Complimentary Copy

VIDYASAGAR UNIVERSITY

JOURNAL OF BIOLOGICAL SCIENCES

NUMBER 5
1999

Vidyasagar University
Midnapore 721102
West Bengal
India

INSTRUCTION TO AUTHORS

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(i) The title of the paper which should be concise but informative, (ii) a short running head of not more than 10 words placed at the foot of the title page, (iii) first name, middle initial and last name of each author, (iv) name of department (s) and instiution (s) to which the work should be attributed, (v) name and address of author for correspondence.

Abstract : The second page should carry and abstract of not more than 200 words. The abstract should state the purpose of the study, basic procedure, main findings and principal conclusions. Abstract should state the purpose of the study, basic procedure, main findings and principal conclusions, Abstract should be followed by relevant Key Words.

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Methods : The methodology, apparatus and procedure in sufficient detail should be identified to allow other workers to repeat the experiments. Standard methods can, however, be identified by proper references. The new or substantially modified methods should be described giving reasons for using them.

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Discussion : This should prescisely deal with interpretation of results. Emphasis should be given on the new and important aspects of the study and conclusions that follow from them. Recommendations, when appropriate, may be included.

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Tables : Tables should be typed on seperate sheets using double space. Each table should be numbered (Roman numerals) consecutively with a brief caption on the top of the table.

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Photographs must be in black and white. A clear print in glossy paper, large enough to be legible after 25% reduction, is necessary for reproduction. These should be submitted along with the paper.

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RECENT BENTHIC FORAMINIFERA FROM THE NEARSHORE INNERSHELF OFF DIGHA, NORTH-EAST COAST OF INDIA

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Abstract

Studies on recent benthic foraminifera collected from the near shore, innershelf environment off Digha,north-east coast of India recognised three distinct bathymetric biozones. 58 species of recent, benthic foraminifera belonging to 31 gnera under 21 families and 4 suborders were identified and reported for the first time from the study area.Faunal assemblages revealed a clear cut dominance of the Suborder Rotallina (represented by 30 species) over Suborder Miliona (13 species). Suborder Textularina (12 species) and Suborder Lagenina (3 species). *Ammonia beccarii, A.tepida, Asterorotalia dentata, A. trispinosa, A. multisphinosa, Elphidium discoidale var. multiloculam, E. somaense* and *Quinqueloculina seminulum* were the most abundant foraminifera recorded from the study sites. Most of the foraminifera were found to be of the Indo-Pacific Zoo-geographical province. Well marked seasonal variations of foraminifera were noticed.

***Key words** : Recent Benthic Foraminifera, Innershelf, Rotaliina, Miliolina, Textulariina, Lagenina.*

Introduction

Studies on recent benthic foraminifera in the continental shelf have been carried out all over the world (1-11). Analyses of recent, benthic foraminifera along the Indian continental shelf are limited to mostly thanatocoenooses (12-18).

Investigations on recent benthic foraminifera on the Bay of Bengal along the Indian coasts were mainly confined to the southern & central parts of the western margin. Despite great eco-diversities, the foraminiferal studies along the northern part of western margin of the Bay Bengal was grossly neglected. The present investigation concerns with the qualitative distribution of foraminifera along the continental shelf off Digha. This, in fact, is the first biocoenose study of foraminifera from this part of the tropical world.

Environmental and Oceanographic Setting :

Digha is a prominent seaside resort in the district of Midnapore, West Bengal. The Shankarpur Fishing harbor is in the vicinity of the study area. The area is directly under the influence of the reverine discharges from River Hooghly and River Subarnarekha. Three seasons-viz., the summer (March-June) the south west monsoon (July-October) and the winter (November-February) are recognised in the study area. The area experiences semidiurnal tides with the tidal range varying between 2.5 M to 4.5 M.

The bathymetric data bring out a continental shelf pattern almost parallel to the coast. The present study is restricted to the relatively flat, near shore, innershelf turbulent environment which is subjected to intense

activities of surface waves, littoral currents and wide temporal variations in salinity (28.75‰-1.15‰), temperature and nutrients (19). The area as such is under the influence of huge suspended solids and hence turbid in nature. The sediment cover of the study area is predominatily of clay and clayey sand though small patches of fine sand occurs near the coast at the Subarnarekha river mouth.

Material and Methods

Eight stations from two selected transects viz., TIV (Digha township; 21 27' N Lat. to 21 36' N Lat & 87 31.4' E Lat. to 87.35'E Lat.) & TV (off River Subarmarekha; 21 29'N Lat. to 21 33.3'N Lat & 87 22.5'E Long. to 87 25.15'E Long.) were selected for sampling during summer, monsoon and winter. Stations were chosen along the transects at 3 Km offshore (TIV/02 & TV/P2), 5 Km offshore (TIV/03 & TV/03), 10 Km offshore (TIV/04 & TV/04) & 20 Km offshore (TIV/05). An additional station TV/01 was selected at 0.5 Km within the Subarnarekha estuary mouth. Samples were collected at a depth range of 1 M-7 M.

Sediment samples were collected by means of a Van veen Grab sampler. Five samples were collected randomly from each site. The top one cm. of each of the samples were removed and mixed thoroughly to prepare a composite sample. Finally one fifth of this composite sample was taken for routine foraminifera analysis following wet sieving and flotation technique (20). Rose Bengal solution was used to recognise the living forams (21-23). Bottom waters from the same stations were collected by using Niskin water sampler for carrying out hydrological analyses by employing standard analytical techiques (24).

Results

a. Benthic Foraminifera:

A total of 58 species of recent, benthic foraminifera have been identified and recorded for the first time from the study area. They belong to 31 genera, under 21 families and 4 suborders. The assemblage includes 30 species of rotaliids, 13 species of miliods, 12 species of textulariids and 3 psecies of lagenids.

Ammonia beccarii, *A. tepida*, *Asterorotalia dentata*, *A. trispinosa*, *A. multispinosa*, *Elphidium discoidale var. multiloculum*, *E. sinaense* and *Quinqueloculina seminulum* were found abundant in the study area.

A taxonomic checklist of the recorded foraminiferal species following taxonomic scheme of Loebich and Tappan, 1988 (30) is given hereunder

Taxonomic Checklist

Order	:	FORAMINIFERIDA Eichwald, 1830.
Suborder	:	TEXTULARIINA DelageandHerourd, 1896.
Super family	:	LITUOLACEA de Blainville, 1827.
Family	:	LITUOLIDAE de Blainville, 1827.
Sub family	:	AMMOMARGINULININEA Podobina, 1987.
Genus	:	*Ammobaculites* Cushman, 1910.
Specimen	:	*Ammobaculites agglutinans* (d' Orbigny) *A. americanus* Cushman *A. exiquus* Cushman and Bronimann A.sp.
Genus	:	*Cribrostomoides*
Specimen	:	*Cribrostomoides jeffrey-*

si (Williamson)

Family : HAPLOPHRAGMOIDIDAE Maync, 1952.

Genus : *Haplophragmoides* Cushman, 1910

Specimen : *Haplophragmoides canariensis* (d' Orbigny) *H. wilberti* Anderson

Super family : TROCHAMMINA Schwager, 1877

Family : TROCHAMMINIDAE Schwager, 1877

Sub family : ARENOPARRELLINAE Saidova, 1981

Genus : *Arenoparrela* Anderson, 1951

Specimen : *Arenoparrela mexicana* (Kornfeld)

Sub family : TROCHAMMININAE Schwagar, 1877

Genus : *Trochammina* Parker and Jones, 1859

Specime : *Trochommina inflata* (Montagu)

Super family : RZEHAKINACEA Cushman, 1933

Family : RZEHAKINACEA Cushman, 1933

Genus : *Miliammina* Heron-Allen and Earland, 1930

Specimen : *Miliammina fusca* (Brady)

Super family : HORMOSINACEA Haeckel, 1894

Family : HORMOSINIDAE Haeckel, 1894

Sub family : REOPHACINAE Cushman, 1910

Genus : *Reophax* Rhumbler, 1895

Specimen : *Reophax dentaliniformes* Brady

Super family : TEXTULARIACEA Ehrenberg, 1838

Family : TEXTULARIIDAE Ehrenberg, 1838

Sub family : TEXTULARIINAE Ehrenberg, 1838

Genus : *Texularia* De ffrance, 1924

Specimen : *Textularia agglutinans* d'Orbigny

Sub Order : MILIOLINA Delage and Herouard, 1896

Super family : SQUAMULINACEA Reuss and Fritsch, 1861

Family : OPTHALMIDIIDAE Weisner, 1920

Genus : *Edentostomina* Collins, 1958

Specimen : *Edentostomina cultrata* (Brady)

Specimen : MILIOLACEA Ehrenberg, 1839

Family : HAUERINIDAE Schwager, 1876

Sub family : MILIOLINELLINAE Vella, 1957

Genus : *Flintina* Cushman, 1921

Specimen : *Flintina bradyana* Cushman

Genus : *Triloculina* d'Orbigny, 1826

Specimen : *Triloculina brevidentata* (Cushman) *T. insignis* (Brady) *T.tricarinata* d'Orbigny *T.trigonula* (Lamarck)

Sub family : HAUERININAE Schwager, 1876

Genus : *Quinqueloculina* d'Orbigny, 1826

Specimen : *Quinqueloculina agglutinans* *Q.crassicarinata* Collins *Q.lamarckiand* d'Orbigny

		Q. parkeri Brady
		Q. seminulum (linne)
		Q. vulgaris d'Orbigny
Family	:	SPIROLOCULINIDAE Weisner, 1920
Genus	:	*Spiroloculina* d'Ordigny, 1826
Specimen	:	*Spiroloculina depressa* d'Orbigny
		S. indica Cushman and Todd.
Sub family	:	LAGENINA Delage and Herouard, 1896
Super family	:	NODOSARIACEA Ehrenberg, 1838
Family		LAGENDAE Reuss, 1862
Genus	:	*Lagena* Walker and Jacob, 1798
Specimen	:	*Lagena laevis* (Montagu)
		Lagena perlucida (Montagu)
Family	:	ELLIPSOLAGENIDAE. Silverstri, 1923
Sub family	:	OOLININAE Loeblich and Tappan, 1961
Genus	:	Oolina d'Orbigny, 1839
Specimen	:	*Oolina globosa* (Montagu)
Sub order	:	ROTALLINA Delage and Herouard, 1896
Super family	:	ROTALIIDAE Ehrenberg, 1839
Family	:	ROTALIACEA Ehrenberg, 1839
Sub family	:	AMMONINAE Saidova, 1981
Genus	:	*Ammonia* Brunnich, 1772
Specimen	:	*Ammonia beccarii* (Binne)
		A. tepida (Cushman)
Genus	:	*Asterorotalia* Hofker, 1950
Specimen	:	*Asterorotalia dentata* (Parker and Jones)
		A. inflata (Millett)
		A. multispinosa (Nakumara)
		A. trispinosa (Thalmann)
Family	:	ELPHIDIIDAE Galloway, 1933
Sub family	:	ELPHIDIINAE Galloway, 1933
Genus	:	*Cribroelphidium* Cushman and Bronnimann, 1948
Specimen	:	*Cribroelphidium poeyanum* (d'Orbigny)
Genus	:	*Elphidium* de Montfort, 1808
Specimen	:	*Elphidium advenum* (Cushman)
		E. crispum (Linne)
		E. discoidale (d' Orbigny)
		E. discoidsale Var. multiloculum (Cushman and Ellisor)
		E. hispidulum (Cushman)
		E. incertum (Williamson)
		E. somaense (Takayanagi)
Super family	:	BOLIVINACEA Glaessner, 1937
Family	:	BOLIVINIDAE Glaessner, 1937
Genus	:	*Bolivina* d'Orbigny, 1839
Specimen	:	*Bolivina seminuda* Cushman
		B. striatula Cushman
Genus	:	*Brizalina* O.G.Costa, 1856
Specimen	:	*Brizalina spathulata* (Williamson)

Family	:	LOXOSTOMATIDAE Loeblich and Tappan, 1962
Genus	:	*Loxostomum* Ehrenberg, 1854
Specimen	:	*Loxostomum karrerianum* (Brady)
Super family	:	DISCORBACEA Ehrenberg, 1838
Family	:	BAGGINIDAE Cushman, 1927
Sub family	:	BAGGININAE Cushman, 1927
Genus	:	*Cancris* de Montfort, 1808
Specimen	:	*Cancris auriculus* (Fichtel and Moll)
Family	:	ROSALINIDAE Reiss, 1963
Genus	:	*Rosalina* d'Orbigny, 1826
Specimen	:	*Rosalina floridana* (Cushman)
Super family	:	DISCORBINELLACEA Sigal, 1952
Family	:	PARRELLOIDIDAE Hofker, 1956
Genus	:	*Cibicidoides* Thalmann, 1939
Specimen	:	*Cibicidoides wuellerstorfi* (Schwager)
Super family	:	PLANORBULINACEA Schwager, 1877
Family	:	CIBICIDIDAE Cushman, 1927
Subfamily	:	CIBICINAE Cushman, 1927
Genus	:	*Cibicides* de Montfort, 1808
Specimen	:	Cibicides hyalinus (Hofker)
Super family	:	NONININAE Schultze, 1854
Family	:	NONIONIDAE Schultze, 1854
Subfamily	:	NONIONINAE Schultze, 1854
Genus	:	*Florilus* de Montfort, 1808
Specimen	:	*Florilus schapha* (Fichtel and Moli)
Genus	:	*Nonionellina* Volshinova, 1958
Specimen	:	*Nonionellina labradorica* (Dawson) *N. turgida* (Williamson)
Genus	:	*Pseudononion* Asano, 1936
Specimen	:	*Pseudononion of P.attanticum* (Cushman) *Pseudononion grateloupi* (d'Orbigny) *Pseudononion* of *P. japonicus* (Uchio)
Super family	:	CHILOSTOMELLACEA Brady, 1881
Family	:	GAVELINELLINAE Hofker, 1956
Sub family	:	GAVELINELLINAE Hofker, 1956
Genus	:	*Hanzawaia* Asano, 1944
Specimen	:	*Hanzawaia concentrica* Cushman.

Biozonations :

On the basis of faunal assemblages three distinct bathymetric zones ranging from i) 0-3 Km. offshore, ii) 5 Km. offshore and iii) 10-20 Km. offshore were recognised.

The major species in Zone I included *Ammonia beccarii A tepida Asterorotalia trispinosa, A multispinosa, A. dentata, Elphidium somaense E. discoidale var. multilioculum, Q. seminulunum.* These forams were mostly robust and euryhaline and can withstand the ecological inhospitability due to changing salinities, wave actions and turbidity.

The assemblages of Zone II were mostly similar to that of Zone I except for the introduction of Bolivina-Brizalina fauna and greater diversities in agglutinated fauna. Majority of the abundant forms were also present in the Zone.

The foraminiferal assemblages in Zone III were distinctly different from that of Zone I and II Ammonia fauna were substantially lesser in number. Various open marine forms were introduced in the Zone. Forms like *Lagena* spp. *Cancris* species, *Cibicidoides wuellerstorfi*, *Cinicides hyalinus*, *Elphidium crispum*, *Rosalina floridana*, *Nonion-Pseudononion-Florilus group*, *Oolina globosa*, *Quinqueloculina* spp, *Triloculina* spp. were noticed in this zone. occureence of typical hypohaline, marsh fauna like *Arenoparrella mexicana*, *Miliammina fusca*, *Textularia agglutinans* well corroborated the presence of marshy mangrove swamp at the mouth of Subarnarekha estuary.

Well marked seasonal variations of foraminifera were noticed. Highest densities & diversities of foraminifera were observed during winter while lowest densities and diversities were noticed during monsoon. This also coincides with the seasonal phytoplankter peak and subsequent Zooplankter peak from this part of the coastal water (26,27 & 28). Salinity, temparature, turbidity, substrate characteristics, tidal movements and wave actions seem to be the major ecological variables that controls foraminiferal assemblages from this part of the world. Majority of the forams are of the Indo-Pacific Zoogeographical Province

Discussion

This is the first biocoenose study of recent benthic foraminifera from this part of Bay of Bengal. The endemic forams underwent various adaptive modifications to tackel such fragile and vibrant environment. Majority of the representative forams exhibited morphological adaptations including robust size, development of spines, longitudinal coastae, hispids, keeled periphery & appertural modifications to adapt themselves in such high energy, turbulent, highly turbid near shore, innershelf environment. Asterorotalia trispinosa, the only species so far reported from Digha beach sand prior to the present stury (29) showed further modifications & many of the specimens possessed an additional spine for iincreasing the buoyant capacity.

It appeared that the fotaliids can best adapt this high energy, turbulent, turbid, near shore innershelf environment than the members of suborder miliolina, textulariina and lagenina. In general, the high energy environment affects the benthic foraminiferal distribution to a considerable extent (25). The foraminiferal densities and diversities from this part of the Bay of Bengal was found to be lower in comparison to similar such environment along Paradip, Kalingapatnam and Visakhapatnam shelf off Bay of Bengal (16,18). However, they exhibit partial similarties with the forams of Indian Sundarbans. (31) This set of information may well act as base line information to assess the temporal variability in view of increasing pollution load in the study area due to development of Shankarpur fishing harbour, development of unplanned and non-ecofriendly tourism, dumping of non-treated sewage and rejects of coastal aqua farm.

Acknowledgement :

The authors wish to express their gratitude to Prof. (Rtd.) M.S.Rao of Andhra University and Dr. S.P.Chakraborty, Ex. Member Secretary, Central Pollution

Control Board, Calcutta for their invaluable support to carry out the programme. The help rendered by Dr. V.V. Shyamsunder of Andhra University, Dr. A.B. Bhunia, Mr. A. K. Sen and other members of Marine Pollution Monitoring team of Central Pollution Control Board, E.Z.O., Calcutta are also greatfully acknowledged.

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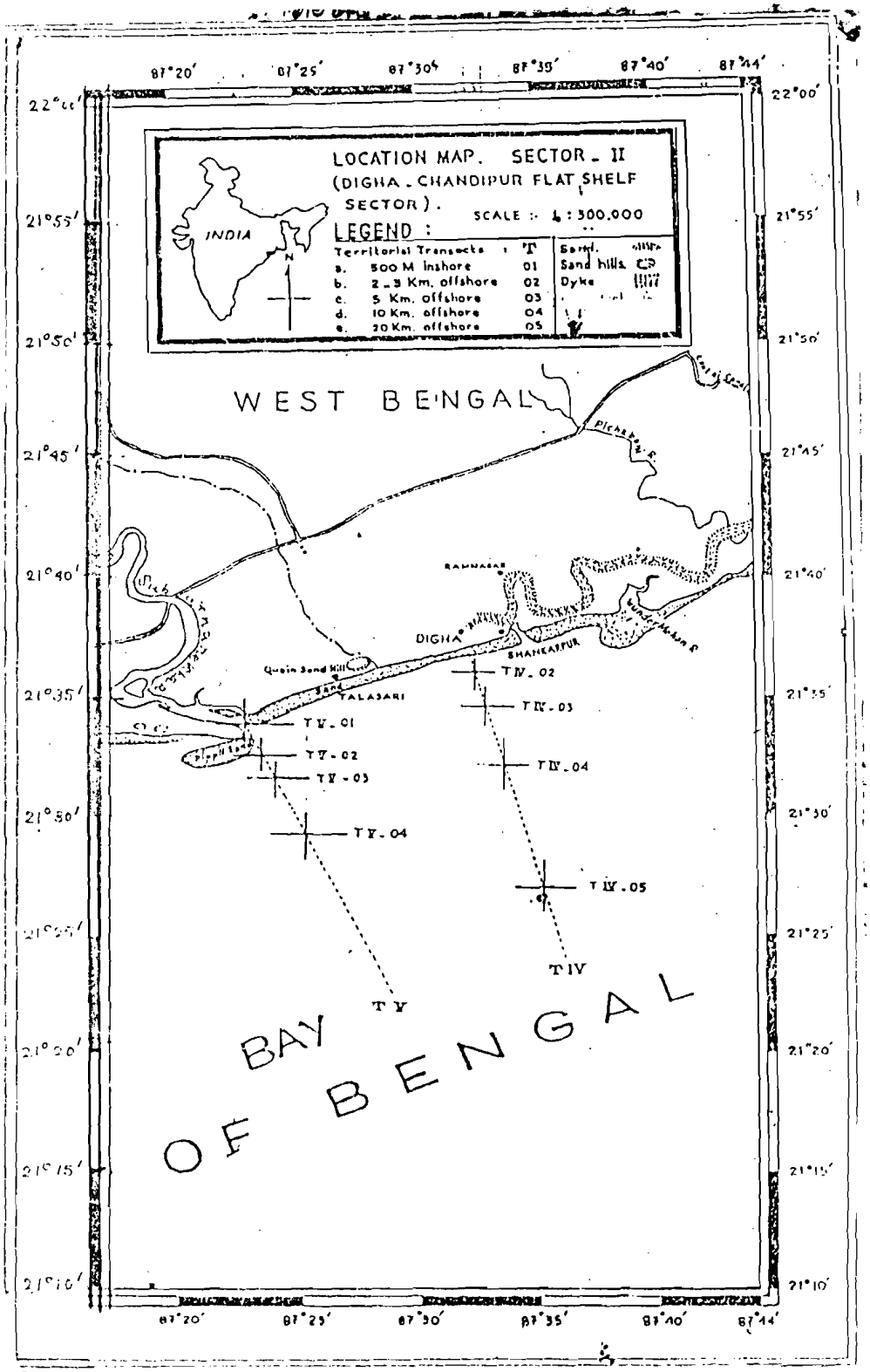
LOCATION MAP. SECTOR - II
(DIGHA - CHANDIPUR FLAT SHELF SECTOR).
SCALE :- 1 : 300,000
LEGEND :
Territorial Transects : T
a. 500 M Inshore 01
b. 2 - 3 Km. offshore 02
c. 5 Km. offshore 03
d. 10 Km. offshore 04
e. 20 Km. offshore 05
Sand.
Sand hills
Dyke
INDIA
N
WEST BENGAL
DIGHA
SHANKARPUR
TALASARI
Qusin Sand Hill
TV - 01
TV - 02
TV - 03
TV - 04
TIV - 02
TIV - 03
TIV - 04
TIV - 05
T IV
T V
BAY OF BENGAL
87°20'
87°25'
87°30'
87°35'
87°40'
87°44'
22°00'
21°55'
21°50'
21°45'
21°40'
21°35'
21°30'
21°25'
21°20'
21°15'
21°10'

V.U. Jr. of Biological Sciences (1999)

STUDIES ON THE EFFECT OF CHROMIUM-INDUCED ALTERATION OF CERTAIN IMMUNOLOGICAL PARAMETERS IN EXPERIMENTAL RATS

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Abstract

Importance of chromium as environmental toxicants is largely due to impact on the body to produce cellular toxicity. The impact of chromium was studied on blood of male Wister rats (80-120g b w). It has been observed that the intoxication with chromium (i.p. at a dose of 0.8 mg/ 100 gm body weight / day) for a period of 28 days causes significant alteration in the total count of erythrocyte and leucocyte and in the percentage of neutrophil, eosinophil, lymphocyte, monocyte and NBT positive cells, except basophil. From this observation it may be suggested that chromium treatment in the present dose and duration produces stimulatory and inhibitory responses to the specific cells of acquired and innate immune systems respectively.

Key Words : Chromium, Blood, TC, DC NBT.

Introduction

Cytotoxic effects of hexavalent chromium compounds demonstrated in various cell types. It is well recognised that these compounds have hepatotoxic, nephrotoxic, mutagenic, teratogenic, and carcinogenic effects (1). Heavy metals can have pronounced both activating and inhibitory influences on all parts of the immune system. For instance, mercuric chloride administrated to certain strains of mice gives rise to autoimmune disease (2,3,4), with polyclonal B-cell activation (5,6). Higher concentrations of mercuric chloride inhibit the proliferation of lymphocytes in vitro (7,8,9), whereas there induced to proliferate by low concentrations at mercuric chloride (10,11). This is a macrophage-dependent effect (12), emphasising the importance of considering toxicity of heavy metals in macrophages. Particles from welding fumes have been shown to be cytotoxic to cultures of bovine alveolar macrophages. The cytotoxic effect has been attributed to the content of Cr (VI) in the fumes (13). Experimental data have pointed toward an adverse effect of Cr(VI) compounds on the immunological funtions in the respiratory system (14,15).

In view of the above, the present investigation was intended to study the in vivo effect of chromium on certain immunological toxicity in terms of total count, differential count and nitro blue tetrazolium (NBT) positive cells of blood.

Materials and Methods

Maintenance and treatment of animals :

Male albino rats of wistar strain weighing 80-100 gm were used for the present investigation. The rats were fed with a diet containing protein (casein) 18%, carbohydrate (amylum) 71%, fat (groudnut oil) 7%, salt mixture 4% and adequate vitamins mixture as reported elsewhere (16,17) and given sufficient water, and were maintained in clean cages. All the rats were acclimated to this diet and laboratory environment

for 4-5 days. Then rats were divided into two groups of equal average body weight. The animals of one at the groups were injected i.p with chromium as CrO_3 at a dose of 0.8 mg/ 100 g body weight per day (20% LD_{50}) for 28 days. The animals of the other group serving as the control group received only the vehicle (0.9% Nacl). The animals of the control group were pair-fed with those of the chromium treated group.

Collection of blood :

After the experimental period, the rats were sacrificed by cervical dislocation. Blood samples were collected from the hepatic vein and kept in a vial with anticoagulant.

Assay methods :

Total count and differential count of the peripheral blood was done according to the method as described by Chatterjee in 1985(18).

Determination of NBT positive cells were performed according to the method described by James et al (19).

Statistical analysis were done using students 't' test.

Results

The results, presented in Table-1 show the changes in the haematological parameters linked with immunological activity in response to chromium exposure. From the table it has been observed that in the present investigation the total count of erythrocyte and leucocyte has been decreased significantly in response to chromium exposure (Table - 1). In the chromium-exposed group the percentage of lymphocyte and monocyte increased significantly, while the neutrophil and eosinophil counts were found to be decreased significantly and the percentage of basophil remains unaltered (Table-1). On the other hand the percentage of NBT positive cells is diminished significantly in response to chromium exposure (Table - 1).

Discussion

It has been known for many yearsthat heavy metals are toxic cell in cultures, as shown for chromium (20,21,23). Chromium (VI) has been demonstrated to have a cytotoxic effect on bovine alveolar macrophages (13). Glaser et al (15) reported that phagocytic capacity was decreased at 2.5 uM Cr (VI) which is also the threshold level found in the long-term toxicity study. Cells exposed to higher levels of chromium showed a rapidly impaired phagocytic activity. In vivo exposure of chromium (VI) has been shown to increase phagocytic activity at low levels chromium exposure while this macrophage function was decreased at high levels of exposure (15). Glaser et al (15) also reported that the immunoglobulin content in serum was either increased or decreased depending on levels of chromium exposure. Metchnikoff (22) discovered the process of phagocytosis and later the invasion and phagocytic activity of white blood cells at the site of an infection. Kitch in et al (25) and Nakada et al (24) reported that the widely used labelling of target cells with sodium radio-chromate in cytotoxicity assay for T-cells, NK-cells etc. thus depending on Cr (VI) being nontoxic below this threshold-concentration. Besides this several studies on other cells including monocytes and lymphocytes suggested the methylated form to be the more toxic. Discrepancy between in vivo and in vitro effect of Cr (VI) on macrophage functions such as respiratory burst and increased oxygen consumption was found by Galvin and Oberg (23). In the present study it has been observed that the total count of erythrocyte and leukocyte has been decreased significantly in response to chromium exposure (Table-1). This changes may be due to present dose and duration dependent manner of chromium exposure. On the other hand, the percentage of neutrophil and eosinophil decreased significantly, while basophil remained unaltered (insignificantly decreased) but the percentage of lymphocyte and monocyte counts were found to be significantly increased in response to chromium exposure (Table-1). From this result, it has been observed that chromium (VI) reduced the phagocytic cells and their activities in the present dose and duration. Besides this chromium (VI) may trigeer the antigen-specific immune system through the cell-mediated immunity. On the other hand, the percentage of NBT positive cells decreased significantly in response to chromium exposure (Table - 1). It may be due to decreament of oxygen consumption in

respiratory burst response after chromium exposure. Therefore, hydrogen peroxide formation and NBT positive cells reduction are impaired in response to chromium.

From these observations it may be indicated that chromium treatment in the present dose and duration produces stimulatory and inhibitory responses to the specific cells of a acquired and innate immunl systems, respectively.

Acknowledgement
The authors are thankful to Vidyasagar University for sanctioning minor research project (U G C) on this problem.

Table 1 : Effect of chromium on certain immunological parameters of blood.

Parameters	Types of cells	Group of Rats Vehicle Treated	Chromiun Treated
Total count	Erythrocytes ($x10^5$ cells/ cu.mm of blood)	39.73±0.32	23.43±0.26*
	Leucocytes ($x10^3$ cells./ cu.mm of blood)	6.12 ±0.04	3.72 ±0.03*
Differential count (%)	Neutrophil	28.5±0.56	18.66±1.02*
	Eosinophil	6.16± 0.70	4.00± 0.51*
	Basophil	0.66 ± 0.21	0.50 ± 0.23
	Lymphocyte	60.66±0.80	71.00± 1.06*
	Monocyte	4.00 ± 0.26	5.83 ±0.54*
NBT (%)	Positive cells	64.15 ± 3.55	39.73± 1.65*

The values are means of six observations± SEM
*Indicates significant difference between two sub groups ($p<0.05$)

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V.U. Jr. of Biological Sciences (1999)

EVALUATION OF THE LEAF EXTRACT OF *STEPHANIA HERNANDIFOLIA* (Ak nandi) AS FEMALE CONTRACEPTIVE AGENT IN MATURE ALBINO RAT

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Abstract

The leaf extract of S. *Hernandifolia* has a contraceptive effect in case of experimental female rats. Administration of this extract for 25 days resulted in significant diminution of several markers of female reproductive system like ovarian somatic, uterine somatic indices, ovarian steriodogenic Δ^5 - 3β HSD and 17β HSD enzyme activities, quantification in the numbers of atretic follicles and acid as well as alkaline phosphatase activities in uterus.

Key words : Ovary, Steroidogenesis, *Stephania hernandifolia*, Acid and Alkaline Phosphatase.

Introduction :

The world population almost doubled between 1950-1980 and by the year of 2000, is predicted to be 7 billion. Global search on anti-fertility agents is going on to solve the problem of "population explosion". There are various methods for fertility control for women and their primary targets are hypothalamus, pituitary and fallopian tube. None of the existing contraceptive methods is free from side effect. At present global search are going on for the identification of potent herbal antifertility agents which are free from side effects. In our country there are several medicinal plants asociated with anti-fertility property (1). Though very few contraceptives have been developed from plant extract, but their potentiality were not determined accurately and their mode of action is beyond our knowledge till now. *S. hernandifolia* is used as a contraceptive agent in female in some rural areas of West Bengal and this has been confirmed in by our preliminary survey. This plant is an herb type plant, the maximum growth of of which could be noted both in plains and hilly areas in the rainy season. It is under the family of Menispermaceae. The length of the individual leaf of the plant is 2-6 inches and there is no lobe along the surface of the leaf. The height of this plant is about 10-15 ft.

Materials and Methods

Animals and experiment :

Wistar strain mature female albino rats, 60 days of age and weighing 75+5 gm. were used.

The light dark cycle of these animals was 12D: 12L. Animals were fed standard laboratory diet and water *ad libitum*. All the animals were kept in animal house at normal environmental temperature.

Preparation of leaf extract :

Leaf extract has been prepared according to the standard method formulated by NIHFW (2). Leaves of *S. hernandifloia* were dried in an incubator for 72

hours at the temperature of 40°C. Dried leaves were crushed. 10 gm of which were soaked in 500 ml of methanol for 4-5 times in a day for two days. Clear green solution was separated from the leaves and it was filtered using a fine filter paper. 5-Ml of diethyl ether was added to the residue and evaporated to get dried *S. hernandifolia* leaves extract in the form of cake. 0.2-Gm of *S. hernandifolia* leaves cake was dissolved in 100 ml of 4% DMSO (Dimethylsulphoxide) in distilled water. This is considered as high dose was then diluted by the same volume of 4% DMSO which may be considered as low dose.

Synchronization of the estrous cycles of all the rats has been performed by single subcutaneous injection of evanol (synthetic estrogen) at the dose of 0.05 mg per 100 gm body weight per rat.

Eighteen rats having regular and synchronous type of estrous cycle were considered for this experiment and were equally divided into three groups.

Group 1 : Control animals were fed forcefully at the volume of 0.5 ml of 4% DMSO per 100 gm body weight per day for 25 days.

Group 2 : Another group of animals was forcefully fed with low dose of *S. hernandifolia* leaf extract at the volume of 0.5 ml per 100 gm body weight per day for 25 days.

Group 3 : Animals of other treated group were forcefully fed with high dose of *S. hernandifolia* leaf extract at the volume 0.5 ml per 100 gm of body weight per day for 25 days.

Estrous cycle of all the animals of each group were noted twice per day at the time of 10am and 4pm. On 26th day, all the animals were killed at diestrous phase and their body weights, ovarian, uterine weights were noted. Ovarian Δ^5-3β-HSD and 17β-HSD activities were measured in all the animals. Uterine acid and alkaline phosphatase activities were measured.

Chemicals :EDTA (BDH Calcutta), NAD (Sigma USA), Testosterone (Organon Calcutta), DHEA (Organon Calcutta), pNPP and pNP (Loba chemical Co. Bombay) were used in this experiment.

Estimation of ovarian Δ^5 3β-HSD and 17β-HSD

Five gm of ovarian tissue was homogenized in 1 ml of 20% spectroscopic grade glycerol containing 5mM potassium phosphate and 1mM EDTA and was centrifuged at 10,000 for 30 minute. 1-Ml supernatant was mixed with 1ml of 100 mM sodium pyrophosphate buffer (pH 8.9), 0.9ml of 1% BSA and 0.1ml of ethanol containing 30 µgm of

dehydroepiendosterone (DHEA) Enzyme activity was measured according to the method of Talalay (3) at 340nm after addition of 0.04 ml of 0.5 M of NAD to the tissue supernatant mixture in spectrophotometer (Hitachi, Japan) against a blank without NAD. 17β-HSD was measured according to the method of Jarabak (4). Here same protocol has been followed like Δ^5 3β-HSD enzyme assay, only testosterone has been added here in lieu of DHEA One unit enzyme activity is the amount causing change in absorbance of 0.001/ min at 340 nm.

Estimation of uterine Acid and Alkaline phosphatase activity :

For quantitative estimation of acid phosphatase activities uterine tissue was homogenized uniformly in a potter-Elvienjem homogenizer using ice cold homogenizing medium (0.22 M Tris-Hcl buffer, pH 7.5) at a tissue concentration of 20mg.Ml. 0.25-Ml of homogenate was added in a centrifuged tube containing 1 Ml buffer (1 Mi p-nitrophenol phosphate in 0.1M acetate buffer, pH 5.0). The mixture was incubated at 37°C for 30 minute in water bath. The assay was based on the formation para nitrophenol (p-NP) in the hydrolysis of p-nitrophenol phosphate (p-NPP). the activity was measured spectrophotometrically at 420nm in presence of sodium fluoride and cobalt as specific activator (5).

For the measurement of alkaline phosphatase activities, uterine tissue was homogenized uniformly in a potter homogenizer using ice cold homogenizing medium (0.02M Tris HCl buffer, pH 7.5) at a tissue concentration of 20mg.Ml.1Ml of the homogenate was added in a centrifuge tube containing 1 ml buffer (1 mM p-NP phosphate in 1 mole Tris buffer, pH 8.0). The mixture was incubated at 37°C for 30 minute in a water bath. The reaction was terminated by the

addition of 0.1 ml of 0.1 mM NaOH. The assay was based on the formation of p-NP in the hydrolysis of p-nitrophenol phosphate (p-NPP). The activity was measured spectrophotometrically at 420 nm (6).

Results :

Sex organs' weight :- Treatment of leaf extract of *S. hernandifolia* both at low and high doses resulted significant diminution in the weight of ovary and uterus in comparison to control (Table - 1).

Table -1. Effect of leaf extract of *S. hernandifolia* on ovarian weight, uterine weight and a number of atretic follicles in mature rats. Wet weight in gm/100 gm body weight.

Group	Weight of ovary (gm%)	Weight of uterus (gm%)	Number of atretic follicle
Control (0.5 Ml DMSO)	0.0468+ 0.024[a]	0.1692 + 0.0067[a]	1.67 + 0.21[a]
Treated (low dose 0.5 Ml)	0.0380 + 0.0023[b]	0.1513 + 0.0048[b]	2.50 + 0.22[b]
Treated (high dose 0.5 Ml)	0.0341 + 0.0023[b]	0.1444 + 0.0062[b]	2.67 + 0.21[b]

Each value represents mean + SE. six animals in each gr)up. Analysis of variance and multiple comparison of two tail "p" test compared the obtained results. In any vertical column, the mean with the same superscript did not differ from each other significantly (P<0.05).

Biochemical studies - Ovarian Δ^5 3β And 17β -HSD activities were decreased both at low and high dose in comparison to contrôl (Table -2). Acid and alkaline phosphatase activities were increased in this leaf extract treated group in respect to control (Table -2)

Table-2. Effect of leaf extract of *S. hernandifolia* on Δ^5 3β-HSD, 17β-HSD activities in ovary and acid alkaline phosphatase activities in uterus of mature rats. (Mean + SE), N=6. [Activity in units/mg, of tissuer/hr.]

Group	Δ^5 3β-HSD activity in ovary	% Change	17β-HSD activity in ovary	% Change
Control (0.5 Ml DMSO)	18.8 + 0.57[a]		15.8+0.68[a]	
Treated (low dose 0.5 Ml)	11.7+0.54[b]	-37.8	6.0+0.68[b]	-62.0
Treated (high dose 0.5 Ml)	10.2+0.53[b]	-45.4	5.8+0.54[b]	+63.0

Group	Uterine Acid phosphatase	% Change	Uterine alkaline phosophatase	% Change
Control (0.5 Ml DMSO)	19.41+1.4[a]		16.41+0.56[a]	
Treated (low dose 0.5 Ml)	26.02+1.1[b]	+34.0	19.80+0.80[b]	+21.0
Treated (high dose 0.5 Ml)	26.17+1.1[b]	+34.4	21.03+0.92[b]	+28.0

Each value represents mean + SE. six animals in each group. Analysis of variance and multiple comparison of two tail "p" test compared the obtained results. In any vertical column, the mean with the same superscript did not differ from each other significantly (P<0.05).

Histological study :- Number of atretic follicles was increased in this leaf extract treated groups when compared to control group (Table -1)

Discussion

Leaf extract of *S. hernandifolia* significantly decreased ovarian somatic, uterine somatic indices which may be due to the adverse effect of this extract on synthesis and secretion of gonadotrophins and ovarian steroids as these hormones regulate the

gonadal growth [7,10]. Consistent diestrous in leaf extract treated animals may be due to low plasma level of estrogen as this the prime hormone that controls the regular etrous cycle [11]. Diminution in ovarian steroidogenesis is also confirmed by the inhibition in the activity of ovarian Δ^5 3β-HSD and 17β-HSD activities in leaf extract treated rats as these are the key steroidogenic enzymes in ovary[12]. Significant elevation in the number of atretic follicles in ovarian histology in leaf extract treated rats also strengthen the inhibition in ovarian steroidogenesis as follicular development is also under the control of ovarian steroids and gonadotrophins[13,14]. Uterine acid and alkaline phosphatase aactivities which are elevated in this leaf extract treated rats also support the significant degeneration in uterine tissue which is also under the control of gonadotrophins and ovarian steroids[9]. In conclusion, it may be stated that the leaf extract of this plant produces contraceptive effect in case of female rat possibly by diminution of the gonadotrophin secretion and ovarian steroidogenesis.

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V.U. Jr. of Biological Sciences (1999)

AQUATIC INSECTS OF MIDNAPORE DISTRICT - II (Coleoptera : Hydrophilidae)

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Abstract

The present paper records 3 subfamilies and 6 genera of Hydrophilidae: subfamily Hydrophilinae is represented by 4 species under 4 genera. subfamily Hydrochinae and Spheridinae each is represened by one genus. All have been recorded for the first time from Midnapore district.

Key words : Aquatic insects, Hydrophilidae, Biodiversity, Midnapore.

Introduction :

Hydrophilidae are commonly known as water scavenger beetles. These are one of the important biotic components of aquatic ecosystem. d'Orchymont (2) published a checklist of the species recorded up to 1920 from India and adjoining areas. 40 species under 19 genera belonging to 5 subfamilies of Hydrophilids are known from West Bengal (1). However, so far there is no record of any Hydrophilid beetle from Midnapore district of West Bengal which is area wise the largest district of the state.

The present paper is second in the series based on survey of wetlands at Pirrakata (22 33° N', 87° 11' E) conducted during 1995. An account on the Dytiscidae of Midnapore district has already been published by the authors (3). Keys for identification of subfamilies, tribes, genera and species found in Midnapore district have also been included.

1. Hydrophilidae

Distinstive charecters :

Antennae short, club shaped, 6-9 segmented and inserted before eyes; abdomen with 4-7 visible ventral segments.

Family Hydrophilidae is represented by 3 subfamilies in Midnapore district. A key to the subfamilies found in Midnapore district is given below.

1(2) Body contour not uniformly curved and body not regularly convex, the pronotum narrower than elytral base and conspicuously separated therefrom, nearly as wide as head with eyes ..... **Hydrochinae.**

2(1) Body contour uniformly curved and body regularly convex; the pronotum not narrower than the hind body and conspicuously separated there from.

3(4) Antennae longer than maxillary palpi which are never very long, the last glabrous segment obconic, fitted more or less tightly against first segment of pubescent club ..... **Sphaeridinae.**

4(3) Antennae as long as and often shorter than maxillary palpi; the last glabrous segment more or less asymetrical, club-like, embracing the first segment of pubescent, always tri-articulate club ..... **Hydrophilinae.**

1. Subfamily : Hydrochinae

1. Genus : *Hydrochus* Leach, 1817.

1817. *Hydrochus* Leach, 1817, Zool. Misc., 3:90.

1860. *Hydrochus binodosus*, Mostchulsky, Schrenka Reis., 2:104.

1922. *Hydrochus binodosus*, d'Orchymont, Rec. Ind. Mus., 8:624.

1995. *Hydrochus binodosus* Biswas and Mukhopadhyay, Zoo. Serv. India, State Fauna Series-3, Fauna of West Bangal, Part 6 (A) 159.

Material examind : 2 exs. from Pirrakata. 15.6.95. P.R.Pahari.

Distribution : India: West Bengal (Calcutta, Hoogli, Midnapore.) Assam

Elsewhere : Annam and Tonkin.

Remark : The genus is recorded for the first time

from Midnapore district. Exact species could not be determined. Only one species *Hydrochus binodosus*, d'Orchymont is so far known from Assam & West Bengal in India.

2. Subfamily : Sphaeridinae

1. Tribe : Sphaeridiini

The subfamily is represented by only one genus *Coelostoma* under Tribe Sphaerinidae in Midnapore.

2. Genus : *Coelostoma* Brulle. 1835

1835. *Coelostoma* Brulle, Hist. Nat. Ins., 2(5) : 293.
1928. *Coelostoma subditum*, d'Orchymont Rec. Ind. Mus., 14: 1-146.
1995. *Coelostoma subditum* Biswas and Mukhopadhyay, Zoo. Serv. India, State Fauna Series-3, Fauna of West Bangal, Part 6 (A) 159.

Material examind : 1 ex. from Pirrakata, 15.6.95, P.R.Pahari.
Distribution : India : West Bengal (Calcutta, Midnapore)
Remark : Recorded from Midnapore district for the first time. The exact species is yet to be identified.

3. Subfamily : Hydrophilinae

Materials collected belong to 3 tribes. Key to these tribes are given below.

1(4) Scutellum not longer or not much longer than its width at base, antennae at most 9 segmented.
2(3) Meso and metasternal carina not reunited intimately. . . . . **Hydrobiini.**
3(2) Meso and metasternal carina reunited and forming only one ridge . . . . . **Hydrophilini.**
4(1) Schutellum a long triangle, longer than its width at base, antennae at most 8 segmented; eye very convex and prominent without complete canthus; posterior leg with long swimming hairs . . . . .**Berosini.**

2. Tribe : Hydrobiini

Only one genus of the tribe Hydrobiini is recorded from Midnapore.

3. Genus : *Helochares* Mulsant, 1844

1844. *Helochares* Mulsant, Palp, P. 197.

Distinctive character :
Second joint of maxillary palpi with anterior side concave or straight, posterior convex, last joint articulated from the outer to the inner towards mouth. palpi sometimes very long.

Helochares ancholaris Sharp 1890,

1890. *Helochares ancholaris* Sharp, Trans. Ent. Soc. Lond., P. 352.
1995. *Helochares ancholaris* Biswas and Mukhopadhyay, Zoo. Serv. India, State Fauna Series - 3, Fauna of West Bangal, Part 6 (A) 159.

Material examined : 3exs. from Pirrakata. 17.5.95. P.P.Pahari.
Distribution : India : West Bengal (Calcutta, Midnapore)
Elsewhere : Sri Lanka; Indonesia.
Remark : Recorded here for the first time from Midnapore district.

3. Tribe : Hydrophilini

Key to the genera of the tribe Hydrophilini recorded from Midnapore.

1(2) Prostital carina ridge like with an anterior brush of long setae and sometimes posteriorly with small emargination; a small notch on anterior part of mesostital carina with a bunch of small setae; maxillary palpi with last joint as long or usually longer than the preceding joint . . . . . **Sternolophus.**

2(1) Prostital carina not cutriform, excavate to receive the anterior side widely emarginat, the emargination filled with a short membraneous poorly chitinized sclerite sometimes of yellow colour, the preclypeus anti-penultimate joint of maxillary pulpi curved with concavity directed towards inner side; antennal club perfoliate; tarsi strongly compressed and oarlike.

tarsal claws dented at base those of anterior tarsi usually unequal and differently shaped; size large . . . . . **Hydrophilus.**

4. Genus : Sternolophus Solier, 1834

1834. *Stenolophus* Solier, 1834, Ann. Soc. Ent. Fr., 3:302-310.
1924. *Stenolophus* Solier, 1834, Col. Cat., 14 (79) : 226-228.

Sternolophus rufipes (Fabricius), 1792.

1792. *Hydrophilus rufipes* Fabricius, Entom. Syst. 1:183.
1840. *Sternolophus rufipes*. Laporte, Castelanu, Hist. Nat. Ins. 2:54.
1995. *Sternolophus rufipes*. Biswas and Mukhopadhyay, Zoo. Serv. India, State Fauna Series-3. Fauna of Wet Bangal, Part 6 (A) 159.

Material examined : 1 ex. from Pirrakata.
Distribution : India: West Bengal (Bardhaman, Murshidabad, Puruliya, Midnapore and Calcutta).
Elsewhere : Sunda Island.
Remark : Recorded for the first time from Midnapore district.

5. Genus : *Hydrophilus* Muller 1764.

1764. *Hydrophilus* Mullar. Fauna Ins. Fridrichsdalina, P 16.
1980. *Hydrophilus* Smetna, Mem. Ent. Soc. Canada, 114: 10-11.

Only one species of the genus *Hydrophilus* is recorded for the first time from Midnapore.

Hydrophilus olivaceus Fabricius.
1781. *Hydrophilus olivaceus* Fabricius, Spec. ins. 1:289.
1995. *Hydrophilus olivaceus* Fabricius, Biswas and Mukhopadhyay, Zoo. Serv. India, State Fauna Series - 3. Fauna of West Bengal, part 6 (A) 159.

Material examined : 1 ex. from Pirrakata 6.5.95, P.R.Phari.

Distribution : India : West Bengal (Birbhum, Midnapore); North India.
Remark : Recorded for the first time from Midnapore district.

4. Tribe : Berosini

Only one genus of the tribe Berosini has been recorded from Midnapore district.
6. Genus : Berosus Leach. 1817

Distinctive characters :
Five ventral non retractable segments, usually more or less prominent 6th retractile ventral segments; antennae composed of seven segments (4+3); upper surface uniform, deep and shining black; shape elongate; femora at least in part without dense pubescence; sutures of ventral segments not deepened.

1817. *Berosus* Leach, Zool. Misc., 3:92.

Only one species of the genus Berosus recorded from Midnapore district.

Berosus indicus Motschulsky
1861. *Berosus indicus* Motschulsky, Bull. Soc. Imp. Nat. Moscou 34:110.
1995. *Berosus indicus* Motschulsky, Biswas and Mukhopadhyay, Zoo. Serv. India, State Fauna Series-3, Fauna of West Bangal, Part 6 (A) 159.

Material examined : 1 ex. from Pirrakata 7.6.95. P.R.Pahari.
Distribution : India: West Bengal (Calcutta, Murshidabad, Midnapore).
Elsewhere : Sri Lanka, South Asia.
Remark : The species is being reported here for the first time from Midnapore district.

Acknowledgement :
The authors express their sincere thanks to Dr. S. Biswas of Zoological Survey of India for help rendered in the identification. They are also grateful to DST & NES, Govt. of West Bengal for financial help.

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V.U. Jr. of Biological Sciencess (1999)

PLANT RESOURCES AND HUMAN EXPLOITATION : A CASE FROM WEST DISTRICT OF SIKKIM

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Animal kingdom is dependent either directly or indirectly on plant resources. In such a case man is not an exception. The three basic needs of mankind are food, clothing and shelter. To fulfill these needs man is dependent on environment. 'Exploitation' is much more than 'Utilisation' and 'Consumption', and development of culture and exploitation of plant resources are competitive not complementary. In this paper an attempt has been made in brief to work out the role and relationship pattern between man and plant in a specific geograghraphical area.

***Key words** : Exploitation, Utilisation, Eco-balance, Matrix ranking*

Introduction

Two major components of ecology are plants and man. There is a tremendous amount of diversity in terms of characterisation of these two components, but at the same time a kind of interdependence is also found between the two where human beings are the main beneficiaries. Not only man but most of the animals have a direct survival link with the plants. For human habitation, the importance of plant resources can hardly be ignored. To a considerable extent, man's culture is governed by plants, as reflected in rituals and activities with an efficacious design.

Man is dependent on plants and he has been constantly exploiting plants resources for his survival.. If this trend continues for a long period of time, the balance within the plant population may not be maintained and there may be adverse effects of imbalance all over. Disorder and discordance thus produced in nature affect human survival in no uncertain terms. Although it has become a general phenomenon, at the microlevel it reflects the interaction pattern in a specific context. Microlevel variations are more because of different cultural experiences of peoples involved and the values they develop. Admittedly, application of culture-specific standard makes sense.

Geographical Outline of Sikkim

Sikkim or Sukhim (meaning New house) is a small state with an area of 7096 sq. km. The state lies between 27° 4' 46" to 28° 7' 48" N and 88° 58' to 88° 55' 25' E. It state is separate from the rest of the country by mountains ranging from 30 m to 8500 m above msl. The northrn, eastern and western portions of Sikkim are mostly formed of hard massive rocks. They do not permit human action to a very large extent. On the other hand, the central and southern parts are composed of soft, thin, slaty.

Table 1. Same general information on Sikkim

Area (sq. Km.)	7096
Altitude range (m)	300-8500
Total no. of families (1991)	76329
population	405505
No of persons/family	5.31
Main Ethnic groups	Lepcha, Bhutia, Limbu, Nepali
Land Use	
Total land	709600
Irrigated	na
Rainfed	78321
Land use pattern(%)	
Forest coverage	36
Cultivated area	15
Waste land	49
Livestock	
Cattle	183025
Sheep	10847
Goat	98210
Yak/Dzo	5354
Horse	1368
Pig	31207

Cultural Diversity

Sikkim is a multi-ehtnic, multi-lingual and multi cultural state. There are Buddhist (17 groups), Hindu (18 groups) and Christians co-existing happily within the same area. There are mainly four ethnic groups in Sikkim, viz (1) Lepcha (2) Bhutia (3) Limbu (4) Nepali. the Lepcha are the original inhabitants of Sikkim. The Buddhist came after them. As Sikkim opened up in the colonial period and particularly after the Independence, the Nepali came in large numbers developing agriculture, trade, and service sector. Today, the Nepalese have emerged as the dominant community in the fields of economy, politics, and administration. Sikkim is a meeting place of two diverse cultures brought in by two immigrant communities, viz the Bhutias and the Nepalese. While the Bhutias brought with them a part of Tibetan cultural life including the language, religion, and an economic system which is a combination of pastoralism and semi setteled agriculture, the Nepalease brought with them a part of Nepal's cultural life including the Nepali language, Hinduism and settled cultivation especially terraced cultivation.

Three main communities practise clan endogamy and exogamy at the sub-clan level. At the societal level, norms of patriarchal society and patrilocal residence are followed. Traditionally, the Lepcha practise polyandry. Though a small state, Sikkim is marked by linguistic diversity. There are many languages, the principal among whom are Lepcha, Bhutia, Nepali, Limbu, Gurung, Tamang and Tibetan (Table 2)

Ethnic group	Traditional Religion	Present Religion	Language	Traditional Occupation	Present Occupation
Lepcha (ST)	Animism	Buddhism	Lepcha (Tibeto-Burman)	Hunter and food gathers	Dry, Slash and burn agriculture
Bhutia (ST)	Animism	Buddhism	Bhutia (Tibeto - Burman)	Bhutias transhumence, pastoral economy	dry agriculture and Yak herding
Limbu (General)	Animism	Buddhism	Subba (Tibeto - Burman)	Pastoralism and animal husbandry	Terrace cultivation
Tibetan (ST)	Animism	Buddhism	Tibetan (Tibeto - Burman)	Trading	Agriculture farming and trading
Sherpa (ST)	Animism	Buddhism	Sherpa Tibeto Burman)	Agriculture	Agriculture
Nepali (General)	Hinduism	Hinduism	Nepali (Indo-Aryan)	Agriculture	Agriculture and Horticulture

Plant Resources of Sikkim

Sikkim is very rich in plant resources. A large number of species are used as food, timber, fodder, fuel wood, medicine and for aesthetic purpose. There are more than 4000 species of flowering plants, 250 species of ferns, 440 species of orchids and more than 40 varieties of rhododendrons in Sikkim Himalaya. A rough estimation reveals that the Sikkemese use more than 100 plants for medicinal purpose alone.

Study Site : Yuksam and Khechoplari of West Sikkim

For a better understanding, two areas of West Sikkim have been selected-one is Yuksam with an altitude of 1700 m and the other Khechoplari with an altitute of 1800 m. In Yuksam area, there are 274 house holds. All the major ethnic groups of Sikkim Himalaya live in this area. There are 74 house holds in Khechoplari area, 95% of them are Lepchas. (Table 3).

Yuksam is the first capital of Sikkim and it has a long historical background. A little distance is the Dubbdi which is one of the oldest Menasteries of Sikkim. Yuksam is the starting point for the trekkers to Tshokka, Dzongri, and Kanchendzonga National Park. Khechoplari, known as the wishing lake, is one of the sacred lakes and a popular destination for the local people and tourists as well.

Table 3. Site characteristics

Characteristics	Yuksam (1758-2050m)	Khechoplari (1800-1950m)
Distribution of population		
Family	274	72
Population	1572	442
No. of person per family	5.7	6.01
Ethnic groups	Mixed	Lepcha, Bhutia
Land use		
Land	1077.05	975.33
Irrigated	22.87	-
Non irrigated	893.95	592.72
Cultivable waste	67.74	100.58
Area not under cultivation	92.47	216.84
Liverstock		
Cattle	399	86
Sheep	180	5
Goat	321	96
Yak / Dzo	311	-
Horse	31	-
Pig	254	53

Yuksam plant resources and nature of exploitation

In Yuksam area the people used 27 species of trees for the purpose of fuelwood, fodder, and timber. Out of these, 6 species were used in house construction, 4 species for furniture making. 14 species for fuel wood and 13 species were used as fodder. Following is the list of timber, fuel wood and fodder and matrix ranking for timber, fuelwood and fodder.

Plants used in house construction (Yuksam)

Local Name	Scientific Name
Uttis	*Alnus neplensis*
Katus	*Castanopsis* sp.
Tarshing	*Beilschmieding* sp
Okhar	*Juglans regia*
Tooni	*Cedrela toona*
Dhupi	*Cryptomeria japonica*

Plants used in furniture making (Yuksam)

Okhar	*Juglans regia*
Tooni	*Cedrela toona*
Lampatay	*Duarbanga Sonneratioides*
Chanp	*Michelia* sp

Plants used as fire wood (Yuksam)

Local Name	Scientific Name
Uttis	*Alnus nepalensis*
Lati	*Amoora rohituka*
Katus	*Castanopsis hystrix*
Asara	*Viburnum colebridkianum*
Ghigune	*Eurya japonica*
Kharani	*Symploco ramosisima*
Angri	*Andromeda elliptica*
Tarsing	*Beilschmieding* sp
Mahua	*Engethardtia spicata*
Cherry	*Prumus cerasus*
Tuni	*Toona ciliata*
Aru	*Prunus nepalensis*
Chitwone	*Nyssa japanica*
Gurans	*Rhododendron arboreum*

Matrix ranking of timber, fuel wood, and fodder

Ranking	Poing score out of 100	Types	Description
1	21	Katus (*Castanopsis hystrix*)	good for fuel wood and also used for timber
2	19	Nebara (*Ficus hookeri*)	good fodder
3	18	Photta (*Trevetia palmata*)	good fodder
4	17	Chanp (*Michelia sp.*)	good timber and as well as fodder
4	17	Asare (*Viburnumcolebrookianum*)	fuel wood and fodder
5	16	Utis (*Alnus nepalensis*)	fuel wood and timber
5	16	Angri (*Andromeda elliptica*)	fuel wood
6	15	Jhiguni (*Eurya japonica*)	fuel wood
6	15	Dudilo (*Ficus nemoralis*)	good fodder
6	15	Amliso (*Thysolanea maxima*)	good fodder as well as soil binder
6	15	Payong (*Cephalostachym capitatum*)	fodder
7	14	Chiplay (*Crataeva unilocularis*)	good fodder
7	14	Gagun (*Sauruea napaulensis*)	fodder
7	14	Tarshing (*Beilschmieding sp*)	fuelwood as well as timber
8	13	Okhar (*Juglans regia*)	good timber
8	13	Mahua (*Engethardtia spicata*)	fuel wood
9	12	Bamboo (*Bambusa sp.*)	fodder
10	11	Khar (*Celtis tetrandra*)	fodder
10	11	Cherry (*Prunus cerasus*)	fodder as well as fuelwood
10	11	Argeli (*Daphne sp.*)	fuel wood
11	10	Tuni (*Toona ciliata*)	timber and fuel wood
11	10	Dhuppi (*Cryptomeria japonica*)	fuelwood and timber
11	10	Aru (*Prunus persica*)	fuelwood
11	10	Chitwone (*Nyssa javanica*)	fuelwood
11	10	Thotene (*Polygonum chinense*)	fodder
12	9	Guras (*Rhododendron arboreum*)	fuelwood
13	7	Kharane (*Symploco ramosisima*)	fuelwood

Plants used as fodder

Local Name	Scientific Name
Nebara	*Ficus hookeri*
Photta	*Trevetia palmata*
Chanp	*Michellia sp*
Asara	*Viburnum colebrookianum*
Dudilo	*Ficus nemoralis*
Amliso	*Thysolaena maxima*
Payong	*Cephalostachyum capitatum*
Chiplay	*Crataeva unilocularis*
Gagun	*Sauruea nepalensis*
Bamboo	*Bambusa sp*
Khar	*Celtis tetrandra*
Cherry	*Prunus cerasus*
thotena	*Polygonum*

Khechoplari plant resources and nature of exploitation

In Khechoplari area, the people used 17 species for the purpose of fuel wood, fodder and timber.

Out of these, 8 species are used as fuel wood, 9 species are used as fodder 8 species are used as timber. Following is the list of timber, fuel wood and fodder and matrix ranking for fodder, fuelwood and timber in Khechoplari area.

Timber plants

Local name (Nepali)	Scientific Name
Chanp	*Mongolia pterocarpa*
Katus	*Castanopsis hytrix*
Utis	*Alnus nepalensis*
Tooni	*Cedrela toona*
Phumsi	
Okhar	*Juglans regia*
Seris	*Albizzia sp.*
Pipli	*Symingtonia populnea*

List of fodder plants

Local Name (Nepali)	Scientific Name
Nebara	*Ficus hookeri*
Chanp	*Mangolia pterocarpa*
Photta	*Trevetia palmata*
Gagun	*Savravia napaulensis*
Asara	*Viburnum colebrookianum*
Amliso	*Grewia vestita*
Phumsi	
Seris	*Albizzia sp.*
Dhudilo	*Ficus nemoralis*

Plants used as fuel wood

Local Name	Scientific Name
Katus	*Castanopsis hystrix*
Asara	*Viburnum colebrookianum*
Utis	*Alnus nepalenis*
Argali	*Daphne sp*
Tooni	*Cedrela toona*
Jeguni	*Eurya japonica*
Mahuas	*Engethardtia spicata*
Pipli	*symingtonia populnea*

Conclusion

The data indicate that plant is not used for a single purpose only. Different plants are used in different ways. Utilisation of the plant resources, however, does not always mean damage or wastage of the total plant body. Selective utilisation by the lcoal people has contributed to develop a relationship with the plant community, which is at the same time intensive and durable. It is interesting to note that the highly used species are naturally profuse in occurrence and pressure of exploitation is not much on these plants. Moreover, indigenous cultures, through their long temporal adaptive mechanism, have developed some norms and values which are enough to maintain their zonal ecobalance. At present, all the balancing measures adopted at the cultural level have come under pressure from different external forces of change. At this stage, it is not possible to estimate as to what extent the balance is maintained. It needs more systematic works on the proper way of exploitation. A social scientist would be more interested in calculating the unit need of man in relation to selectivity of utilisation, rate of use, territoriality of exploitation, the plant resource productivity of any area, and the pressure of exploitation on any particular species, if any. If we are able to assess these factors quantitatively and qualitatively, evaluation of the problem of ecobalance may perhaps be possible to some extent and while doing that, one has to acknowledge the role of culture in promoting an eco-friendly approach Ambio-scientific evaluation should also give due consideration to the applicability of these factors.

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V.U. Jr. of Biological Sciencess (1999)

EXERCISE TRAINING AND ITS IMPACT ON BODY COMPOSITION AND LIPID LEVELS

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Abstract

Study of body composition and lipid levels are essential to get a detailed idea about ones' health and physique. The present investigations were carried out on 24 men with the age range of 25 to 34 years. The subjects were equally divided into two groups, keeping one group as control and the other as experimental. The subjects of the experimental group underwent a physical training on treadmill with the intensity of 60% of peak heart rate for 45 minutes per day, 3 days per week for 3 months. Body weight, BMI, LBM, body fat percent, fat weight, LBM/fat weight ratio, total cholesterol and triglyceride were studied at the beginning and the end of the tenure of experiment. Significant decrease in body weight, BMI, body fat percent, fat weight, total cholesterol and triglyceride and significant increase in LBM /fat weight ratio in the experimental group were observed after the exercise-training programme. No significant change in either body composition or lipid levels were seen in the control group. Therefore, the study indicates that physical exercise not only favourably changes ones' body weight and body fat percent, but also controls lipid levels and thus is essential for ones' health promotion.

Key words : Body composition, BMI, lipid, exercise.

Introduction

Presently, overweight and obesity are not only the problems of the affluent countries, but they are also major problems of the Indian society. Some of the probable reasons behind it may be a revolutionary change in the food habit and life-style in Indians. Overweight and over fatness are not only cosmetic problems, but are also related to hypertension, dyslipidaemia, diabetes mellitus and coronary artery diseases (8,9,12,13,14, 16, 24). Therefore, information on total body weight, body fat percent, fat weight, lean body mass (LBM) and LBM / fat weight ratio are useful in making judgement about one's health, physique and fitness.

Moderate to heavy exercise on a regular basis has been known to promote the expenditure of large amount of calories, and thus to help in achieving weight loss. Therefore, in order to deal with the problem of overweight and obesity, regular vigorous exercise may be prescribed to one who is fat. Exercise should also be prescribed to non-obese persons. Regular exercise not only reduces ones' body weight and body fat percent, but also controls hypertension (1,7), diabetes (6) and dyslipidaemia (5,21, 23). It thus is needed for ones' health promotion. Cross-sectional studies of occupational and leisure activity show encouraging associations between physical activity and good health at every age of people. (22). But unfortunately Indians are less conscious about the beneficial role of physical activity than the Westerner. Scanty reports are available regarding the impact of physical activity on body composition and blood lipids in Indians, which had prompted the authors to study in this field. The aim of the present study was (1) to find out how

physical exercise alters body composition and blood lipids in Indians, and (2) to find out how much of the exercise training will be effective to promote one's health if the intensity of exercise is sub-maximal, because most of the sedentary persons do not like to exercise with a high intensity.

Material and Methods

Subject Selection : -
24 healthy sedentary subjects with the age range of 35 to 44 years were recruited from a mediocre economic society. The subjects were healthy, well nutrited, free of any chronic disease, like,asthma, diabetes mallitus, anaemia, liver or kidney disease, and were not taking any medicine, known to affect lipid metabolism. Subjects, taking more than 4 cigarettes a day were excluded from the study. After an initial health check-up, subjects were divided into two groups : Group A and group B. Subjects of group A (Sedentary group) were asked to maintain a sedentary life throughout course of experiemnt. Subjects of the Group B (Experimental group) underwent a definite training schedule for 3 months.

Training Protocol :

Instrument used : Treadmill
Intensity of exercise : 60% of peak heart rate.
Duration of exercise : 45 minutes per day
Frequency of exercise : 3 days per week.
Tenure of exercise training : 3 months.
Time of exercise : Morning (between 7 am to 9 am)

Diet:

To avoid the influence of diet on body weight and fat, a similar type of food was supplied to the volunteers. As all the subjects, of both the groups, who volunteered themseleves to take part in the experiment, resided in the same university hostel, food was supplied to them by the hostel. Though the diet was adlibitum, fat intake was limited within 30% of total calorie intake. People were asked not to take any food outside the hostel during the course of experiment.

Parameters Studied :

Physical parameters : Height, weight, body mass index, lean body mass, % fat, fat weight, LBM / fat weight ratio.

Blood parameters : Total serum cholesterol and triglyceride.

Methods Used To Measure Different Parameters :

To determine the intensity of exercise, peak heart rate was calculated by subtracting ones' age from 220. The subjects used to run with the steady state heart rate of 110-115 beats per minute.

Height (cm) and weight (Kg) were measured with the help of standard anthropometric technique. BMI was calculated from body-weight (Kg) divided by height (miter) squared. Abdominal, chest and mid-thigh subcutaneous fat were measured by using Lange skin fold caliper to calculate body density by using the JP equation (11). Body fat percent (%fat) was calculated from body density, using Siri equation (25). Body fat weight (Kg) was calculated by dividing the product of body fat percent and body weight by 100. LBM (Kg) was calculated by subtracting BFW from body weight.

Between 7.30 to 8.30 a.m. venous-blood samples were obtained from the volunteers after a 12 hours fast, using the sitting position without an overly tight tourniquet. Proper care was taken so that hemolysis of blood could not take place. The blood samples were allowed to coagulate.Serum was collected in centrifuge tubes and allowed to centrifuge at 3000 rpm at 4^{0}C for 5 minutes to make it corpuscles free. Clear serum was collected in screw capped glass vials for storage. For all the subjects of group-B, time of collecting blood samples was at least 24 hours after the last training session.

Total cholesterol and triglycerides were estimated using the Boehringer Mannheim commercial kit for cholesterol and triglyceride, respectively.

Statistical Analysis :

Two-tail t-tests of significance for paired observations were performed to observe the significance level in each parameter between pre and post exercise-training session those were at the beginning and end of the experimental tenure (3 months).

Results

Table.1 and table.2 show the mean and SD value of the physical parameters, ie, height, weight, BMI, LBM, %fat, fat weight, LBM / fat weight ratio, and total cholesterol and triglyceride in control and experimental groups, respectively. Data show that the initial values of all the parameters and triglycerides in both the groups are within normal limit, though, the cholesterol levels and % fat remain at the higher normal range.

Table .1 : Mean and SD of the physical parameters and serum lipid levels in group A, at the beginning and end of the experiment.

CONTROL GROUP	Base-line values	After 3 months of Experiment
Age(years)	38.91,±2.97	-
Height (cm)	172.68,±5.85	-
Weight (Kg)*	64.87,±6.01	64.91,±5.87
BMI*	21.74,±1.53	21.75,±1.57
LBM(Kg)*	51.76,±13.6	51.73,±3.52
Fat weight (Kg)*	13.11,±3.31	13.18,±3.35
LBM/Fat weight ratio*	3.95,±0.61	3.92,±0.55
Body fat percent*	20.02,±3.39	20.12,±3.51
Total cholesterol (mg/dl)*	191.45,±20.09	193.86,±22.69
Triglyceride (mg/dl)*	126.52,±33.68	127.28,±29.68

*-p> 0.05 (not significant)

Table.1 shows no significant changes in any parameters, between the initial and the final levels (after the end of 3 months tenure of the experiment) in the control group.

Small but significant changes in body weight, % fat, fat-weight, LBM/fat weight ratio and lipid levels have been observed in the experimental group. Significant changes in both the total cholesterol and triglyceride levels have also been seen in the same group (Table 2).

Table.2 : Mean and SD of the physical parameters and serum lipid levels in group B, at the beginning (Pre-training) and end (Post-training) of the experiment.

EXPERIMENTAL GROUP	Pre-exercise-training (base line) value	Post-exercise training Value
Age(years)	38.75,±2.86	-
Height (cm)	169.33,±7.84	-
Weight (Kg)***	64.63,±7.04	63.29,±6.57
BMI***	22.49,±1.35	22.05,±1.56
LBM(Kg)*	51.80,±4.71	51.32,±4.66
Fat weight(Kg)*****	12.82,±2.94	11.97,±2.49
LBM/Fat weight ratio **	4.04,±0.75	4.29,±0.68
Body fat percent****	19.67,±2.78	18.78,±2.44
Total cholesterol (mg/dl)****	192.22,±20.44	180.88,±16.57
Triglyceride (mg/dl)**	130.29,±37.54	115.64,±27.93

*p>0.05,**p<0.05,***p<0.02,****p<0.01,*****p<0.001

Discussions

Results show that all the volunteers had normal body weight, BMI and triglyceride at the time they entered the training program but their average serum cholesterol levels and %fat were at the upper limit of the normal range as Lohman reported that 10-20% body fat is optimal for men (15).

Changes in body composition and lipid levels in men, aged 25 to 34 years, who exercised 3 days a week, at the intensity of 60% of peak heart rate, were observed after 3 months of training and compared to their pre-exercise levels. The control group did not show any significant difference in any parameter at the end of the experiment from

the initial values, though there were little increase in body weight, %fat and lipid levels. This was probably due to the fact that the volunteers of group A were not allowed to do exercise except the normal sedentary activities during the course of the present investigation so that there was no opportunity to spend excess energy like the subjects of group B and at the same time, they were bound to take same diet as the group B to avoid the dietary influence on body weight and lipid profile. So significant change in body weight and other parameters including lipids did not occur after 3 months in the control group.

The subjects of group B exercised at the intensity of 60% of peak heart rate for 45 minutes for 3 days a week for 3 months. The frequency was so chosen because exercise frequency was important while considering exercise for weight reduction. In a summary of six studies investigating optimal training frequency (20), it was observed that training 2 days a week did not change body mass, fat folds or percent body fat. Training 3-4 days a week , however, had a significant effect. At least 3 days of training per week seemed to be required to bring about changes in body composition through exercise (2). 45 minutes duration per day was fixed becuase Milesis et al (17) reported that fat loss is directly associated to the duration of exercise and 30-45minutes per day is essential to get a favorable change. Regarding the intensity of exercise, we chose a moderate one (60% of peak heart rate) to investigate the effect of moderate intensity on body composition and lipid levels. The average distance covered by the volunteers of group B at the end of the experiment, after 12 weeks, was 165 km. The average speed was 6.5 km per hour.

No significant change in LBM after 3 months of exercise training was observed in the volunteers of the experimental group, while body weight and BMI reduced to 1.99% and body fat percent and body fat weight reduced to 4.26% and 6.21% respectively (figure1). The observations of the present study were very similar to the observations of Wilmore et al (26) who reported the effect of 10 week jogging on 17-59 years aged men and observed a small but significant change in body ,fat percent and body mass but not in LBM in them, though Ballor et al (3) reported an increase in LBM, following an exercise training along with reduction in body weight and fat weight. As there was no significant change in lean body mass but fat weight reduced to 6.21% (figure.1), the LBM/fat weight ratio increased significantly in the experimental group after 3-month of physical conditioning (table.2), and the decrease in body mass was solely due to reduction in fat weight. Exercise induced fat loss was also reported by several authors (4,18). Zuti and Goldding reported combination of diet and exercise to be the most effective approach to weight loss rather than diet or exercise alone, because the dieters lost a considerable amount of lean tissue along with the fat loss which may not be desirable by an individual (27).

Loss of body weight and body fat following exercise training take place due to burning of calories which usually comes from lipolysis in adipose tissues (19). As a result, there is reduction in the fat percent, fat weight and ultimately in the body weight. The rate of reduction depends on the amount of exercise, that is the combination of intensity, duration and frequency of exercise (19). In 1976, Milesis *et al* showed the effect of duration of exercise on fat loss with training. According to their observations, body mass, fat fold and fat weight decrease gradually with the increase in duration of exercise per day. They showed maximum reduction in body mass and fat weight

occurred in the subjects of that group who exercised for 45 minutes per day in comparison to the other two groups, the subjects of which used to exercise for 15 and 30 minutes respectively (17). Cholesterol and triglyceride levels also decreased significantly in group B (table.2) while there was a nonsignificant increase in group A (table.1). 5.66% reduction in cholesterol level and 9.22% reduction in triglyceride level (figure.2), after 3 month of exercise training in group B, indicated that regular physical exercise resulted favorable changes in serum lipid concentrations.

From the present experiment, it may be concluded that regular exercise, even in moderate intensity, is effective enough to cause a favorable change in body composition and blood lipid components in young adult Indians.

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Figure. 1. COMPARISONS OF PERCENTAGE CHANGES IN SOME PHYSICAL PARAMETERS BETWEEN CONTROL AND EXPERIMENTAL GROUP, TAKING THE BASE LINE LEVELS AS 100%

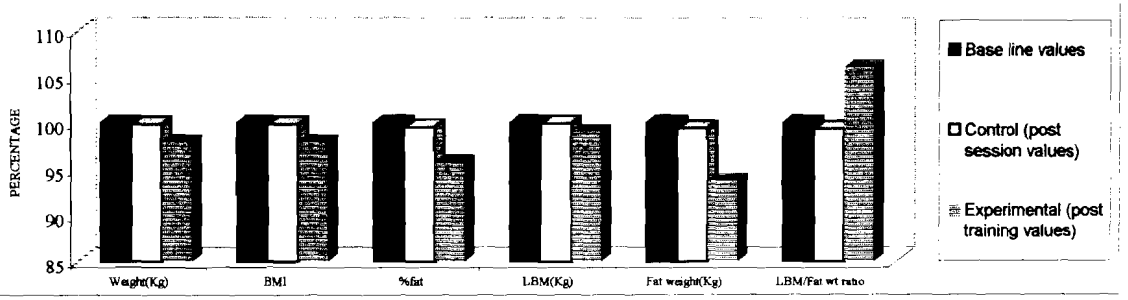
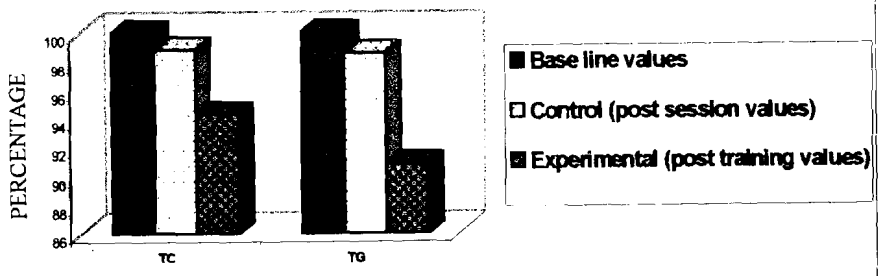


Figure. 2. COMPARISON OF PERCENTAGE CHANGES IN TOTAL CHOLESTEROL (TC) AND TRIGLYCERIDE (TG) CONCENTRATIONS BETWEEN CONTROL AND EXPERIMENTAL GROUP, TAKING THE BASE-LINE LEVELS AS 100%



MAKING AQUATIC WEEDS USEFUL III : NUTRITIVE VALUE OF *Nechamandra alternifolia* (Roxb. ex Weight) Thw. MEAL AS FEED FOR THE INDIAN MAJOR CARP, *Labeo rohita* (Hamilton)

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Abstract

A 60 day culture experiment was conducted during early summer (28.0-32.5°C) with duplicate treatments in 100 l aquarium to determine the suitability and possible utilization of *Nechamandra* meal as an ingredients for Indian Major Carp, *Labeo rohita* (length 71.0 ±3.0 mm and weight 3.2±0.7g). feed. Five experimental diets were formulated to contain 25% (D_1), 50% (D_4) and 100% (D_5) of the total dietary protein as plant protein using *Nechamandra* leaf meal, a control diet (D_2) with fishmeal and a cheap quality conventional diet (D_3). All the diets were isonitrogenous (30% CP) except for diets containing 100% plant protein (19.7% CP0. There was a trend of reduced growth performance and feed utilization efficiency with increase in *Nechamandra* incorporation for all treatments. In general, *Nechamandra* meal gave a significantly better growth response (up to 50% meal) as compared to fish meal-based diet (D_2) and 100% meal diet (D_5). even lower than the cheap quality conventional diet (D_3).

Key words : *Aquatic weeds (Nechamandra), Labeo, growth, feed efficiency, metabolism*

Introduction

The meance of aquatic weed is reaching alarming proportions in many parts of the world, but it is particularly sever in tropical nations where warm water and increasing number of dams and irrigation projects foster aquatic plant growth. Furthermore, the problem has become more acute because of increasing enrichment of natural water by fertilizer run off and by nutrients from human and agricultural wastes. Unfortunately, there is no simple way to reduce the infestations. The present study explores an alternative through the conversion of aquatic weeds to our food through fish.

The increasing cost of fish feed and their unavailability in future has focused research on reducing the cost of the msot expensive item, the protien source. Numerous works have been reported on the possible replacement of fish meal which is used in most fish feeds: algal meals or single-cell proteins(18,9,7), leaf protein concentrate (LPC) and aquatic weeds (20, 16, 3, 31, 21). Inspite of availability of a number of literature on the utilization of aquatic weeds by *Ctenopharyngodon* idella (28, 17, 15, 14), *Tilapia sp. Sarotherodon sp., Metynnis roosvetti and Mylossoma argentium, Hypophthalmichthys molitrix, Barbus gonionotus, Cyprinus carpio, Carassius auratus*, etc. (20, 10) very little attempt has so far been made to see the possibilities of incoropration of weds as feed by the IMC. Observations revealed that the Indian Major carps can utilize some of the aquatic weeds to a limited extent (2, 19, 25).

The present study is one of a series aimed at developing least cost technology using readily available plant ingredients for *Labeo rohita* (Ham.) to evaluate the influence of the aquatic weed *Nechamandra alternifolia* on growth performance, conversion efficiency and biochemial composition of fish flesh, thereby making biological control of the weeds more easy and economised on one the hand and reducing the cost of feed on the other.

Materials And Methods

Diets

Ground fish meal and test *Nechamandra* leaf meal were used as major dietary protein sources in diet supplemnts with animal fat, mustard oil cake and rice bran. Five experimental diets were formulated to contain varying ratios of plant to animal proteins - 25:75 (D3), 50:50 (D_4) and 100:0(D). Diet D_2 with 100.0% fish meal protein served as a control. D_1 as a cheap quality conventional diet and D_2, D_4 and D_5 contained sun dried (72 h) leaf meal which contributed 25.0% (D_2), 50.0% (D_4) or 100.0% (D_5) of the total dietary protein, respectively (Table 1A). The diets were isonitrogenous and isocaloric except diets D_5 (19.7% crude protein) (Table 1B).

Esperimental systems and animals

The feeding trial was conducted in specially designed fibre glass aquaria (Ray and Patra, 19870 of 100 l capacity and the water flow from the header tank into the azquaria was maintained at a maximum rate of 1 min^{-1}. Each experiment was replicatd . Water temperature, dissolved oxygen, total alkalinity, total ammonia and pH were monitored at each week intervals and varied from 26.0-28.0°C, 9.1-9.5 mgl^{-1}, 101.0-105.5mg^{-1}, 0.5-1.5 mgl^{-1}, and 7.2-7.6, respectively (APHA, 1976).

Labeo rohita fingerlings (average length 71.0 mm and weight 3.2g) were obtained from lcoal fish seed dealer, and acclimatized for 15 days in the laboratory conditin, with standard diet (30.0% crude protein). The fingerlings were randomly distributed between the aquaria at a stocking density of 20 fish/aquaria. Fishes were fed twice daily to satiation (6.0% body weight) between 9.00 & 10.00 hr. and 16.00 and 17.00 hr. Daily feeding allowance was adjusted each week on the basis of the average weight of the fish. The experimental fish were weighted individually at the beginning and the end of the feeding trial, but batch weighting was used at one-week intervals for growth rate calculation.

The study was conducted for 60 days after which the experimetnal fish was sacrificed, and fish carcasses taken for gross chemical analysis. In the last week of the experiment, faeces were sampled from the experimental aquaria. Faeces collected from replicate treatments were pooled, dried in an air-oven (at 60°C), and stored for subsequent proximate analysis.

Analytical Methods

Feed ingredients, experimental diets, and fish carcasses were analyzed for their proximate composition by the AOAC (1984) methods in triplicate: moisture, determine by ove-drying at 85.0°C to constant weight; crude protein, determined indirectly from the analysis of total Kjeldahl notrogen (crude protein = N x 6.25) by the meiro-Kjeldhal methods; crude lipid, determined by extraction with petroleum ether (60-.0-62.0°C bp) for 6 hr. in a Xoxhlet apparatus; ash, determined from weighed samples in a porcelain-silica crucible placed in a muffle furnace 500.0±50°C for 4 hr. (minimum.); fibre content were determiend using acid-base digestion. The apparent nutrient digestibility measurements, Chromic oxide

(Cr_2O_3) were estimated in the diets and faeces using the rapid method of Furukawa and Tsukahara (1966).

Statistical analysis of the results of the feeding trials were made by using ANOVA and Duncan's Range Test (12) to evaluate the mean differences among individuals diets at the 0.05 significance level.

Results and Discussion

Proximate composition of *Nechamandra alternifolia*

It is a submerged aquatic herbs. Stem long, slender, branched, and herbaceous. Leaves simple, linear, alternate, green, apex acute. Flowers actinomorphic and epigynous subtended and encolosed by spathe. Perianth segments 6, free, usually 2-seriate with 3 in each series. Fruit berry like. Common in tanks, ponds and other swampy areas.

The proximate composition of *Nechamandra*, and diets D1-D4, performed on a dry matter basis are presented in Table-1. The protein (19.7%) and calorie content (3.87 Kcal g^{-1}) of *N. alternifolia* is comparable to otehr aquatic weeds (*Nymphoides*: 15.17, 3.85; *Hydrilla*: 14.67, 3.96; *Spirodelal: 13.60, 3.17;* Deratophylum: 14.37, 3.17; *Cynodon:* 14.80, 3.94; etc.).

Feed Intake, Weight gain and condition factor

The performance of fish feed on diets D_1-D_5 are given in Table-2 and 3. The average daily dru matter intake per 100 g of fish was significantly higher with D2 (fish meal based diet) as compared with the diet D_1, D_3, D_4 and D ($p<0.05$-0.01). the mean daily food consumption was variable in all groups of fish as seen in the consumption patterns in the three *Nechamandra* meal based diets and D_1, D_2,. Generally a day or two of high consumption was followed by a low consumption. Consumption in g/g fish day-1 decreased with increasing body weight and as g/fish day-1. The same kind of observations was recorded by De Silva and Gunasekera (10) in *Oreochromis* fry and (23) in *Anabas* fry.

Digestibility of nutrients

The apparent digestibility values of crude protein, crude lipid and gross energy were significantly higher ($p<0.050$ for the diet D_2 as compared to D_1, D_3, D_4 and D_5 respectively (Table 2). the increased crude protein digestibility may be due to reduced fibre content and slightly higher protein contents in the diet as has been reported by Wannigama *et. al.* (1985) in *Sarotherodon*, for diets devoid of rice bran. High values of lipid digestibility with all the diets may also be a result of high temperature (26-28°C) with the level of incorporation of *Nechamandra* leaf meal. An increase in the level of plant protein, regadless of treatment, resulted in a significant reduction in apparent nutrient digestibility.

Nitrogen and energy balance

The intake and absorption of feed N_2 (mg/100 g fish d^{-1}) was significantly higher ($p<0.05$) in D_2, D_3, D_4, and D_1 respectively as compaed to D5 (100.0% *Nechamandra* leaf meal diet). Where as, the absorbed feed energies (Cal/100 g fish day^{-1}) was significantly higehr ($P<0.010$ with the diet D_3, D_1 and D_2 in comparison with D_4 and D_5 (100.0% plant protein) (Table 2). The net dietary nitrogen and energy intake increases with increasing body weight. However, these were dependent on the dietary protein level.

Percentage weight gain, FCR, PER and %NPU

The mean weight and percentage weight

gain (Fw-Iw/Iwx 100), a 15 days interval, of *Labeo* fry maintained on different diets (D_1-D_5) is shown in Table 5. The fry maintained on the formulated diet D_2 grow significantly ($p<0.05$) well and at all the three incorporated level the best performance was observed in fry maintained on diets with substitution up to 25.0% (D_3) followed by 50.0% (D_4) and 100.0%(D_5), which may be comparable with the conventional diets (D_1).

The food conversion ratio (g dry weight of feed consumed/g increase in biomass), the protein efficiency ratio (g increase in biomass/g dry weight of protein consumed) and the % net protein utilization [(net increase in carcass protein x 100)/ protein consumed)] ranged from 1.62 (D_2) to 2.19 (D_5), 1.73(D_1) to 2.32(D_3), and 20.16(D_1) to 27.30(D_3), respectivley (Table 4). The best PCR of 1.62 was observed in fry maintained on the diet D_2. The FCR of diets with up to 50.0% *Nechamandra* leaf meal substitution was not significantly differ from the diet (D_1), however, at the 100.0% plant protein level, the FCR was substantially poor. the trends of change in PER and %NPU in relation to the substitution level are shown in Table 4, i.e. within each treatment the PER and NPU values were significantly reduced with an increase in the level of leaf meal incorporation for all treatments (except D_2). The present study, correlate the observations of Bemis and Medland (8) between the dietary protein level and FCR, and negative correlation of dietary protein level and PER.(25)

Carcass Composition

The carcass composition of experimental fish at the beginning and end of the experiment is shown in Table 6. An increase in the *Nechamandra* leaf meal inclusion resulted in a decrease in carcass protein, dry matter, and energy contents and an increase (not signifidant0 in carcass moisture, fat and ash content in all treatments. At the low level of incorporation of 25.0% up to 50.0% plant protein, the carcass composition was not differ, significantly. A positive correlation was observed between the dietary protein level and that of the carcass (not significant) which has been reported earlier by Patra and Ray (26) in *Anabas*. The present investigation did not show a reciproal relationship btween moisture and lipid content in the carcass, although reported by Alexis *et al* (1) and Patra (22). Ash and lipid contents, showed a direct relationship with that of diet, which agreed with the obsdervations of Viola and Zohar (29). Wee and Wang (1987) reported that fish meal could be replaced up to 50.0% by *Leucaena* leaf meal (soaked) in practical diets for Nile *Tilapia*.

Conclusion

The present study indicates the *Nechamandra* leaf meal could be incorporated up to 50.0% into practical diets of *L. rothita*, as a non-conventional source of protein on the one hand and reduce the cost of feed on the other during formulation.

Acknowledgements

We are grateful to the All India Council for Technical Education (AICTE), New Delhi, India of financial support and Department of Zoology, Vidyasagar University and Central Institute if Freshwater Aquaculture (CIFA), Bhubaneshwar, India, for all kinds of laboratory and field facilites.

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Table - 1 : Composition (g/100g) and proximate analysis (%, dry weight basis0 of experimental diets (D_1-D_5)

A. Composition of Experimental Diets

Diets	*nechamandra* leaf meal				
	D_1	D_2	D_3	D_4	D_5
Plant protein as % of total protein	0.0	0.0	25.0	50.0	100.0
Nechamandra meal	0.0	0.0	43.0	63.0	93.0
Fish meal	0.0	50.0	40.0	25.0	0.0
Mustard Oil Cake	50.0	20.0	10.0	5.0	0.0
Rice Bran	43.0	23.0	0.0	0.0	0.0
Cod Liver Oil	2.0	1.0	1.2	2.0	2.5
Corn Oil	1.0	2.0	1.8	1.0	0.5
Binder1	1.5	1.5	1.5	1.5	1.5
Premix2	2.0	2.0	2.0	2.0	2.0
Chromic Oxide	0.5	0.5	0.5	0.5	0.5

1. Wheat Flour

2. Vitamin and mineral mixture (Vitaminate Forte; Roche India Ltd.). Each 0.8g contains : Vit. A I.P. 2500 I.U.; Vit. B1 I.P. 2.0 mg; Vit B2 I.P. 3.0 mg; Nicotinamide I.P. 25.0mg; Vit. B6 I.P. 1.5mg; Calcium Pantothenate U.S.P. 5.0mg; Vit. B12 I.P. 1.0 mcg; Vit C I.P. 50.0mg; Vit D3 U.S.P. 200 I.U.; Vit. E.N.F. 10.0mg; Vit. H 0.05mg; Calcium Phosphate I.P. 208.0mg; Dried Ferrous Sulphate I.P. 10.6mg; Magnesium Phosphate 48.0mg; Manganese hypophosphite 0.6mg; total phosphorus in the preparation 44.6mg.

B. Proximate Analysis of Experimental Diets

Components	Diets				
	D_1	D_2	D_3	D_4	D_5
Moisture	4.92	3.36	3.66	4.00	4.97
Ash	13.47	11.08	14.68	16.62	21.01
Crude protein	28.21	30.55	29.37	29.07	19.70
Crude lipid	11.23	9.98	10.33	10.29	10.95
Crude fibre	14.47	8.31	4.50	5.36	7.12
Nitrogen-free extract	26.59	26.51	3.32	37.74	45.05
Gross energy (Cal.)	375.3	375.6	400.2	416.2	399.5

Each data is a mean of 10 separate determinations.

Table - 2 : Performance of the fish fed experimental diets for 60 days.

Parametrs	Diets				
	D_1	D_2	D_3	D_4	D_5
A. Feed Intake and Weight Gain					
Numbber of test animal	20	20	20	20	20
Initial body weight (g)	3.21	3.12	3.24	3.15	3.22
Live weight gain(g)	16.0	28.6	23.9	19.9	14.3
Average weight gain (g/d)	0.27	0.48	0.40	0.33	0.24
Percentage weight gain(%)	498.4	916.4	740.04	636.2	445.3
Specific growth rate (%)	2.98	3.87	3.53	3.28	2.83
Daily dry matter intake (mg/ 100 g fish)	5416	5978	5812	5729	5410
Digestible protein intake (mg/100 g fish/d)	1527	1826	1706	1665	1065
B. Apparent Digestibility Co-efficient (%)					
Crude protein	62.75	89.19	78.26	67.11	58.97
Crude lipid	80.77	90.78	87.23	84.19	71.12
Gross energy	67.05	78.82	73.17	70.23	65.67
C. Nitrogen Balance (mg/100 g fish/d)					
Nitrogen intake	244.3	292.1	272.9	266.4	170.4
Nitrogen absorbed	203.8	252.3	231.7	224.9	137.5
D. Energy Balance (Cal/100 g fish/d)					
Gross energy intake	2032	2245	2325	2384	2161
Energy absorbed	1695	1939	1963	1941	1743

Table - 3 : Average length, weight, condition factor and daily growth rate of *L. rohita* fed on experimental diets D1OD5 for 60 days[1].

Diets	Initial			Final			ADG
	Length (mm)	Weight (g)	c.f.	Length (mm)	Weight (g)	c.f.	(g/day)
D_1	72.0±1.0	3.21±0.6	0.860	109.0±3.0	19.21±0.2	1.483	0.266[c]
D_2	71.0±1.0	3.12±0.5	0.871	145.0±4.0	31.72±0.3	1.040	0.477[a]
D_3	73.0±1.0	3.24±0.4	0.832	126.0±3.0	27.23±0.6	1.361	0.399[b]
D_4	70.0±3.0	3.15±0.7	0.918	118.0±5.0	23.19±0.7	1.411	0.334[b]
D_5	72.0±1.0	3.22±0.6	0.862	103.0±2.0	27.56±0.5	1.606	0.239[c]

[1]figures in the same rows having the same superscript are not significantly different ($p<0.05$).

Table - 4 : Percentage weight gain(%) food conversion ratio (FCR) protein efficiency ratio (PER) and Net protein utilization (NPU) (%) of *L. rohita* fry maintained on different diets for 60 days[1].

Diets	% weight gain	FCR	PER	% NPU
D_1	498.4[d]	2.05[b]	1.73[b]	20.16[a]
D_2	916.4[a]	1.62[a]	2.19[a]	24.57[b]
D_3	737.6[b]	1.69[a]	2.00[a]	21.16[a]
D_4	631.7[c]	1.86[a]	1.85[ab]	21.62[a]
D_5	444.1[d]	2.19[b]	2.32[a]	27.30[b]

[1]Figures in the same rows having the same superscript are not significantly different ($p<0.05$).

Table - 5 : The effec tof diffeent levels of *Nechamandra* meal on grwoth rate of *L. rohita*[1].

Diets	Days on trial				
	0 (mean±S.E.	15	30	45	60 (mean±S.E.)
D_1	3.21[a]±0.6	7.54 (134.8)	10.66 (231.7)	15.12 (371.0)	19.21±0.2[c] (498.4)
D_2	3.12[a]±0.5	8.77 (181.0)	15.75 (404.8)	23.87 (665.0)	31.72±0.3[b] (916.6)
D_3	3.24[a]±0.4	8.15 (151.5)	13.71 323.1)	20.05 (518.8)	27.23±0.6[d] (740.4)
D_4	3.15[a]±0.7	7.82 (148.2)	12.11 (284.4)	17.96 (470.1)	23.19±0.7[d] (636.2)
D_5	3.22[a]±0.6	7.24 (124.8)	9.94 (208.6)	14.39 (346.8)	17.56±0.5[c] (445.3)

[1]Figures in the same rows having the same superscript are not significantly different ($p<0.05$).

Figures in the paenthesis represent the % weight gain.

Table 6. Gross carcass composition of experimental fish at the beginning and end of the experiment (values are expressed as %, wet weight basis)[1].

Components	Intial	Diets				
		D_1	D_2	D_3	D_4	D_5
Moisture	89.63[a]	81.92[b]	78.27[b]	79.19[b]	80.01[b]	82.46[b]
Dry matter	10.37[a]	18.08[b]	21.73[bc]	20.81[bc]	19.99[bc]	17.54[b]
Crude protein	4.07[a]	9.73[b]	10.97[b]	10.56[b]	10.09[b]	9.59[b]
Crude lipid	2.17[a]	4.12[b]	3.92[b]	3.97[b]	4.05[b]	4.16[b]
Ash	2.12[a]	2.76[a]	2.30[a]	2.39[a]	2.47[a]	2.82[a]
Gross energy	0.51[a]	0.99[a]	1.17[a]	1.13[a]	1.09[a]	0.92[a]

[1]Figures in the same rows having the same superscipt are not significantly different ($P<0.05$)

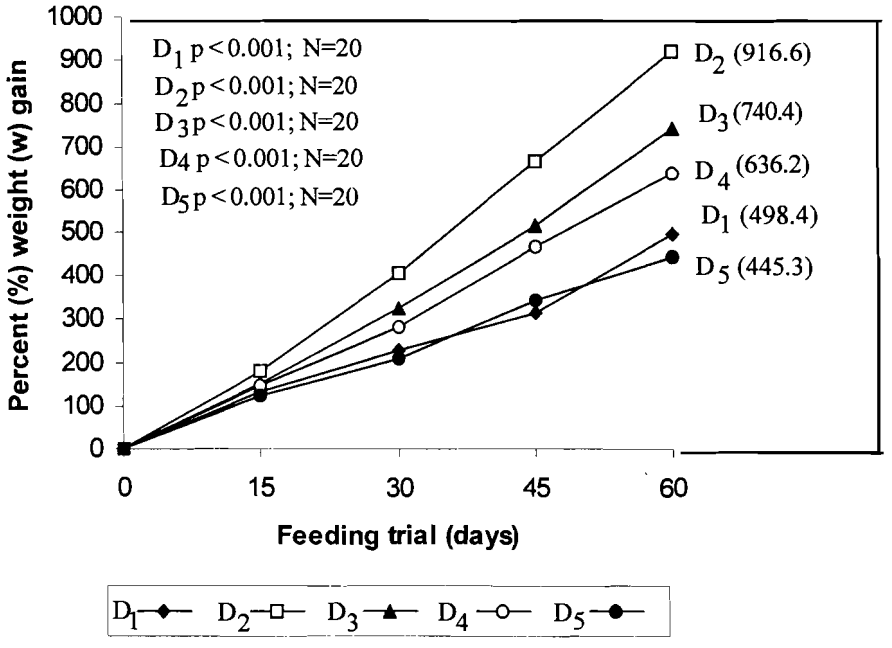

Fig. 1. The percent weight gain of *Labeo rohita* fed with experimental diets (D1 - D 5) containing different levels of *Nechamandra.*

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VARIATION IN PALM INDEX : AN ANTHROPOMETRIC APPRAISAL

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Abstract

Variation in palm index of right and left hands occurs almost naturally. But this variation may have a community bias in as much as culturally-defined activities pertaining to a community may also have a bearing on it. In the present study a comparison of the width and length of the palm expressed as 'palm index'has been made between two sampling groups of males and females drawn from the Brahmins and Santals of rural Midnapore. The results indicate that hands engaged in heavier and harder works are more likely to have wider palms. Here culturally determined division of labour within the community and between communities may appear to function as variables.

Key words : palm index, bilateral asymmetry, sexual dimorphism.

Introduction

It is a natural tendency that right handed individuals would be more numerous: nearly 90% of the individuals are right handed. Science has not yet come up with a reasonable explanation for such marked imbalance in handedness among humans. Despite research for more than half a century, experts are still quibbling over the complex web of genes, culture and environment.

The right handed individuals use right hand more for performing various types of works than the left hand. The right hand is not only used more frequently, but it is used for performed skillful, artistic and heavy works than the left hand. The differential use of right and left hands may affect the structure of palm. In this study an attempt has been made to calculate the palm index and compare the indices at various levels.

The present investigation is related to the collection of somatometric data relating to the width and length of the palm. It has been indicated that differential hand use pattern may have something to do with the width and length of the palm. Therefore, the first objective of this study is to find out the range and variability of the palm indices.

The second objective is to find out the extent of bilateral asymmetry in the palm index of the same individual with the assumption that there may be considerable variation between the right and left hands.

Apart from differences in the primary sex characters between the males and females, there may be many other physical characters which are virtually unknown to us. So, the third objective is to know the magnitude of sexual dimorphism relating to the palm index among the Brahmins and Santals, who, incidentally, form the core study groups.

The last consideration is to assess the extent of variation in the palm index at the intercommunity level on the consideration that each and every community has its own type of subsistence pattern. The differential grades of hand use among the Brahmins and Santals may be viewed from this angle.

Materials and Methods

In the present investigation four hundred unrelated, adult, non-senescent and right handed individuals of both sexes belonging to the age class ranging between 25 to 50 years have been included. The samples have been drawn from the rural areas of Midnapore district. The Santal samples came from the Santal-dominated villages of Jhargram sub-division and the Brahmn samples from North Sadar and Ghatal subdivisions.

Group and sex-wise composition of the samples are given below :

Group	Male	Female	Total
Brahmin	100	100	200
Santal	100	100	200
Total	200	200	400

Both Santals and Brahmins are representatives of two endogamous goups the former of caste endogamy and the latter of tribal endogamy. As endogamous groups, they are more or less reproductively isolated, and therefore, may be treated as two distinct populations.

Right handedness has been determined through the asking of some pre-set questions to the subjects regarding their hand use pattern. The subject who uses his or her right hand more than the left hand and performs heavier, skillful and artistic works by the right hand has been identified as right handed individual.

Emphasis has also been given to ensure that subjects should not be uterine brothers or sisters. Only one among the uterine brothers and one among the uterine sisters were selected for study. Any particular genetical trend that might have within the family was taken care of.

It is a difficult task to determine the actual age because most of the rural people have no written records of their age.yet, efforts were made to record their age as accurate as possible through cross-comparison with the known age of an individual in the neighbourhood or on the basis of any chronologically established event.

Only a standard sliding caliper was used for taking the measurements and a skin marking pencil was used for marking the land marks. The measurements were taken on the hand with the help of techniques recommended by Martin (1928). The measurements taken on the palm are given under results.

Palm Length :- It is the distance between the stylion to the basal crease of the ventral surface of the middle finger, nearest to the palm surface.

Palm breadth :- It is the distance between the metacarpal radiale to ulnare.

The placing of hand is an important aspect for taking the accurate measurement. While taking the measurements on the hand, the straight position of forearm and hand was used. In this position, the palm was kept down, with stretched fingers on the table or any flat surface with the axis of the forearm and axis of the middle metacarpal in one line. Palm index has been calculated in the following way (Bayer et al, 1930).

$$\text{Palm index} = \frac{\text{Palm breadth}}{\text{Palm length}} \times 100$$

After calculating the palm indices, the range, arithmetic mean, standard deviation and co-efficient of variation of these indices of each category have been estimated.

Results And Discussion

Table 1. Nature of each category

Brahmin	Right hand	Left hand
Male series		
Range	68.60-89.89	66.09-87.78
X ± S.E.	80.11±0.476	77.99 ± 0.467
S.D.± S.E.	4.76±0.336	4.67±0.330
C.V.±S.E.	5.94±0.420	5.99±0.423
Female series		
Range	69.70-90.90	62.72-89.41
X±S.E.	77.40±0.421	75.66±0.466
S.D.±S.E.	4.21±0.298	4.66±0.330
C.V.±S.E.	5.44±0.385	6.16±0.435
Santal		
Male series		
Range	69.82-98.94	70.80-95.79
X±S.E.	82.46±0.520	80.80±0.486
S.D.±S.E.	5.20±0.368	4.86±0.344
C.V.±S.E.	6.31±0.445	6.01±0.425
Female series		
Range	74.72-94.50	72.17-92.13
X±S.E.	82.10±0.391	80.11±0.339
S.D.±S.E.	3.91±0.276	3.99±0.282
C.V.±S.E.	4.76±0.337	4.98±0.352

From the above table, it is observed that the highest value of palm index is 98.94 which belongs to the right hand of the Santal male series and the lowest value of it is 62.72 which comes from the left hand of the Brahmin female series. The range of palm index is higher in the right hand of the Santal male series varying between 69.82 to 98.94. Its lower range belongs to the right hand of the Santal female series which varies between 74.72 to 94.50. It is to be noted from the Table 1 that the right hand of the Santal male series has the highest variability. The right hand of the Santal famale series is the least variable as indicated by the corresponding values of standard deviation and co-efficient of variation.

Table-2. Bilateral asymmetry with respect to palm index

	Mean Right hand	Left hand	Mean difference
Brahmin			
Male Series	80.11	77.99	2.12
Female Series	77.40	75.66	1.74
Santal			
Male Series	82.46	80.90	1.66
Female Series	82.10	80.11	1.99

If we compare the mean values of the palm indices of the right hand of each category with those of the corresponding left hand, it is evident that the former has higher mean values than the left hand in each and every case. The right-left mean difference is the highest in the Brahmin males and it is the lowest in the Santal males. Therefore, it can be said that the palm of right hand is of broader type and in the left hand it is more of an elongated type. The possible explanation for broadness of the palm of right hand may be that at the time of using right hand for power and precision gripping maximum stress is exerted on that hand.

Table 3. Sexual dimorphism

Brahmin	Mean Male series	Female series	Mean difference.
Right hand	80.11	77.40	2.71
Left hand	77.99	75.66	2.33
Santal			
Right hand	82.46	82.10	0.36
Left hand	80.80	80.11	0.69

Table 3 reveals that sexual dimorphism is more pronounced in the Brahmin than is the case with the Santals. The values of mean

differences are more than two in the Santals, but in the Brahmins it is below one. The Brahmin males have broader hands than their female counterpart. In the Santals the palm indices have greater mean values then the Brahmin but the sexual dimorphism is less marked. The Santal males and females have more or less similar types of hand.

In the socio-cultural field among the Brahmins there is a clear distinction of labour between the males and females. In general, heavy and strenuous works are done by the Brahmin males. On the other hand, the females are engaged in lighter works. But in the Santals there is no such clearcut division of labour and the Santal females also perform heavy and strenuous works side by side with their male counterpart. The division of labour between the males and females may have something to do with the sexual dimorphism as indicated in the palm ndex.

Table 4. Inter-community difference

	Mean Santal	Mean Brahmin	Mean difference
Male series			
Right hand	82.46	80.11	2.35
Left hand	80.80	77.99	2.81
Female series			
Right hand	82.10	77.40	4.70
Left hand	80.11	75.66	4.45

To understand the inter-community difference a comparison has been made between the corresponding categories. From the Table 4 it is observed that inter-community differences are well marked in each and every category. But it is interesting to note that inter-community differences are more marked in the female series in both the hands. There is a clear distinction in hand use pattern between the Brahmins and the Santals and this distinction is more pronounced in the females. Probably hand use pattern affects the palm structure as well. In general, the Santals have wider palms than their Brahmin counterpart.

From the observations made, it may be tentatively suggested that the difference in hand use pattern is partly conditioned by culturally-guided labour division between the males and females and between the Santal and Brahmins. This difference may have something to do with the shaping of palm as well. Broadly speaking, the hand engaged in heavier and harder works is likely to have a wider palm. On the other hand, it is more probable that the hand used less frequently and engaged in lighter works will have a narrower palm. Palm indices are indicative of this trend.

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