 respectively). There are various factors causing variation of protein and lipid in fish flesh. The factors like food, temperature, size or age, season, maturity, environment etc. are reported to have influencing effect on protein or lipid concentration in fishes. Therefore, moderate deviation of protein and lipid quality does not markedly vary the demand, taste as well as the market value of fish. Statistical analysis of experimental results reveled that the taste, flavour and biochemical composition are highly significant.

INTRODUCTION

The main components in the edible portion of fish are water, protein, lipid and ash i.e. minerals. The analysis of these four basic constituents of fish muscle is often referred to as proximate analysis (Love, 1970). Even though data on proximate composition are critical for many applications, investigations on these lines had been carried out as early as in the 1880's (Atwater, 1982; Miescher, 1987). Reliable data on proximate composition of most of the species of fish are difficult to obtain. Stansby in1979 had observed that proximate composition was considered to be such an elementary sort of thing that it did not receive due attention from scientists. The different environmental conditions such as temperature, salinity, water pressure, availability of food etc. have profound influence on the biochemical composition. There may be group specific or even species specific differences in the biochemical composition.

***Corresponding author:**
bdmandal@yahoo.co.in; basudevmondal@vidyasagar.ac.in

Fish and shellfish are the primary sources of animal protein and valuable in the diet because they provide a good quantity (usually 70 per cent or more) of protein of high biological value, particularly sulphur containing amino acids (Latham, 1997).

Fish is one of the most important sources of animal protein and has been widely accepted as a good source of protein and other elements for the maintenance of healthy body (Andrew, 2001). Nair and Suseela (2000) have reported that the proximate compositions of Indian fishes are: Water: 65 – 90%; Protein: 10 – 22%; Lipid: 01 – 20% and Minerals: 0.5–05%. They have also pointed out the proximate composition of Indian Major carps like *Catla catla*: water – 76.30%; protein - 19.60%; fat - 1.30% and ash 0.90%: *Labeo rohita*: water – 76.90%; protein 19.10%; fat – 0.20% and ash – 0.90% and *Cirrhinus mrigala*: water – 77.10%; protein - 19.00%; fat - 1.10% and ash – 1.40%. Water is present in two forms in the tissues: bound to the proteins and in the free

form. These forms have well defined biological roles. Quantitatively,

Table 1. Monthly changes of total muscle protein of Experimental fishes following their release (mg100g^{-1} muscle)

	Catla catla		Labeo rohita		Cirrhinus mrigala	
MONTHS	**EP**	**CP**	**EP**	**CP**	**EP**	**CP**
July	9.77 ± 0.25	9.81 ± 0.04	9.87 ± 0.06	10.31 ± 0.04	9.95 ± 0.25	10.16 ± 0.12
August	10.12 ± 0.02	10.41 ± 0.06	10.20 ± 0.09	10.71 ± 0.08	10.02 ± 0.15	10.24 ± 0.35
September	10.19 ± 0.09	10.59 ± 0.05	10.53 ± 0.07	11.32 ± 0.04	10.11 ± 0.29	10.47 ± 0.29
October	10.42 ± 0.11	10.81 ± 0.09	10.92 ± 0.16	11.84 ± 0.22	10.18 ± 0.45	10.65 ± 0.39
November	10.57 ± 0.23	10.98 ± 0.12	11.21 ± 0.15	12.53 ± 0.41	10.27 ± 0.61	10.81 ± 0.49
December	10.86 ± 0.06	11.64 ± 0.31	11.63 ± 0.56	12.95 ± 0.35	10.38 ± 0.67	10.98 ± 0.67
January	10.95 ± 0.41	11.73 ± 0.06	11.82 ± 0.88	13.37 ± 0.46	10.47 ± 0.37	11.12 ± 0.59
February	11.04 ± 0.22	11.84 ± 0.08	12.27 ± 0.29	13.62 ± 0.38	10.52 ± 0.68	11.29 ± 0.69
March	11.29 ± 0.06	12.43 ± 0.25	12.67 ± 0.47	13.95 ± 0.45	10.74 ± 0.69	11.42 ± 0.68
April	11.37 ± 0.33	12.67 ± 0.22	12.93 ± 0.37	14.27 ± 0.61	10.92 ± 0.58	11.67 ± 0.84
May	11.55 ± 0.13	12.83 ± 0.16	13.04 ± 0.64	14.47 ± 0.53	11.02 ± 0.77	11.86 ± 0.94

(Mean ± Standard Error of Mean; Each data is mean of 5 separate determinations)

Table 2. Monthly changes of total muscle lipid of Experimental fishes following their release (mg100g^{-1} muscle)

	Catla catla		Labeo rohita		Cirrhinus mrigala	
MONTHS	**EP**	**CP**	**EP**	**CP**	**EP**	**CP**
July	1.31 * (0.01)	1.40 ± 0.02	1.38 ± 0.07	1.44 ± 0.05	1.40 ± 0.05	1.46 ± 0.08
August	1.42 ± 0.06	1.57 ± 0.06	1.46 ± 0.08	1.59 ± 0.09	1.56 ± 0.37	1.62 ± 0.11
September	1.59 ± 0.03	1.78 ± 0.05	1.62 ± 0.02	1.74 ± 0.06	1.72 ± 0.32	1.83 ± 0.25
October	1.91 ± 0.06	2.04 ± 0.06	1.83 ± 0.26	1.96 ± 0.11	1.98 ± 0.61	2.13 ± 0.38
November	2.13 ± 0.03	2.26 ± 0.03	2.03 ± 0.46	2.31 ± 0.17	2.27 ± 0.57	2.36 ± 0.59
December	2.31 ± 0.05	2.46 ± 0.04	2.41 ± 0.48	2.56 ± 0.15	2.52 ± 0.69	2.61 ± 0.48
January	2.54 ± 0.06	2.68 ± 0.06	2.67 ± 0.61	2.89 ± 0.25	2.86 ± 0.82	2.94 ± 0.68
February	2.92 ± 0.11	3.11 ± 0.01	2.97 ± 0.58	3.14 ± 0.08	3.16 ± 0.73	3.27 ± 0.60
March	3.32 ± 0.08	3.41 ± 0.04	3.37 ± 0.25	3.52 ± 0.78	3.54 ± 0.48	3.64 ± 0.82
April	3.79 ± 0.07	3.92 ± 0.12	3.68 ± 0.39	3.88 ± 0.81	4.16 ± 0.58	4.32 ± 0.67
May	4.59 ± 0.22	4.71 ± 0.06	3.94 ± 0.67	4.23 ± 0.28	4.34 ± 0.37	4.52 ± 0.28

(Values are Mean + Standard Error of Mean; Each data is mean of 5 separate determinations)

protein is the second major component in muscle tissues of fish. Amino acids are the building blocks of proteins. All the common amino acids are present in the fish tissues, but the proportion may vary from species to species.

MATERIALS AND METHODS

At the outset of the experiment, the 'Khadan' water was immensely turbid and unable to survive any kind of aquatic organisms. So this unsuitable water was transformed to a productive one by periodical application of organic and inorganic manures. After standardization of 'Khadan' water the fingerling stage of *Catla catla, Labeo rohita* and *Cirrhinus mrigala* was released and recorded by the different parameters like growth, percentage of protein and lipid etc. in every month. Organoleptic quality assessment of experimental fishes was done through the preparation of some questionnaires like appearance, taste, texture, flavour of fish etc. Protein was estimated according to the methods of Lowry *et al.* (1951) using

Folin Phenol reagent. Different kinds of fish were sampled and sacrificed at every 30 days' interval for growth trial and protein estimation for each of the experimental trial. Lipid of fish muscle was estimated following the method of Folch *et al.* (1957) using chloroform methanol mixture (1:1). Lipid was estimated on every 30 days' interval from 0.2 g of fish muscle. Methods used for amino acid analysis are usually based on a chromatographic separation of the amino acids present in the test sample. Current techniques take advantage of the automated chromatographic instrumentation designed for analytical methodologies. The commonly used instruments are high-pressure liquid chromatography (HPLC).

RESULTS AND DISCUSSION

Discussion of our present work is fully based on the analysis of questionnaires, final results of different experiments and statistical analysis. Results of different questionnaires relating to taste of organoleptic quality are satisfactory. They could not find any deviation of quality between experimental fish flesh and general freshwater Indian major carps (IMC). On the basis of the results from protein estimation (Table-1), it has been found that there is a disparity in protein content or fatness in different months of the year and seasons. From this experiment it has been found that in *Catla catla* protein content at the time of release of fry in control pond was 9.81% and in china clay 'Khadan'(Experimental Pond) 9.77%. This value increased gradually up to the level of 12.83 % in Control Pond (CP) and 11.%5 % in Experimental Pond (EP). In the experimental trial, initial muscle protein value of *Labeo rohita* in Control Pond (CP) was 10.31% and in Experimental 'Khadan' (EP) it was 9.87%. At the time of harvesting of experimental fishes this muscle protein concentration increased up to a level of 14.47 in CP and 13.04 in EP. Monthly changes of muscle protein of *Cirrhinus mrigala,* following their release into experimental pond were recorded regularly and at initial stage it was 10.16% in CP and 9.95% in EP, but after culture operation it reached the highest concentration of 11.86% in Control Pond and 11.02% in experimental mines.

Table 3. Amino acid composition of the experimental fish muscle proteins (g/100g protein)

	Catla catla		Labeo rohita		Cirrhinus mrigala	
Name of the amino acid	EP	CP	EP	CP	EP	CP
Aspertic acid	10.09	10.28	9.26	9.42	10.16	10.31
Threonine	5.29	5.83	4.47	4.82	3.94	4.12
Serine	3.18	3.62	3.19	3.41	3.68	3.91
Glutamic acid	17.24	17.76	12.94	13.11	14.06	14.27
Proline	1.72	2.04	4.08	4.26	2.58	2.74
Glycine	9.20	9.49	3.71	3.88	3.71	3.88
Alanine	5.18	5.77	6.40	6.52	5.83	5.92
Valine	6.12	6.46	4.26	4.31	4.86	4.94
Cystine	0.92	1.13	2.02	2.13	1.21	1.33
Methionine	2.03	2.24	2.04	2.23	2.40	2.53
Isoleucine	4.17	4.45	5.64	5.72	4.15	4.26
Leucine	9.08	9.33	8.22	8.35	7.74	7.91
Tyrosine	4.14	4.51	3.14	3.31	3.04	3.11
Phenyl alanine	3.41	3.58	3.68	3.91	3.71	3.82
Histidine	5.19	5.33	6.14	6.22	2.77	3.16
Lysine	8.13	8.49	12.16	12.37	13.08	13.26
Arginine	5.62	5.96	3.52	3.74	5.38	5.51
Tryptophan	1.06	1.27	1.25	1.33	0.97	1.12

Each data is a mean of 5 separate determinations

From this investigation, it can be observed that muscle protein content of *Labeo rohita* is higher than *Catla catla* and *Cirrhinus mrigala*. From this investigation muscle lipid of *Catla catla* at the time of release in Control Pond was 1.40% and in Experimental Pond i.e. china clay 'Khadan' it was 1.31%. Through the passage of time it was increased gradually and finally reached the value of 4.71% in Control Pond and in experimental 'Khadan' it was 4.59%. Muscle lipid content of *Labeo rohita* in experimental trial at the time of release in Control Pond as well as experimental 'Khadan' is very low i.e. 1.44% and 1.38%, but with growth increment it was increased gradually up to the level of 4.23% in Control Pond and 3.94% in experimental china clay mines. Muscle lipid content of *Cirrhinus mrigala* in experimental trials in Control Pond at the initial stage it was 1.46% and experimental 'Khadan' was 1.40%. Through the passage of time the lipid content in muscle increases gradually and reaches the highest concentration like 4.52% in Control Pond and 4.71% in experimental china clay mines. Table 3 shows the variation of amino acid composition in fish muscle. Similar trends were observed in case of amino acid increment i.e. all amino acid content in the fish muscle of Control Pond is higher as compared to Experimental Pond. Table-4 represents the statistical analysis of various experimental data. Correlation of muscle protein, lipid and amino acid composition of experimental china clay mines are significant at the 0.01 level (2-tailed). Fig: 1 & 2 indicate the variation of protein and lipid increment in between general Indian major carps and experimental fishes cultured in china clay mines. There is no marked deviation of protein and lipid composition among experimental fishes. The related work has been studied by Mandal *et.al.* in 2006, 2008 and 2009.

The off-flavour of fresh water fish growing under various water qualities and nutrition treatments was reported by Meyers (1975) with particular reference to consumer acceptance and a standard allowing the identification of the producer with other than conventional individual characteristics such as flavour, taste and appearance. In general, the biochemical composition of the whole body indicates the fish quality. Therefore, proximate biochemical composition of a species helps to assess its nutritional and edible value in terms of energy units compared to other species. Variation of biochemical composition of fish flesh may also occur within same species depending upon the fishing ground, fishing season, age and sex of the individual and reproductive status. The spawning cycle and food supply are the main factors responsible for this variation (Love *et al.*, 1980). An increasing amount of evidences suggest that due to its high content of polyunsaturated fatty acid fish flesh and fish oil are beneficial in reducing the serum cholesterol (Stansby, 1985). In addition to that, the special type of fatty acid, omega-3 polyunsaturated fatty acid, is recognized as an important drug to prevent a number of coronary heart diseases (Edirisinghe, 2006). It is recommended by cardiologists to use generous quantities of fish in food to obtain adequate protein without taking in excessive fatty acids and lipids (Kinsella, 1991).

Correlation of muscle proteins

Correlations

		VAR00009	VAR00010	VAR00011		VAR00012	VAR00013
		VAR00014					
Pearson Correlation	VAR00009	1.000	1.000	.827	.829	.856	.858
	VAR00010	1.000	1.000	.827	.830	.858	.860
	VAR00011	.827	.827	1.000	1.000	.951	.954
	VAR00012	.829	.830	1.000	1.000	.953	.956
	VAR00013	.856	.858	.951	.953	1.000	1.000
	VAR00014	.858	.860	.954	.956	1.000	1.000
Sig. (2-tailed)	VAR00009	.	.000	.000	.000	.000	.000
	VAR00010	.000	.	.000	.000	.000	.000
	VAR00011	.000	.000	.	.000	.000	.000
	VAR00012	.000	.000	.000	.	.000	.000
	VAR00013	.000	.000	.000	.000	.	.000
	VAR00014	.000	.000	.000	.000	.000	.
N	VAR00009	18	18	18	18	18	18
	VAR00010	18	18	18	18	18	18
	VAR00011	18	18	18	18	18	18
	VAR00012	18	18	18	18	18	18
	VAR00013	18	18	18	18	18	18
	VAR00014	18	18	18	18	18	18

**Correlation is significant at the 0.01 level (2-tailed).

Correlation of muscle lipid

Correlations

		VAR00005	VAR00006	VAR00003		VAR00004	VAR00001
		VAR00002					
Pearson Correlation	VAR00005	1.000	1.000	.997	.998	.988	.988
	VAR00006	1.000	1.000	.996	.996	.989	.990
	VAR00003	.997	.996	1.000	.998	.984	.984
	VAR00004	.998	.996	.998	1.000	.987	.988
	VAR00001	.988	.989	.984	.987	1.000	1.000
	VAR00002	.988	.990	.984	.988	1.000	1.000
Sig. (2-tailed)	VAR00005	.	.000	.000	.000	.000	.000
	VAR00006	.000	.	.000	.000	.000	.000
	VAR00003	.000	.000	.	.000	.000	.000
	VAR00004	.000	.000	.000	.	.000	.000
	VAR00001	.000	.000	.000	.000	.	.000
	VAR00002	.000	.000	.000	.000	.000	.
N	VAR00005	11	11	11	11	11	11
	VAR00006	11	11	11	11	11	11
	VAR00003	11	11	11	11	11	11

**Correlation is significant at the 0.01 level (2-tailed).

Amino acid Correlation

Correlations

		VAR00009	VAR00010	VAR00011		VAR00012	VAR00013
		VAR00014					
Pearson Correlation	VAR00009	1.000	1.000	.827	.829	.856	.858
	VAR00010	1.000	1.000	.827	.830	.858	.860
	VAR00011	.827	.827	1.000	1.000	.951	.954
	VAR00012	.829	.830	1.000	1.000	.953	.956
	VAR00013	.856	.858	.951	.953	1.000	1.000
	VAR00014	.858	.860	.954	.956	1.000	1.000
Sig. (2-tailed)	VAR00009	.	.000	.000	.000	.000	.000
	VAR00010	.000	.	.000	.000	.000	.000
	VAR00011	.000	.000	.	.000	.000	.000
	VAR00012	.000	.000	.000	.	.000	.000
	VAR00013	.000	.000	.000	.000	.	.000
	VAR00014	.000	.000	.000	.000	.000	.
N	VAR00009	18	18	18	18	18	18
	VAR00010	18	18	18	18	18	18
	VAR00011	18	18	18	18	18	18
	VAR00012	18	18	18	18	18	18
	VAR00013	18	18	18	18	18	18

**Correlation is significant at the 0.01 level (2-tailed).

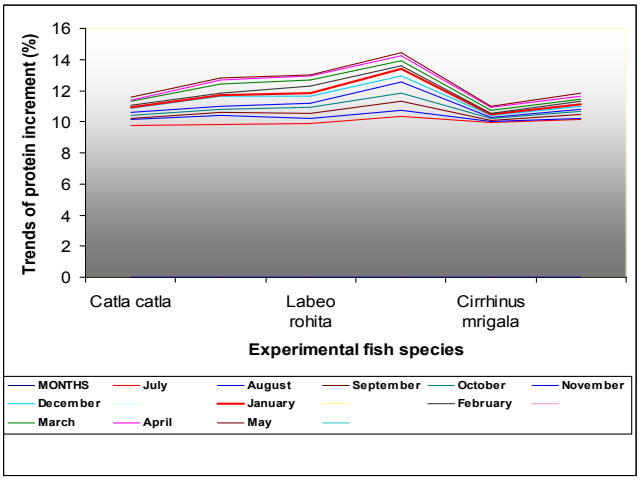

Fig. 1. Level of muscle protein increment

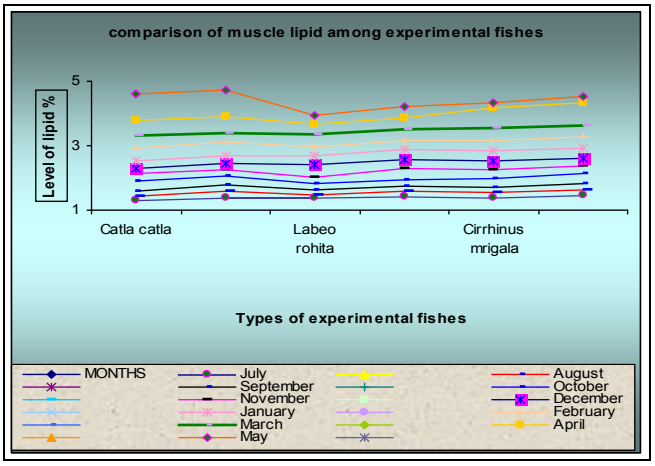

Fig.2. Level of muscle lipid increment

ACKNOWLEDGEMENT

We are indebted to the Department of Science & Technology and Non-conventional Energy Sources, Government of West Bengal for extending their support by providing sufficient fund to carry out the experimental work.

REFERENCES

Andrew, A.E. 2001. Fish Processing Technology. University of IIorin press, Nigeria.pp.7-8.

Atwater,W. O. 1982. U.S. Fish Commissioners Report 1888, pp.679 .

Edirisinghe, J.P. 2006. Rice Fields:An ecosystem rich in Biodiversity. Journal of the National Science Foundation of Sri Lanka 34, 57 -59.

Folch, T., Lee, M. and Stanley, G.H. 1957. A simple method for the isolation and purification of total lipids from animal tissues. J. Biol. Chem., 226: 497-509.

Kinesella, J.E. 1991. Effect of emulsion droplets on the rheology of whey protein isolate gells. Journal of Texture Studies. 24(4): 411- 422.

Latham, M.C. 1997. Human Nutrition in the Developing World. Report of FAO (Food and Agricultural Organization). pp. 508.

Love, R.M. 1970. Chemical Biology of Fish. Academic Press London, pp. 260.

Love, W.G., Nakayama, K. and Franey, M.A. 1980. Isovector couplings for nucleon charge-exchange reactions at intermediate energies. Journal of Phys. Rev.Lett. 59 (13): 1401-1404.

Lowry, O. H., Rosebrough, N. J., Farr, A. L. and Randall, R. J. 1951. Protein measurement with the folin-phenol reagents. J. Biol. Chem., 193, 265 – 275.

Mandal, B., Bandyopadhyay, P., Sarkar, B., Tewary, A., Patra, S., Maity, J. and Patra, B.C. 2006. Aquacultural possibility and Economic viability in the pits of china clay mines of West Bengal, India: A Breakthrough. Proceedings of the Sixth Indian Fisheries Forum. Published by AFSIB, Mangalore and IFA, Mumbai, India: pp.19-33.

Mandal, B., Patra, B. C. and Chand B. K. 2008. Possibilities of sustainable aquaculture practice in abandoned china clay mines of West Bengal, India. Research Journal of Fisheries and Hydrobiology (INSInet Publication), 3(2): 36-40.

Mandal, B., Patra, B. C. and Chand B. K. 2009. Restoration of soil and water quality of abandoned china clay mines of West Bengal for fish production. Proceedings of the International Conference. Published by Agriculture and Food Engineering Deptt. IIT, Kharagpur, West Bengal, India; SFA : pp. 11-18.

Meyers, S.P. 1975. Aquaculture and Fish / Crustacean off-flavour. Feedstuffs, pp. 24.

Miescher, F. 1987. Histochemischen and Physiologischen Arbeisten, 2, pp. 192 .

Nair, P.G.V. and Suseela, M. 2000. Biochemical Composition of Fish and shell Fish. CIFT Technology Advisory Series, Central Institute of Fisheries Technology, Cochin.

Stansby, M.E. 1979. Nutritional properties of fish Fatty alcohol details linking dietary copepod fat with certain fish depot fats, Lipids, J. Amer. Oil. Chemists Soc., 14, pp. 795.

Stansby, M.E. 1985. Technology Common to Aero and Marine Engineering: Proceedings of an international conference, January 26 - 28, 1988, London, UK. Advances in Underwater Technology and Offshore Engineering, 15.

****