Radical changes in land use and natural resource governance over the past century have resulted in rapid degradation of our native ecosystems and biodiversity. The time has come to conserve biodiversity for sustainable development by comprehensive plan designed for the benefit of the entire world. Preserving global biodiversity is a priority in strategic conservation plans that are designed to engage public policy and concerns affecting local, regional and global scales of communities, ecosystems, and cultures. This book constitutes research and review papers on various topics like diversity of medicinal plants, animals, phytoplanktons, zooplanktons, aero bio components, fungi from soil, decomposing leaf , water, biodiversity and environmental sustainability, sustainable development etc. written by professors and researchers. This book is useful for researchers, academicians, students, nature lovers, environmentalists, government officials and policy makers etc.

Dr. Pratap Naikwade is editor and one of authors of this book. He has outstanding academic career and presently working as Head, Dept of Botany, ASP College Devrukh, India. He has completed post doc research from USA. He is author of several research papers, worked as invited speaker, recipient of many Awards and got international recognition.

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CHAPTER 1

Medicinal Plants Diversity in Forest Area of Raigad District of Maharashtra State-India

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Abstract

The present study deals with the exploration, identification, documentation and ethnobotanical survey with respect to medicinal plants from Raigad district of Maharashtra state-India. This area is rich in flora where plants of various categories are growing in their unstudied habitat. The rich resource is disappearing at an alarming rate as a result of over-exploitation, industrialization, development projects and civilization. Therefore, the management of traditional medicinal plant resources has become a matter of urgency. An ever-increasing demand of uniform medicinal plants based medicines wants their systematic utilization and mass production through various propagation practices. The information pertaining to botanical name, common name, family, morphology, parts used and therapeutics (Medicinal properties and values) was identified with the help of local population and available literature. The survey documented 294 wild medicinal plant species belonging to 255 genera and 90 families. Out of these wild medicinal plants 18 species belongs to the family Fabaceae, 12 Species from Euphorbiaceae, 11 Species from Malvaceae, 10 species each from Apocynaceae, Caesalpinaceae;

Nine species each from Amaranthaceae, Asteraceae, Cucurbitaceae. Eight species each from Asclepiadaceae and Zingiberaceae; Seven species each from Rutaceae and Verbenaceae. Six species each from Acanthaceae, Anacardiaceae, Combretaceae, Liliaceae, Meliaceae, Mimosaceae, Poaceae and Rubiaceae. Five species each from Convolvulaceae, Moraceae and Solanaceae. Remaining families are having less than five species each. Life forms indicated that trees were dominating (37%) followed by herbs (29%), shrubs (18%), climber (8%), creepers, grasses, lianas, twiners (2%) each.

Key Words: *Diversity, ethnobotanical, medicinal plants, Raigad, traditional knowledge*

Introduction

The use of plants and animals as source of medicine and food is as old as humanity. Health and diseases are coeval with life. By necessity man has undoubtedly always been concerned with the question of health and survival and has sought within the framework of his knowledge, solution to problem of illness (Rubin, 1960). Human being everywhere, at all times and place had to deal with the threats of disease and illness. The herbal occupied a distinct place in the life right from the primitive period to today and the primitive or ethnic populations have their own medical lore, and some of their therapeutic practices have found place in today's medical knowledge (Jain, 1995). This traditional knowledge is useful to develop new food sources. Exploration of natural resources and documentation of traditional knowledge is necessary. Maharashtra state with its Sahyadri ranges and Konkan region, is also considered as veritable emporium of medicinal plants. The tribal people of the

state mostly rely on traditional medicines directly based on plant materials (Mishra, 2004). Present work is an attempt to explore the traditional knowledge of wild medicinal plants of Raigad district of Maharashtra state.

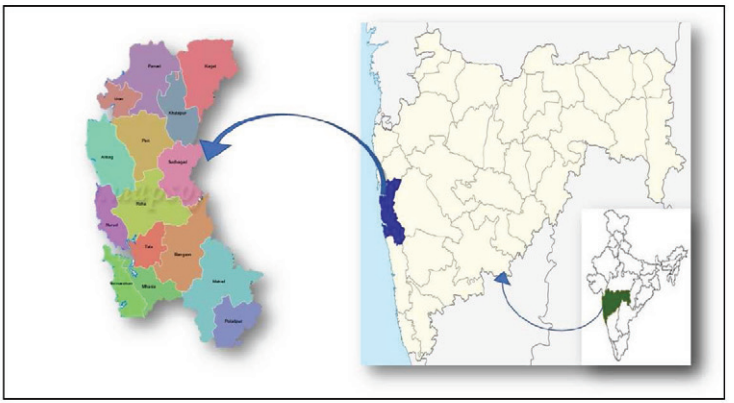

Fig 1: Map of Raigad district of Maharashtra showing study area

Raigad district, geographically it is located in Konkan of west costal region of Maharashtra. The Konkan is lying in the world-famous Western Ghats. Raigad district is sharing border with Pune, Ratnagiri, Thane, Mumbai Districts. It lies between 17^0 51' to 19^0 80' North latitude and between 72^0 51' to 73^0 40' East longitude and it includes 15 tahsils. Map of Raigad district of Maharashtra showing study area presented in Fig. 1. Raigad district occupies an area of approximately 7148 sq. km. which is consisting with 1748.32 sq. km forest area i.e. 24.46% of its total area. The region is also home to various scheduled tribes such as Mahadev-Koli, Katkari, Dhangar, Sonar, Mali, Kunbi and Thakar etc. During study medicinal plants have been identified for the various medicinal properties. The information pertaining to botanical name, local name, family, parts used, medicinal uses, their does and process of

administration was identified with the help of local population and available literature.

Materials and Methods

Study Area

Raigad District, the work regarding data collection done by repeated surveys at different localities. The representative places in various tahsils of Raigad district were visited during 2017-18.

Data Collection & analysis

The Ethnobotanical information was obtained from knowledgeable person, Vaidya, experienced people of forest department, medicine men, herbal vendor and heads and local inhabitants of the village who have knowledge of plants for health & livelihood security. The knowledge of medicinal plants, information was collected by asking questions in interview session. Data was also recorded during the field visits. Plant samples and plant parts identified during the survey were cross checked against different informants to validate the information. The plant samples were identified with the help of published, authentic literature. The Flora of British India, vol. I-VII (Hooker, 1872-1879), Cooke, 1967, Flora of Maharashtra (Almeida, 1996-2004), Flora of Maharashtra state (Sharma *et al.,* 1996 and Singh *et al.,* 2001) have been consulted for the identification of plant sample. Also, some information is available on books ethnobotany, flora and life-classes of plants (Joshi, 2000, Jain 1981 and Puspangadan, 1995)

Results and Discussion

The present study describes the 294 plants species belonging to 255 genera and 90 families. Among the all species, life forms indicated that 109

species of trees were dominating (37%) followed by 86 species of herbs (29%), 52 species of shrubs (18%), 24 species of climber (8%), 6 species of creepers, grasses, lianas, and twiners (2%) each. Diversity in the habits of Medicinal plants presented in Fig. 2. Medicinally most important plants family was Fabaceae with 18 species followed by 12 Species from Euphorbiaceae; 11 Species from Malvaceae; 10 species each from Apocynaceae and Caesalpinaceae; Nine species each from Amaranthaceae, Asteraceae and Cucurbitaceae. Eight species each from Asclepiadaceae and Zingiberaceae; Seven species each from Rutaceae and Verbenaceae; Six species each from Acanthaceae, Anacardiaceae, Combretaceae, Liliaceae, Meliaceae, Mimosaceae, Poaceae and Rubiaceae. Five species each from Convolvulaceae, Moraceae and Solanaceae. Four species each from Arecaceae, Bignoniaceae, Clusiaceae, Lamiaceae, Lythraceae, Menispermaceae. Three species each from Apiaceae, Araceae, Capparaceae, Dioscoreaceae, Ebenaceae, Gentianaceae, Sapindaceae and Sapotaceae. Two species each from Aristolochiaceae, Burseraceae, Chenopodiaceae, Flacourtiaceae, Lecythidaceae, Malpighiaceae, Oxalidaceae, Piperaceae, Polygonaceae, Rhamnaceae, Strychnaceae and Zygophyllaceae.

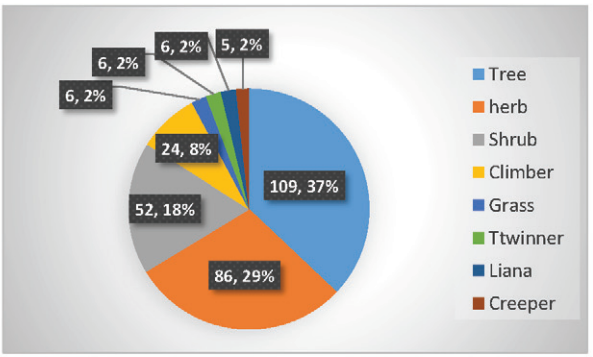

Fig. 2: Diversity in the habits of Medicinal plants.

Remaining 41 families having only one species are Adianthaceae, Agavaceae, Aizoaceae, Amaryllidaceae, Annonaceae, Averrhoaceae, Basellaceae, Bixaceae, Boraginaceae, Cannabaceae, Celastraceae, Cleomaceae, Commelinaceae, Compositae, Crassulaceae, Cyperaceae, Dipterocarpaceae, Hypoxidaceae, Lauracaeae, Melastomataceae, Moringaceae, Musaceae, Myristicaceae, Myrtaceae, Nyctaginaceae, Nymphaeaceae, Oleaceae, Pandanaceae, Papaveraceae, Pedaliaceae, Plumbaginaceae, Portulacaceae, Primulaceae, Ranunculaceae, Santalinaceae, Scrophulaceae, Simaroubaceae, Symplocaceae, Ulmaceae and Vitaceae.

The plant parts like root, rhizome, bulb, stem, bark, root bark, latex, leaves, gum, gum-resin, flower, peduncle, arrilus, fruit, tuber, oil, seed, sap, shoot, resin and whole plant are used for the treatment of various diseases. These parts are used effectively against fever, cough, cold, cuts, bronchitis, epilepsy, paralysis, inflammation, piles, wounds, mental disorder, abdominal pain, bone fracture, skin problems, jaundice, urinary trouble, stomach

disorder, snake and insect bite, joint pain, impotency, weakness, diarrhea, joint pain, headache, eye diseases, liver problems, constipation, digestive problems and disease, asthma, etc. The plant containing different active ingredients like alkaloids, tannin, nicotine, sapponinetic, resin, vitamins etc is possible to boost up human health.

Conclusion

During the survey, the discussion, interviews and field visits with traditional stakeholder, Vaidu, herbal vender, it is found that they have great knowledge of medicinal uses of wild plants species and having close association with surrounding environment. The medicinal uses of some species may vary from village to village i.e. used to cure multiple ailments. Traditional knowledge of tribal and local people on human disease is very important to find out new drugs for human health, also the doses and their administration needs to standardization with scientific way.

Deforestation, civilization, development projects, modernizations and industrialization largely depleting the biodiversity and natural habitat of this wild species as well as the traditional knowledge and it is needs to be that protection, preservation and conservation practices with in situ or ex situ conservation activities before they lost forever and training to young generation and close association with surrounding nature. An emphasis on suitable harvesting of wild edible plants will help to enhance and maintain the biodiversity. This study reveals that traditional medical plants are still play a vital role in primary health care of human and knowledge gathered from this area will be helpful in further ethnobotanical studies for researches.

Table No. 1. List of medicinal plants, families and morphological characteristics of Raigad district of Maharashtra State

Sr no	Scientific name	Common name	Family	Morphology	Part used	Therapeutics (Medicinal properties & value)
1	*Abelmoschus moschatus* (L.) Medik.	Kasturbhend (Musk mallow)	Malvaceae	Herb	Seeds	Pain-killers, sedatives, arthritis, rheumatism, naso-pharyngeal affections, pulmonary & stomach troubles, vermifuge
2	*Abrus precatorius* Linn.	Gunj (Crab's eye, Indian liquorice)	Fabaceae	Climber	Leaves, seeds	Stomachache, aphrodisiac, fever, cough, cold, contraceptive
3	*Abutilon indicum* (Linn.) Sweet.	Petaaree, Mudra (Country mellow)	Malvaceae	Shrub	Seeds, bark, root leaves, flowers	Febrifuge, anthelmintic, anti-inflammatory, in urinary, uterine discharge, piles, convulsion, cramps, colic, dysentery
4	*Acacia catechu* (L.f.) Willd.	Khair (Cutch Tree)	Mimosaceae	Tree	Stem, bark	Diarrhea, ulceration, antiseptic, gingivitis, toothache
5	*Acacia concinna* DC.	Shikakai (Soap Pod)	Mimosaceae	Climber	Pods	Control dandruff, promote hair growth and strengthening hair root

6	*Acalypha indica* Linn.	Kokila, Kakali (Indian acalypha)	Euphorbiaceae	Herb	Leaves, root	Diuretic, bitter, acrid, cathartic, expectorant, emetic, anthelmintic, in gastro intestinal irritation, tooth and ear ache, scabies and snake bite,
7	*Achyranthes aspera* Linn.	Aghada (Devil's horsewhi)	Amarantaceae	Herb	Whole plant	Asthma, bleeding, in facilitating delivery, boils.
8	*Adiantum philippense* Linn.	Kalijhant (Walking maidenhair fern)	Adiantaceae	Herb	Whole plant	Pungent, alexiteric, in blood diseases, burning sensation, epileptic fits, dysentery, febrile affection
9	*Aegle marmelos* (L.) *Correa*	Bel, Bilva (Stone apple, Bengal quince)	Rutaceae	Tree	Fruits, leaves, twinges and root	Diarrhea, constipation, typhoid, chronic, dysentery astringent, laxative
10	*Aerva lanata* Juss.	Kupari madhuri, Astambeta	Amarantaceae	Herb	Roots, leaves, flower	Cooling, diuretic, lithotripsic, in hematemesis, diabetes, kidney stone,
11	*Agave americana* L.	Ghaypat (Century plant)	Agavaceae	Herb	Root	Diuretic, syphilis
12	*Ailanthus exelsa* Roxb.	Maharukh (Indian Tree of Heaven)	Simaroubaceae	Tree	Bark, leaves	Powerful fever-cure tonic, after labor, pains.
13	*Albizia lebbeck* (L.) Benth.	Shirish (Women's Tongue Tree)	Mimosaceae	Tree	Seeds, bark, leaves, flowers	Astringent, skin diseases, breathing difficulties, blood pressure control

14	*Alocasia indica* (Roxb.) Schott.	Shewra (Giant Taro)	Araceae	Large herb	Leaves & rhizome	Digestive laxative, diuretic, astringent, nutritive, pile, swelling, anorexia, gout, rheumatism
15	*Aloe vera* (L.) Burm. f. Syn. *Aloe barbadensis* Mill.	Korphad, Ghrutkumari (Aloe vera)	Liliaceae	Herb	Leaves	Cough, laxative, wound healing, skin burns & care, ulcer.
16	*Alstonia scolaris* (L.) R. Br.	Satvin (Devil's tree)	Apocynaceae	Tree	Bark	Antimalarial, analgesic, antidiarrheal
17	*Alternanthera sessilis* (L.) R.Br. ex. DC.	Gudrisag (Sessile Joyweed)	Amarantaceae	Herb	Leaves	Astringent, cooling, digestive, galactagogue, diarrhea, fever, anemia
18	*Amaranthus paniculatus* L.	Lalmath, Rajagira (Purple amaranth)	Amarantaceae	Annual herb	Leaves and tender stem, grains	Diuretic, laxative hemostatic, blood purifier Constipation, piles and anemia
19	*Amaranthus spinosus* L.	Katili, Kate math (Spiny amaranth)	Amarantaceae	Spinous herb	Leaves, stem	Cooling, laxative, diuretic, stomachic, appetizer, tonic, leucorrhoea, menorrhagia, anemia, anorexia fever
20	*Amaranthus viridis* L.	Chauli (Green amaranth)	Amarantaceae	Annual herb	Leaves and tender stem	Astringent, diuretic, digestive, appetizer, mild laxative, constipation, piles, anemia, jaundice, leucorrhoea

21	*Ammannia baccifera* Linn.	Aagiyaa, Dadmari (Blistering ammannia)	Lythraceae	Herb	Whole plant	Vitamin-C, anti-typhoid, anti-tubercular, bitter, appetizer, laxative, stomachache, in fever, skin disease, ring worm, herpetic eruption,
22	*Amorphophallus sylvaticus* (Roxb.) Kunth.	Jangli-Surana (Elephant foot)	Araceae	Herb	Rhizome	Aphrodisiac, urinary tract, itching of penis with erections
23	*Anacardium occidentale* Linn.	Kaju (Cashew nut)	Anacardiaceae	Tree	Fruits, seeds, bark	Purgative, anti-hypersensitivity, leprosy, corns, ulcer
24	*Andrographis paniculata* (Burm.f.) Wall. ex. Nees	Kalmegh (King of bitters)	Acanthaceae	Herb	Whole plant	Dysentery, bronchitis, influenza, fever, liver disease, weakness, release of gas.
25	*Anethum sowa* Roxb. ex Flem.	Shepu (Indian dill)	Apiaceae	Annual herb	Leaves	Pungent, thermogenic, ulcers, digestive, carminative, spermatorrhea, anthelmintic, antispasmodic, worms, inflammation, flatulence, intestinal
26	*Anisomeles malabarica* (L.) R. Br.	Chaudhara (Malabar catimint)	Lamiaceae	Herb	Whole plant	Acrid, bitter, aromatic, stomachic, anthelmintic, sudorific,colic, anorexia, dyspepsia, flatulence, worms, fever, indigestion

27	*Annona reticulata* L.	Ramphal (Bullock's heart)	Annonaceae	Tree	Fruits	Febrifuge, diarrhea, dysentery
28	*Aphanamixis polystachya* (Wall.) Parker.	Rohitaka, Harinhara	Meliaceae	Tree	Bark, seeds	Astringent, laxative, refrigerant, anthelmintic, in enlarge gland, corpulence, liver and spleen disease,
29	*Areca catechu* L.	Supari (Areca nut)	Arecaceae	Tree	Nut	Para sympathomimetic, sialagogue, vermicide, taeniafuge in veterinary
30	*Argyreia nervosa* (Burm. f.) Boj.	Samudrashok (Elephant Creeper)	Convolvulaceae	Large twiner	Root	Aphrodisiac, diuretic alterative and tonic, gleet, gonorrhea, strangury, chronic ulcers
31	*Aristolochia bracteata* Retz.	Kidamaar (Worm-killer)	Aristolochiaceae	Climber	Entire plant	Bitter, purgative, emmenagogue, anthelmintic, uterine contraction, roundworm, eczema.
32	*Aristolochia indica* Linn.	Saapasana, Eeshwaree (Indian birthwort)	Aristolochiaceae	Climber	Rhizome, leaves, stem	Snake poison, blood purifier, skin disease, appetizer, aphrodisiac, anthelmintic, febrifuge, in leprosy, inflammation, biliousness, cough
33	*Artemissia valgaris* L.	Dhordavana (Indian wormwood)	Asteraceae	Herb	Leaves, flower	Laxative, expelling round worm and on wound

34	*Artocarpus heteropyllus* Lamk.	Phanas (Jackfruits)	Moraceae	Tree	Fruits	Cooling, tonic, aphrodisiac, cough, stimulant, diarrhea, stomachic,
35	*Asparagus racemosus* Willd.	Shatavari (Asparagus)	Liliaceae	Climber	Root	Gastro intestinal disorder, increase in lactation in women,
36	*Atalantia floribunda* Wight	Ran limba, Makada nimbu (Wild lime)	Rutaceae	Shrub	Berries, leaves, rots	Roots antiseptic, antispasmodic, stimulant, leaves in itches, hemiplegia, snake bites, berries in fever, ailment
37	*Averrhoa carambola* Linn.	Kambrak (Carambola apple)	Averrhoaceae	Tree	Fruits, root, leaves	Antipruritic, antipyretic, anthelmintic, antidote in poison, chicken pox, ringworm, headache, cooling, increase flow of milk
38	*Azadirachta indica* A. Juss.	Neem (Indian Margosa tree)	Meliaceae	Tree	Entire plant	Antiseptic periodic, fever, ulcers, skin disease, antifungal, antidiabetics antibacterial., antiviral, contraceptive
39	*Bacopa monniera* (Linn.) Wettst.	Brahmi (Indian pennywort)	Scrophulaceae	Creeper	Whole plant	Nervous, memory enhancer, mental disorder.
40	*Baliospermum montanum* (Willd) Muell. Arg.	Danti (Red physic nut)	Euphorbiaceae	Shrub	Seeds	Anti-dentalgia, anti-rheumatic, anti-asthmatic purgative,

41	*Bambusa arundinarea* (Retz.) Willd	Bamboo (Thorny bamboo)	Poaceae	Woody perennial grass, Herb	Young shoot, seeds, sugary sap	Aphrodisiac, cooling, tonic
42	*Bambusa bambos* (L.) Voss	Kalak (Bamboo)	Poaceae	Woody perennial grass, herb	Leaves	Hematemesis, bleeding disorders
43	*Barleria prionitis* Linn.	Vajradanti, Koranti-piwali	Acanthaceae	Shrub	Whole plant	Antiseptic, febrifuge, in dropsy, toothache, urinary and paralytic affection, cough
44	*Barringtonia acutangula* (L.) Gaertn.	Samudraphal (Freshwater Mangrove)	Lecythidaceae	Tree	Leaves	Bitter, cooling, aperient, antipyretic, stimulant, emetic, in catarrh, fever constipation, headache, diarrhea, dysentery,
45	*Barringtonia racemose* (Linn.) Roxb.	Nivar, Sadaphali (Small Indian Oak)	Lecythidaceae	Tree	Root, fruits, seeds, bark	Cooling, tonic, vermifuge, fish poison, cough, asthma, diarrhea,
46	*Basella alba* L. Synn *Basella rubra* Linn.	Poi /Maayalu / (Indian Spinach)	Basellaceae	Perenial herb	Leaves	Cooling, emollient, aphrodisiac, laxative, appetizer constipation, flatulence, anorexia, ulcers etc.
47	*Bauhinia purpuria* L.	Kanchan (Pink butterfly tree)	Fabaceae	Tree	Root, flowers	Carminative, laxative

48	*Bauhinia racemosa* Lam.	Apata (Bidi leaf tree)	Fabaceae	Tree	Leaves, gum, seeds, bark, fruits, flower,	Astringent, anthelmintic, antimicrobial, antiulcer, antibacterial,
49	*Bauhinia varigata* Linn.	Rakt kanchan (Orchid Tree)	Fabaceae	Tree	Bark	Antipyretic, reduce fat, leprosy, malarial fever
50	*Bauhinia vihlii* Wight & Arn.	Chimbeli, Malu (Camels Foot Climber)	Fabaceae	Woody climber (Liana)	Seeds	Aphrodisiac, tonic, intestinal worms
51	*Bixa orellana* Linn.	Shendri (Annatto/lipstick tree)	Bixaceae	Shrub	Root, seeds leaves, bark,	Astringent, purgative, removes intestinal worm, appetizer, diuretic, asthma
52	*Blumea lacera* (Burn.f.) DC	Kukurband	Asteraceae	Herb	Root, leaves	Root in piles and cholera, leaves for mouth disease
53	*Boerhovia repens ver. diffusa*	Punarnava (Spreading hogweed)	Nyctaginaceae	Annual or perennial herb	Whole plant	Cardiac disorder, leucorrhoea, stomachic, expectorant
54	*Bombax ceiba* Linn.	Kate Sawar, Shalmali (Indian Kapok Tree)	Malvaceae	Tree	Flower, bark, root	Astringent and refrigerant, skin diseases
55	*Borassus flabellifer* Linn.	Taad (Brab tree)	Arecaceae	Tree	Fruits, sap	Cooling, restorative diuretic & anthelmintic

56	*Boswelia serrata* Roxb.	Salai (Indian Olibanum tree)	Burseraceae	Tree	Gum	Central nervous system, anticancer, cardiovascular system, hypoglycemic
57	*Bridelia retusa* Spreng.	Asana	Euphorbiaceae	Tree	Root, stem, bark	Astringent, anticancer, antiviral, hypotensive, rheumatism, to prevent pregnancy, diarrhea, earache
58	*Buchanania lanzan* Spreng	Char, Charoli (Cuddapah tree)	Anacardiaceae	Tree	Fruits	Used as substitute skin disease, diarrhea
59	*Butea monosprema* Roxb. ex Willd.	Palas (Flame of Forest)	Fabaceae	Tree	Seeds, bark, flower	Piles, menstruation disorder, diarrhea
60	*Caesalpinea digyna* Rottl.	Waakarmulla (Teri pods)	Caesalpinaceae	Climbing herb	Leaves, roots	Astringent, in phthisis, scrofula, goiter, affection, emaciation, chronic fluxes
61	*Caesalpinia bonduc* (L.) Roxb.	Sagargota, Latakaranj (Bonduc nut)	Caesalpinaceae	Shrub	Seeds, root bark, leaves	Antibacterial, antifungal, anticancer, febrifuge, tonic, stomachic,
62	*Calophyllum inophyllum* Linn.	Undi (Alexandrian laurel)	Clusiaceae	Tree	Seeds oil,	Skin diseases
63	*Calotropis gigantia* (L.) W.T. Aiton	Rui (Gigantic Swallow Wart)	Asclepiadaceae	Shrub	Root, leaves, bark	Leprosy, skin diseases

64	*Calotropis procera* (Willd) W.T.Aiton	Rui (Madar/Swallow wart)	Asclepiadaceae	Shrub	Root, leaves, bark	Antiseptic, emetic, purgative and vermifuge, dysentery, leprosy, elephantiasis, epilepsy, asthma
65	*Calycopteris floribunda* Lam.	Ukshi, Baanguli	Combretaceae	Shrub	Leaves, roots, fruits,	Anthelmintic, laxative, febrifuge, astringent, bitter, in snake bite, intestinal worm, colic, leprosy, malarial fever, dysentery,
66	*Canarium strictum* Roxb.	Dhup (Black Damar)	Burseraceae	Tree	Gum	Psoriasis, pityriasis, stimulant to skin
67	*Canavalia gladiata* (Jacq.) DC	Ghevada (Sword bean)	Fabaceae	Climber	Unripe tender pod	Astringent, cooling, appetizer, digestive, anorexia, dyspepsia, hyperdipsia
68	*Cannabis sativa* L.	Bhang (Hemp)	Cannabaceae	Shrub	Leaves	Analgesic, anti-allergic, insomnia, hysteria, cough, bronchitis, muscle pain, rheumatism
69	*Canscora decussata* Roem. & Sch.	Shankhphuli (Winged-Stem Canscora)	Gentianaceae	Herb	Whole plant	Nervine tonic, insanity, epilepsy,
70	*Capparis zeylanica* Linn.	Waaghaati	Capparaceae	Shrub	Leaves, fruits, root bark	Sedative, demulcent, appetizer, bitter, cholagogue, in pain, rheumatism, swelling, hemiplegia, sores, colic, breast pain

71	*Cardiospermum helicacabum* Linn.	Kanphuti (Baloon vine)	Sapindaceae	Climbing shrub	Leaves	Rheumatism, piles, fever, hydrocele, ear ache
72	*Carrisa conjesta* Wight	Karvand (Karonda)	Apocynaceae	Climbing shrub	Fruits ripe, unripe	Antiscorbutic, purgative, fever, anemia
73	*Carthamus tinctorius* Linn.	Kardi (Safflower)	Compositae	Annual herb	Tender leaves, flower	Expectorant, anti-inflammatory, cold cough, bronchitis, liver tonic
74	*Cassia alata* Linn.	Dadmari (Ringworm Weed)	Caesalpiniaceae	Shrub	Leaves, flowers	Anti-parasitic, purgative, skin disorders, poisonous insect bites, eczema, asthma, bronchitis
75	*Cassia auriculata* Linn.	Torad, Tarawada (Tanner's cassia)	Caesalpiniaceae	Shrub	Bark, fruits. Leaves, fruits, seeds	Urinary discharge, tumors, skin diseases, asthma, chronic fever
76	*Cassia fistula* Linn.	Bahava (Golden shower tree)	Caesalpiniaceae	Tree	Fruits, flower	Astringent, constipation, piles, fever, gastric
77	*Cassia sophera* Linn.	Raantaakalla (Senna sophera)	Caesalpiniaceae	Shrub	Bark, leaves, seeds, root, root bark	Anthelmintic, antiseptic, purgative, febrifuge, diuretic, in acute bronchitis, ringworm, eczema, skin ailment
78	*Cassia tora* Linn. Synn. Senna tora (L.) Roxb.	Takla (Sickle pod)	Caesalpiniaceae	Herb	Leaves	Cold, cough, thermogenic, laxative, anthelmintic, liver tonic helminthiasis, fever, constipation, cardiac disorders

79	*Catharanthus roseus* (L.) G. Don	Sadaphuli (Periwinkle)	Apocynaceae	Herb	Root, leaves	Insomnia, anti-cancer, anti-diabetic, cardio tonic, blood pressure, tranquilizer, sedative, dysmenorrhea, stomachic, menorrhagia
80	*Catunaregam spinosa* (Thunb) Tirveng Synn. *Randia dumetorum* (Retz.) Poir	Madanphal, Gel (Common emetic nut)	Rubiaceae	Tree	Fruits	Nervine, calmative, antispasmodic, emetic, anthelmintic, abortifacient
81	*Ceiba pentendra* (L.) Gaertn.	Safed Savar (Kapok tree)	Malvaceae	Tree	Bark	Diuretic, aphrodisiac, headache, type II diabetes
82	*Celastrus paniculatus* Willd.	Maalakangani (Black oil tree)	Celastraceae	Climbing shrub	Seeds, leaves, oil	Bitter, emetic, alternative, laxative, stimulant, nervine, aphrodisiac, to sharpen memory, brain cleaner,
83	*Celosia argentea* Linn. var. cristata Kuntze.	Kurdu /Safedmurga	Amarantaceae	Herb	Leaves	Diuretic, cooling, aphrodisiac, blood purifier, astringent, calculi, diabetes, spermatorrhoea
84	*Centella asiatica* (L.) Urb.	Bramhi (Indian pennywort)	Apiaceae	Herb	Whole plant	Anthelmintic, bronchodilator, insomnia, cardiac debility, asthma, amentia

85	*Chenopodium album* Linn.	Bathua (Goose foot)	Chenopodiaceae	Herb	Whole plant	Digestive, carminative, laxative, diuretic, flatulence, seminal weakness, cardiac disorders
86	*Chlorophytum borivillanum* Santapau & R.R Fern.	Safed Musli (Musali)	Liliaceae	Herb	Roots	Improving strength, capable of promoting the semen & sexual vigor
87	*Chlorophytum tuberosum* (Roxb.) Baker	Phodshi/Kuli (Edible Chlorophytum)	Liliaceae	Herb	Tender leaves, tuberous root	Astringent, diuretic, colic, anorexia, bronchitis
88	*Cinnamon zeylanicum* Blume.	Dalchini (Cinnamum)	Lauracaeae	Tree	Bark	Carminative, stomachic, mild astringent, antiseptic
89	*Cissampelos pareira* L.	Patha (Velvet leaf plant)	Menispermacae	Climber	Whole plant	Antioxidant, antispasmodic, antiseptic, aphrodisiac, in menstrual problem, hormonal imbalance, ease child birth, cardiac problem, kidney stone
90	*Cissus quadrangularis* Linn.	Hadjod (Bone-setter)	Vitaceae	Climber	Leaves, stem	Antiulcer, anti-hemorrhoid, pain relieving, treating bones, feminine disorders,
91	*Citrus lemon* (Linn.) Burm. f.	Limbu (Lemon)	Rutaceae	Shrub	Fruits, leaves	Scurvy, blood cleanser, nerve tonic

92	*Clematis triloba* Heyne ex Roth	Murhari, Ranjani	Ranunculaceae	Climber	Root	Boils, itches, blood disease, fevers, leprosy
93	*Cleome viscosa* Linn.	Aryaval, Kaanaphodi (Sticky cleome)	Cleomaceae	Herb	Whole plant, seeds	Rubefacient, vesicant, sudorific, irritant, acrid, in wound, ulcers, earache, kill maggots
94	*Clerodendrum serratum* (Linn.) Moon	Bharangi	Verbenaceae	Shrub	Leaves	Fever, boiled with oil, cephalic, ophthalmic,
95	*Coccinia grandis* (L.) Voigt.	Kundru, Tondali (Ivy gourd)	Cucurbitaceae	Climber	Fruits	Antidiabetic, antitussive eye-medicine, cooling, astringent, depurative, antipyretic, diuretic, fever, burning sensation, agalactia, jaundice
96	*Cocculus hirsutus* (Linn.) Diels.	Vaasanavel (Broom creeper)	Menispermaceae	Climbing shrub	Roots, leaves	Refrigerant, alternative, laxative, sudorific, in chronic rheumatism, venereal diseases, eczema
97	*Cocos nucifera* Linn.	Naral (Coconut)	Arecaceae	Tree	Fruits, fruits, oil, root	Diuretic, astringent, uterine diseases, gonorrhea, wounds, cooling, tonic, laxative, sedative

98	*Colocasia esculenta* (L.) Schott	Alu, Arum ((Taro)	Araceae	Herb	Tubers	Expectorant, astringent, cough, thermogenic, appetizer, laxative, galactogogue, hemorrhage, adenitis, alopecia, anorexia
99	*Commelina benghalensis* L.	Kena / kanchata	Commelinaceae	Herb	Leaves	Diuretic, antiseptic, laxative, cooling, digestive, demulcent, piles, constipation, fever calculi, indigestion
100	*Cordia dichomata* G. Forst.f.	Bhokar (Indian cherry)	Boraginaceae	Tree	Leaves, fruits, bark and seeds	Antidiabetic, antiulcer, anti-inflammatory, immune-modulator and analgesic activity
101	*Costus speciosus* (Koen. ex Retz.) Sm.	Pewa, Ruk	Zingiberaceae	Herb	Rhizomes	Catarrhal fever, cough, dyspepsia, worms, skin diseases
102	*Crateava nurvala* Butch-Ham.	Waayawarna (Gartic Pear)	Capparaceae	Tree	Bark, leaves, root bark	Astringent, bitter, acrid, diuretic, stomachic, carminative, promote appetite, increase biliary secretion, as contraceptive
103	*Cressa cretica* Linn.	Rudavanti, Chaval (Littoral Bind Weed)	Convolvulaceae	Herb	Whole plant	Acrid, salty, galactagogue, blood purifier, thermogenic, anthelmintic, digestive, carminative,

						whooping cough, constipation, diabetes, agalactia, flatulence, colic, anorexia, helminthiasis
104	*Crinum asiaticum* Linn.	Kanvil, (Poison bulb)	Amarylli daceae	Herb	Bulb, root	Pungent, laxative, aphrodisiac, useful in bronchitis, disease of chest and lung, urinary concretion, lumbago
105	*Croton oblongifolius* Roxb.	Gannasaur a, Chuka	Euphorbi aceae	Tree	Root, stem, bark, leaves, fruits	Purgative, in constipation, diarrhea, dysentery, fever, headache, foul breath, cholera
106	*Curculigo orchioides* Gaertn.	Kalimusali (Musali)	Hypoxid aceae	Herb	Tuberou s root	Rejuvenative, aphrodisiac, bitter, tonic, aromatic, viriligenic, restorative, in piles,
107	*Curcuma amada* Roxb.	Amba Halad (Mango Ginger)	Zingiber aceae	Herb	Rhizome s	Cure digestive problem like gas, stomachache, indigestion and in skin treatment, ulcers, bruises
108	*Curcuma aromatica* Salisb.	Ran Halad (Wild Turmeric)	Zingiber aceae	Herb	Rhizome s	Checking bleeding and dissolving clots, antibiotic, hemorrhages jaundice
109	*Curcuma longa* L.	Halad (Turmeric)	Zingiber aceae	Herb	Rhizome s	Intestinal diseases, inflammation, peeling skin, antiseptic, blood purifier

110	*Curcuma zedoaria* Rosc.	Kachoraa (Zedoary)	Zingiberaceae	Herb	Rhizome	Stimulant, diuretic, demulcent, carminative, expectorant & rubefacient, cooling, aromatic, in flatulence, dyspepsia, to check gonorrheal and lecorrheal discharges, cold and stomach problem
111	*Cynodon dectylon* (L.) Pers.	Durva (Dog's teeth grass)	Poaceae	Creeper	Whole plant	Astringent, wound, leprosy, cooling, to stop excessive bleeding in menstruation
112	*Cyperus rotundus* Linn.	Nagarmothha (Nut grass, Coco grass)	Cyperaceae	Grass	Whole plant	Astringent, diaphoretic, diuretic, analgesic, antispasmodic
113	*Dalbergia sisoo* Roxb. ex. DC	Shisam (Sisso)	Fabaceae	Tree	Leaf, bark	Tonic, antiseptic, gonorrhea, leprosy, dysentery
114	*Datura metal* L.	Dhotara (Thorn Apple)	Solanaceae	Shrub	Whole plant	Narcotic, anodyne, antispasmodic, asthma, stomach problems
115	*Dendroclamus strictus* L.	Bamboo	Poaceae	Grass	Tender shoot	Nutritive, thermogenic, T.B.
116	*Desmodium gangaticum* (L.) DC	Salvan, Shaliparni	Fabaceae	Shrub	Root	Expectorant, bronchodilator, analgesic, antiemetic, asthma, dysentery, fever, vomiting,

117	*Desmostachya bipinnata* (L.) Stupf	Darbha (Salt reed-grass)	Poaceae	Grass	Root	Diuretic, dysentery and menorrhagia
118	*Digera muricata* (L.) Mart.	Manjarik	Amaranthaceae	Annual herb	Whole plant	Laxative, astringent, stomachic, diuretic, demulcent, diabetes, constipation, piles.
119	*Dioscorea alata* L.	Kand (China Kand)	Dioscoreaceae	Climber	Stem, tubers	Cooling, aphrodisiac, diuretic, anthelmintic, gonorrhea, helminthiasis, astringent, digestive, useful in piles,
120	*Dioscorea bulbifera* Linn.	Kadu-Karandaa (Air potato)	Dioscoreaceae	Twiner	Tuberous root, bulbil	Anthelmintic, aphrodisiac, diuretic, blood purifier, astringent useful in syphilis, gonorrhea, hydrocele. Goiter, piles, dysentery.
121	*Dioscorea digitata* Mill.	Til Karandi, Shendvel (Five leaf yam)	Dioscoreaceae	Twiner	Tuberous root, bulbil	Anthelmintic, aphrodisiac, diuretic, blood purifier, astringent gonorrhea, hydrocele. Goiter, piles, dysentery.
122	*Diospyros melanoxylon* Roxb.	Tendu (Indian persimmon)	Ebenaceae	Tree	Leaves, fruits	Bark in diarrhea, leaves in skin and blood disease and seeds in dysentery
123	*Diospyros montana* Roxb.	Vis Tendu	Ebenaceae	Tree	Bark, leaves, seeds,	Expectorant, bronchodilator, antipyretic, fever, jaundice, pleurisy, tuberculosis

124	*Diospyros penegria* Gurke.	Tembhurni (Riber eboney)	Ebenaceae	Tree	Bark, fruits, seeds and seeds oil	Acrid, astringent, styptic, bitter, oleaginous, in gravel, rinderpest, dysentery, intermittent fever, diarrhea,
125	*Dolichandrone falcata* (Wall.ex.DC.) Seem.	Mendhshingi (Mendhshing)	Bignoniaceae	Tree	Leaves, bark, fruits	Abortifacient, diabetes, urinary disorders, bronchitis and skin diseases
126	*Drypetes roxburghii* (Wall.) Hur.	Putranjiva (Putrajiva tree)	Euphorbiaceae	Tree	Leaves fruits, stones of fruits	Laxative, diuretic, aphrodisiac, burning sensation, elephantiasis, cold fever, rheumatism
127	*Eclipta alba* Hassk.	Makka (Bringaraj)	Asteraceae	Herb	Leaves, root	Skin, expels, intestinal worms, cough asthma, hair fall problems
128	*Elletaria cardamomum* Maton.	Velchi (Cardamom)	Zingiberaceae	Herb	Fruits, seeds	Tonic, purgative, aromatic, adjuvants or correctives of cordial
129	*Embelia tsjeriam-cottam* (Roem. & Schult.) A.DC.	Vavding, Vidang (Malabar Embelia)	Primulaceae	Shrub	Fruits	Insanity, heart diseases, carminative, anthelmintic, contraceptive
130	*Ensete superbum* Roxb.	Raan Kyaanle, Raan Keli (Rock Banana)	Musaceae	Shrub	Fruits	Stomachache

131	*Entada pursaetha* DC. Ssp. pursaetha.	Gaarambi (Lady nut)	Mimosaceae	Woody climber (Liana)	Seeds	Seeds as fish poison, emetic, antiperiodic, application seeds paste on glandular swelling
132	*Erythrina indica* Lamk.	Paangaara (Indian coral tree)	Fabaceae	Tree	Bark, stem, leaves,	Anthelmintic, hot, acrid, carminative, expectorant, febrifuge, laxative, in joints pain, dysmenorrhea, reduce fat, increase secretion of milk, kill worms, snake bite
133	*Euphorbia hirta* Linn.	Naayati, Mothidudhi (Asthma weed)	Euphorbiaceae	Herb	Whole plant	Demulcent, antispasmodic, anti-asthmatic, anthelmintic, in worms, bowel complaints, cough, postnatal complaints, failure of lactation, breast pain
134	*Evolvulvus alsinoides* Linn.	Shankhapushpi	Convolvulaceae	Herb	Whole plant	Alternative, bitter, tonic, anthelmintic, antiphlogistic, febrifuge, antispasmodic, brain stimulant, esp. Dysentery, hair growth, duodenal ulcers
135	*Exacum Bicolor* Roxb.	Udichirayat	Gentianaceae	Herb	Whole plant	Tonic, stomachic

136	*Fagonia arabica* Linn.	Dhamaasas, Ustar-khar	Zygophyllaceae	Shrub	Leaves	Cooling, tonic, asthma, tumors, delirium, antiseptic
137	*Ficus benghalensis* L.	Vad (Banyan tree)	Moraceae	Tree	Latex, bark, leaves	Latex as tonic, bark for gonorrhea and leaves as antidote in snake bite
138	*Ficus glomerata* Roxb. Synn. *Ficus racemosa* Linn.	Umber (Country fig)	Moraceae	Tree	Latex, bark, fruits	Astringent, antiseptic, cooling, tonic, abortion, failure of lactation, gonorrhea
139	*Ficus hispida* L. f.	Bhui Umber (Hairy fig)	Moraceae	Tree	Fruits, root, bark,	Diarrhea, weakness, diabetes, hemostatic
140	*Ficus religiosa* Linn.	Pimpal (Peepal tree)	Moraceae	Tree	Fruits, root, bark,	Small pox, rheumatism, cachexia, mouth sores,
141	*Flacourtia indica* (Burm.f.) Merr.	Kumbal, Atak, Taambat (Governor's plum, Tomi-Tomi)	Flacourtiaceae	Tree	Fruits	Carminative, asthma, diarrhea, fever, malaria, diabetes
142	*Garcinia indica* (Thouars) Choicy	Kokama (Kokum butter tree)	Clusiaceae	Tree	Fruits	Cooling, antiscorbutic, emollient, demulcent, astringent, in dysentery and mucous diarrhea
143	*Garcinia xanthochymus* Hook. f.	Pivala Kokam (Mysore Gamboge)	Clusiaceae	Tree	Fruits	Anthelmintic, cardio tonic, improve appetite, antacids

144	*Gardenia gumifera* L.	Dikemali (Cambia gum)	Rubiaceae	Tree	Gum-resin	Healing ulcers, dysentery, diarrhea, toothache, epilepsy
145	*Gloriosa superba* L.	Kalhalaali (Glory lily)	Liliaceae	Climber	Rhizome	Cold, ulcers, piles skin disease, abortion, and general debility.
146	*Gmelina arbora* Linn.	Shivan (Beachwood/ Goomar teak)	Verbenaceae	Tree	Fruits, root, leaves, bark	Improve appetite, galactagogue, laxative, anthelmintic,
147	*Grewia tilifolia* Vahl	Dhaman	Malvaceae	Tree	Bark, stem	Dysentery, cough, pain
148	*Gymnema sylvestre* R. Br. ex Schult.	Gudmar (Small Indian Ipecacuanha)	Asclepiadaceae	Climber	Roots, leaves	Diabetes, stimulant, heart disease,
149	*Gynandropsis gynandra* (Linn.) Briquet.	Pandhari-tilwan (Caravella)	Capparaceae	Herb	Seeds, leaves, roots	Anticancer, spasmolytic, carminative, rubefacient in scorpion string and snake bite, skin diseases, intestinal wounds, piles
150	*Helictris isora* Linn.	Murudsheng (Indian Screw Tree)	Malvaceae	Shrub	Fruits	Antidiarrheal, astringent, antipyretic, diarrhea, anthelmintic, asthma, colic pain
151	*Hemidesmus indicius* (L.) W. T. Aiton.	Anantmul (Indian Sarsaparila)	Asclepiadaceae	Creeper	Root	Antidiarrheal, astringent, antipyretic, appetizer, blood purification, diuretic, appetite, rheumatism

152	*Hibiscus rosa-sinensis* Linn.	Jaswand (Shoe flower)	Malvaceae	Shrub	Flower	Leucorrhoea, venereal diseases, fevers, menorrhagia, vomiting of blood, stomachic,
153	*Hiptage benghalensis* (Linn.) Kurz.	Madhumalati, Haladvel	Malpighiaceae	Climbing shrub	Leaves, vine, bark	Chronic, rheumatism, skin diseases, asthma, insecticide, arthritis
154	*Holarrhena pubescens* (Buch. – Ham.) Wall.	Kuda (Connessi bark)	Apocynaceae	Tree	Flower and pods, stem bark, root bark	Anti-dysentery, diarrhea
155	*Holigarna grahamii* (Wight) Kurz	Ranbibba (Blistering Varnish Tree)	Anacardiaceae	Tree	Latex, stem bark, leaves, mature fruits	Arthritis
156	*Hydnocarpus pentendra* (Buch-Ham.) Oken	Kadukavath (Chalmurga tree)	Flacourtiaceae	Tree	Seeds oil	Alterative, antibacterial and stimulant, lepromatous leprosy, anesthetic patches.
157	*Hydrophilia spinosa* T. And.	Kollasunda	Acanthaceae	Shrub	Roots, seeds	Aphrodisiac, bitter, cold, sour, cures oedema, dysentery, bladder stone, ascites, thirst, eye diseases
158	*Ichnocarpus frutescens* R. Br.	Kaatebhowari (Black creeper)	Apocynaceae	Shrub	Roots, leaves	Bleeding gum, convulsion, cough, delirium, dysentery, glossitis, measles, night blinder

159	*Ipomoea aquatica* Forssk.	Takasi Vel (Water Morning Glory)	Convolvulaceae	Herb	Leaves	Astringent, expectorant, emetic, alexipharmic, bronchitis, asthma, nervous disorders, fatigue anemia
160	*Ixora parviflora* L.	Devhari, (Torch Tree)	Rubiaceae	Tree	Flower, fruits, root, wood oil	Antiviral, spasmolytic, hypotensive, hepatoprotective
161	*Jatropha curcus* L.	Vanerand (Physic Nut)	Euphorbiaceae	Tree	Leaves, bark, seeds	Antiseptic, analgesic, skin diseases, rheumatic pain, toothache, wounds
162	*Justica adhatoda L. Syn. Adhatoda vasica L.*	Adulsa (Malabar nut tree)	Acanthaceae	Shrub	Whole plant	Asthma, antispasmodic, respiratory, stimulant, cold, cough
163	*Justica procumbens* Linn.	Pittapada	Acanthaceae	Herb	Whole plant	Anthelmintic, febrifuge, laxative, diuretic, diaphoretic, alternative, expectorant, in asthma, rheumatism, cough, backache, plethora, flatulence
164	*Kaempferia rotunda* Linn.	Bhui Chaaphaa	Zingiberaceae	Herb	Rhizome	Stomachic, in tumor, swelling, wounds, stomach and gastric complaints, to remove blood clots,
165	*Kalanchoe pinnata* (Lam.) Pers.	Panphuti (Life plant)	Crassulaceae	Shrub	Leaves	Dissolve kidney stone, in small pox, diarrhea, dysentery,
166	*Kydia calycina* Roxb.	Warang (Roxburgh's Kydia)	Malvaceae	Tree	Leaves	Skin diseases, body pain,

167	*Lagenaria vulgaris* Seringe.	Kadu Bhopala (Bitter bottle gourd)	Cucurbitaceae	Climbing herb.	Whole plant	Bitter, emetic, purgative, diuretic, refrigerant, astringent, constipation, inflammation, asthma, fever, constipation, jaundice, calculi
168	*Lagerstromia speciosa* (Linn.) Pers	Tamhan (Queens Crepe-myrtle)	Lythraceae	Tree	Stem, bark	Cardiovascular system, central nervous system, diabetic, blood pleasure control, control urinary dysfunction
169	*Lantana camara* L.	Ghaneri	Verbenaceae	Shrub	Leaves	Stomachic, antipyretic, red discharges, colic pain, ringworms, malarial fever
170	*Launaea procumbens* (Roxb.) Ramayya & Rajagopal	Bhopatri (Creeping launaea)	Asteraceae	Herb	Leaves	Sweet, diuretic, cholagogue, astringent, expectorant, blood purifier, lactagogue diarrhea, dysentery, toxemia, fever, calculi
171	*Lawsonia inermis* Linn.	Mehendi (Henna plant)	Lythraceae	Shrub	Leaves	Scabies, hair treatment, steam, anti-inflammatory
172	*Leucus cephalotes* (Roth) Spreng.	Deokumbha (Head Leucas)	Lamiaceae	Herb	Flower, leaves	Antidiarrheal, astringent, antipyretic, cough & cold, diarrhea, fever, malarial fever

173	*Lippia nodiflora* Mich.	Jal Pimpali (Wild Sage)	Verbenaceae	Herb	Whole plant	Cooling, diuretic, febrifuge, antiseptic, diaphoretic, vulnerary in stoppages of bowel and pain nee-joint, fistula, disease of heart, eye and for piles.
174	*Luffa acutangula var. amara* C.B. Clarke	Kadudodakaa (Ridge gourd)	Cucurbitaceae	Tendril climber	Unripe fruits	Bitter, astringent, demulcent, diuretic, tonic, nutritive, calculi, anorexia, piles, & constipation
175	*Luffa cylindrica* M.Roem.	Turi, Ghosala (Smooth gourd)	Cucurbitaceae	Climber	Unripe fruits	Diuretic, emollient, laxative, fever, carminative, anthelmintic, syphilis, tumor, galactagogue, stomachache, hematuria
176	*Macaranga peltata* Muell.-Arg.	Chandada, Chanda (Macaranga)	Euphorbiaceae	Tree	Bark, gum	Enlarged spleen, venereal sores
177	*Madhuca longifolia var. latifolia* (Roxb.) A.Chev.	Moh (Indian butter tree)	Sapotaceae	Tree	Fruits, flower and bark	Leprosy, heal wounds, coughs, biliousness, heart-trouble and blood diseases.
178	*Mallotus philipensis* (Lam.) Mull. Arg	Kunkuphal (Monkey face tree, Kamela)	Euphorbiaceae	Tree	Whole tree	Skin diseases, ulcer, tapeworm, contraceptive
179	*Mangifera indica* L.	Amba (Mango tree)	Anacardiaceae	Tree	Roots, bark	Wound, ulcer, vomiting, diarrhea, rheumatism

180	*Maninkara hexandra* Roxb.	Khirani	Sapotaceae	Tree	Fruits, bark	Antipyretic, gastrointestinal trouble
181	*Melia azedarach* Linn.	Nimbara (Persian Lilac)	Meliaceae	Tree	Root & stem bark, fruits, leaves	Blood detoxifying and anthelmintic, diseases of skin kill parasitic roundworms, headache,
182	*Melothria maderaspatana* (Linn.) Cogn.	Ghugree, Ghantalee	Cucurbitaceae	Herb	Leaves, seeds, seeds oil	Expectorant, sudorific, in chronic diseases with cough, toothache, vertigo,
183	*Memecylon umbellatum* Burm.f.	Anjan (Ironwood)	Melastomataceae	Tree	Bark, flower, root, leaves,	Anti-inflammatory, anti-tumor, cardio protective,
184	*Mesua ferrea* Linn.	Nagkeswar (Ceylon iron wood)	Clusiaceae	Tree	Bark, leaves, flower	Asthma, skin, burning, vomiting, dysentery, piles
185	*Michelia champaca* Linn.	Sonchaapha (Golden champak)	Magnoliaceae	Tree	Bark, root leaves, fruits, flower	Purgative, bitter, tonic, febrifuge, in colic, nausea, dyspepsia, fever, gonorrhea, vertigo, healing cracks feet
186	*Mimosa pudica* L.	Lajalu (Sensitive plant)	Mimosaceae	Creeper	Leaves	Useful in hydrocele, hemorrhoids fistula, scrofula
187	*Mimusops elengi* Linn.	Bakul	Sapotaceae	Tree	Fruits, seeds	Cardiovascular system, anthelmintic, tooth and gum problems
188	*Momordica charantia* Linn.	Wild Kaarali (Bitter gourd)	Cucurbitaceae	Climber	Unripe fruits	Bitter, acrid, thermogenic, Depurative, purgative, antidiabetic,

						carminative, skin diseases, worms, ulcers, constipation, anorexia, colic
189	*Momordica dioica* Roxb.	Kartoli, Kasaka	Cucurbitaceae	Perennial climber	Unripe fruits & tubers	Bitter, astringent, diuretic, appetizer, leprosy, malignant ulcer, worms, jaundice, calculi, fever, diabetes, hypertension.
190	*Moringa oleifera* Lam.	Shevaga (Drum stick)	Moringaceae	Tree	Leaves, unripe pods	Useful in scurvy, inflammation, helminthiasis,
191	*Munuca pruniens* (L.) DC	Kuhili, Khaajkuhili (Velvet bean)	Fabaceae	Climber	Seeds, roots	Tonic, stimulant, diuretic, diarrhea
192	*Murraya koenigii* (L) Spreng .	Kadipatta (Curry leaf tree)	Rutaceae	Tree	Leaves, roots and bark	Burning sensation, skin disease, colic, diarrhea, helminthiasis, improve appetite and digestion
193	*Myristica malbarica* Lam.	Raan Jayphala (False Nutmeg)	Myristicaceae	Tree	Seeds, arillus	Local stimulant, aphrodisiac, ulcer, allays pain
194	*Naregamia alata* W. & A.	Pitvel, Teen panni (Goanese ipecacuanha)	Meliaceae	Shrub	Root, leaves	Emetic, cholagogue, expectorant, in acute dysentery, biliousness, rheumatism, itches
195	*Nelumbo nucifera* Gaertn.	Kamal, Padma (Lotus)	Nymphaeaceae	Large aquatic herb	Stem	Astringent, cooling, fragrant, diuretic, vomiting, leprosy, skin diseases

196	*Neolemarkia cadamba* Roxb.	Kadamb (Burflower tree)	Rubiaceae	Tree	Bark, fruits	Mouth ulcer, nausea, vomiting, redness, lactating in women
197	*Nerium indicum* Mill.	Kanher (Indian oleander)	Apocynaceae	Shrub	Leaves, bark, root	Emetics, heart tonics, tumors
198	*Nyctanthes arbor-tristis* Linn.	Prajakta, Parijatak (Night jasmine)	Oleaceae	Tree	Leaves, seeds, bark	Malarial fever, pain, sores, ulcer
199	*Ocimum tenuiflorum* L.	Krishna Tulsi (Sacred Basil)	Lamiaceae	Shrub	Whole plant	Fever, cough, constipation, antiseptic, arthritis
200	*Operculina turpethum* (L.) Silva-Manso	Nishotter, Krivrutt (Indian jalap)	Convolvulaceae	Climber	Stem, rhizome	Laxative, obesity, release of gas
201	*Oroxylum indicum* Vent.	Tetu, Shyonak (Indian trumpet flower)	Bignoniaceae	Tree	Bark, seeds	Mouth cancer, gastric ulcer, scabies and other skin diseases
202	*Oxalis corniculata* L.	Tipali, Tinpatiya (Creeping wood sorrel)	Oxalidaceae	Creeper	Leaves	Sour, astringent, thermogenic, cooling, digestive, carminative, diuretic, liver tonic, dyspepsia, hemorrhoids, anemia, fever, diarrhea, dysentery, scurvy, ulcer
203	*Oxalis corniculata* Linn.	Chuka tripati (Indian Sorrel)	Oxalidaceae	Herb	Whole plant	Diarrhea, dysentery, epilepsy, cuts, wounds

204	*Oxystelma esculantum* R. Br.	Dudhanne e	Asclepia daceae	Twine r	Whole plant	Bitter, pungent, diuretic, laxative, aphrodisiac, anthelmintic, lactogogue, in leukoderma, bronchitis, ulceration, jaundice
205	*Pandanus tectorius* Soland. Ex Parkinson	Kewda (Screw pine)	Pandana ceae	Shrub	Flower, root, oil	Bitter, cooling, aromatic, antiseptic, aphrodisiac, carminative, cures, scabies earache, headache, eye disease, ulcer
206	*Papaver somniferum* Linn.	Aphoo (Opium)	Papavera ceae	Herb	Latex from fruits	Sedative, analgesic, morphine, narcotic
207	*Parkinsonia aculeata* Linn.	Ram Baval (Jerusalem thorn)	Caesalpi naceae	Shrub	Unripe green pods	Antipyretic & anti-inflammatory, cough, fever, & for quick energy
208	*Pedalium murex* Linn.	Bhar-Gokharu (Burra Gokhru)	Pedaliac eae	Herb	Fruits, stem, roots, leaves	Antispasmodic, aphrodisiac, demulesent, diuretic, antiblious, gonorrhea, dysuria, spermatorrhea
209	*Penagum harmala* Linn.	Harmalla (Foreign henna)	Rutaceae	Herb	Leaves, seeds, root	Aphrodisiac, antiperiodic, stimulant, lactagoguge, abortifacient
210	*Pentatropis capensis* (L. Fil.) Bullock	Shingroti (Ambervel)	Asclepia daceae	Herb	Leaves	Cooling, astringent, appetizer, expectorant, cough, bronchitis, epilepsy, anorexia

211	*Peucedanum grande* (Dalz. & Gibs.) C.B.Cl.	Baphali (Hill carrot)	Apiaceae	Herb	Leaves	Thermogenic, expectorant, carminative asthma, cough, bronchitis, flatulence, colic rheumatism, toothache
212	*Phoenix sylvestris* Roxb.	Shindi, Khajri (Date Sugar Palm)	Arecaceae	Tree	Fruits, leaves	Toothache, tonic, restorative, cooling beverages, toddy source of Vitamin B
213	*Phyllanthus emblica* Linn.	Amla (Indian gooseberry)	Euphorbiaceae	Tree	Fruits	Cough, diabetes, cold, laxative, hyper acidity.
214	*Phyllanthus niruri* Linn. *Synn. Phyllanthus amara* L.	Bhui Amla (Country gooseberry)	Euphorbiaceae	herb	Whole plant	Anemic, jaundice, dropsy, appetizer, hepatitis and liver disorder
215	*Physalis minima* L.	Kaknaj (Sun berry)	Solanaceae	Herb	Fruits	Sour, sweet, appetizer, bronchitis, gastropathy, colic, ulcer, cough,
216	*Piper longum* L.	Pimpli (long pepper)	Piperaceae	Climber	Fruits, root	Appetizer, enlarged spleen, bronchitis, cold, antidote.
217	*Piper nigrum L.*	Kalimiri (Black pepper)	Piperaceae	Climber	Dried unripe fruits	Aromatic, stimulant, stomachic, carminative, tumorigenic
218	*Pithecellobium dulce* (Roxb.) Benth.	Jungle Imli (Jungle Jalebi)	Mimosaceae	Tree	Fruits	Astringent, sweet, sour, expectorant, nutritive, fatigue, cough, spondylitis, fracture, toxemia, jaundice, diabetes

219	*Plumbago indica* Linn.	Chitrak (Red lead wort)	Plumbaginaceae	Shrub	Root, rootbark	Appetizer, antibacterial, anticancer, expectorant, antiseptic antipyretic rheumatism
220	*Pogostemon heyneanus* Benth.	Paanch (Patchouli)	Lamiaceae	Herb	Leaves	Diuretic, carminative, insecticidal, in rheumatism, boils, headache, asthma, dropsy
221	*Polygonum plebium* R. Br.	Jungle Chaurai	Polygonaceae	Herb	Young leaves	Astringent, diuretic, digestive, mild laxative, constipation, piles, anemia, etc.
222	*Pongamia pinnata* (L.) pierre.	Karanj (Indian beech)	Fabaceae	Tree	Seeds	Dyspepsia, scabies, herpes, leukoderma, rheumatism, skin diseases and rheumatic joints
223	*Portulaca oleracea* L.	Ghol bhaji	Portulacaceae	Herb	Whole plant	Laxative, emollient, cooling, stomachic, diuretic, gastropathy, anorexia, constipation, jaundice, scurvy
224	*Premna corymbosa* (Burn.f.) Rottler & wild	Agnimanth, Airan	Verbenaceae	Shrub	Whole plant	Obstinate fevers, laxative, cardio tonic, neurological diseases,
225	*Psoralea corylifolia* Linn.	Baawachi, Bavanchi (Babachi)	Fabaceae	Herb	Seeds & seeds oil	Germicidal laxative, aphrodisiac, diaphoretic, diuretic, help in hair growth, piles, bronchitis

226	*Pterocarpus marsupium* Roxb.	Bivala, Bijasar (Indian kino)	Fabaceae	Tree	Gum, leaves, bark, heartwood, flowers	Alternative, sharp taste, laxative, anthelmintic, in blood diseases, leukoderma, urinary discharge, elephantiasis, eruption in body
227	*Pterocarpus santalinus* Linn. f.	Raktchandan (Red sander)	Fabaceae	Tree	Wood	Cooling, antipyretic, antiperiodic, astringent, diaphoretic, in boils, abscesses, headache, blood purification, skin disease, tonic
228	*Rauwolfia serpentina* (L.) Benth. ex Kurz	Sarpgandha (Indian snake root)	Apocynaceae	Shrub	Root	Central nervous system, cardiovascular, isolated tissue, anti-venom, hyper tension, insomnia.
229	*Rhinacanthus nasutus* Kurz.	Gajakarani, Yuthakparnni	Acanthaceae	Shrub	Root, leaves, seeds	Antiseptic, aphrodisiac, eczema, ring worm, dhobi itch, skin diseases
230	*Ricinus communis* Linn.	Ranpangara (Coral Tree)	Euphorbiaceae	Tree	Roots, seeds	Spasmolytic, bronchodilator, scorpion and snake sting
231	*Rubia cordifolia* Linn.	Manjistha, Raktapushpi	Rubiaceae	Climber	Root	Leukoderma, gouty arthritis, skin pigmentation, pimple, freckles, discoloration
232	*Rumex elongates* Guss.	Chukka bhaji (Yellow dock)	Polygonaceae	Glabrous herb	Leaves & tender shoot	Sour, nutritive, digestive, diuretic cooling, blood purifier, anemia,

						constipation, cardiac problem, scurvy, syphilis, piles, anorexia, colic
233	*Salicornia herbacea* L.	Soda (Jointed glasswort)	Chenopodiaceae	Herb	Stem	Laxative, nutritive, useful in digestion
234	*Salvadora indica* Wight.	Miraj, Pilva, Rhakhan, (Toothbrush tree)	Salvadoraceae	Shrub	Root & stem bark, fruits, oil seeds, flowers,	Asthma, cough, rheumatism, piles, deobustruent, lithontripic
235	*Santalum album* L.	Chandan (Sandal wood tree)	Santalinaceae	Tree	Heart wood, oil	Skin disorder, burning, sensation, jaundice
236	*Sapindus trifoliatus* Linn.	Ringi, Ritha (Soupnut tree)	Sapindaceae	tree	Fruits	Sharp, hot, tonic, alexipharmic, expectorant, emetic
237	*Saraca asoca* (Roxb.) De Willde.	Sita ashok (Sorrow-Less tree)	Caesalpinaceae	Tree	Flower, bark	Menstrual pain, uterine, disorder, diabetes.
238	*Schleichera oleosa* (Lour) Oken.	Kusum (Lac tree)	Sapindaceae	Tree	Seeds oil, bark	Skin diseases, rheumatic pain, itches, ulcers
239	*Semecarpus anacardium* Linn. f.	Bibba (Marking nut)	Anacardiaceae	Tree	Bark, seeds	Asthma, diarrhea, dysentery, rheumatism
240	*Sesbania grandiflora* (Linn.) Pers.	Hadagaa, Agasti (Sesban)	Fabaceae	Tree	Flowers and tender fruits	Astringent, nutritive, useful in digestion & weakness
241	*Sida acuta* Burm.	Naagabala	Malvaceae	Shrub	Roots, seeds, leaves	Astringent, cooling, bitter tonic, abortifacient, in nervous and urinary

						discharge, blood disorder, bile, stomachic
242	*Smilex indica* Burm.f.	Ghotwel (Kumarika)	Liliaceae	Climber	Tender tips	Nutritive, thermogenic, digestion
243	*Solanum khasianum* C.B. Clarke.	Laghukavali (Nightshade)	Solanaceae	Herb	Berries	Sex hormone, oral contraceptives
244	*Solanum viriginianum* L.	Bhuiringani (Yellow berried night shade)	Solanaceae	Herb	Ripe fruits	Toothache, asthma, catarrh, expectorant
245	*Soymida febrifuga* A. Juss.	Rohan (Indian rosewood)	Meliaceae	Tree	Bark, resin	Astringent, bitter, febrifuge, tonic, diarrhea, dysentery, fever, tonic, malaria
246	*Spermadictyon suaveolens* Roxb.	Jitsaya, Gidesa (Forest Champa)	Rubiaceae	Shrub	Root	Oedema, rheumatoid, arthritis
247	*Sphaeranthus indicus* Linn.	Gokharmundi (Indian globe thistle)	Asteraceae	Herb	Whole plant	Laxative, tonic, deobstruent, alternative, aphrodisiac, in spleen, pain, in uterus, vagina, pile
248	*Spilanthes oleracea* Murr.	Akkal Kadha (Para cress,)	Asteraceae	Herb	Leaves, flowers	Stammering, toothache, stomatitis,
249	*Spondias pinnata* Kurz.	Aambaadaa (Bile tree, Wild Mango)	Anacardiaceae	Tree	Dried fruits, bark, leaves	Appetizing, astringent, refrigerant, cure Vatta, regulating menstruation

250	*Sterculia urens* Roxb.	Kandol, Sardol (Indian tragacanth)	Malvaceae	Tree	Gum	Constipation, debility, demulcent, immunity booster
251	*Stereospermum chelenoides* (L.F.) DC	Padal (Fragrant Padri Tree)	Bignoniaceae	Tree	Root bark, flowr, seeds,	Diuretic, cardiac, tonic, anti-inflammatory, blood purifier, blood disorder
252	*Stereospermum suaveolens* (Roxb.) DC.	Paatalaa, Paral	Bignoniaceae	Tree	Root, root bark, leaves, flower, fruits	Bitter, astringent, cardio tonic, cooling, diuretic, tonic, in anorexia, difficulty in breathing, anasarca, pile, vomiting, hiccough, thirst
253	*Strychnos nux-vomica* L.	Kuchala (Nux Vomica)	Strychnaceae	Tree	Seeds	Upset stomach, vomiting, constipation, intestinal irritation, heartburn, insomnia, certain heart diseases, depression, migraine headaches,
254	*Strychnos potatorum* Linn. f.	Niwali, Nirmalli (Clearing nut)	Strychnaceae	Tree	Root, fruits, seeds	Urinary discharge, appetite, maggot infested
255	*Suaeda fruticosa* (L.) Forssk. ex. Gmel.	Saloonakbuti (Shrubby seablight)	Amarantaceae	Shrub	Leaves	Diuretic, laxative, asthma, rheumatism
256	*Swertia chirata* Buch-Ham.	Chirata (Chiretta)	Gentianaceae	Herb	Whole plant	Bitter tonic, dyspepsia, chronic fever

257	*Symplocos racemosa* Roxb.	Lodhra (Cinchona)	Symplocaceae	Shrub	Bark, wood	Uterine complaints, vaginal and menstrual disorder, cooling, antidiarrheal
258	*Syzygium cumini* (L.) Skeels	Jambhul, Jamun	Myrtaceae	Tree	Fruits, seeds	Constipation, skin diseases, diarrhea, diabetes
259	*Tabernaemonta divanicata* (L.) Br. ex Roem. & Schult	Tagar (Crape jasmine)	Apocynaceae	Shrub	Root	Jaundice, anthelmintic, anti-inflammatory, anodyne, diuretic
260	*Tabernaemonta heyneana* Wall.	Naagkuda (Wax flower)	Apocynaceae	Shrub	Wood, root, milky juice,	Anticancer, leukemia,
261	*Tamarindus indica* Linn.	Chinch (Tamarind)	Caesalpinaceae	Tree	Tender leaves, fruits	Helminthiasis, gastropathy, ulcer, anorexia, digestive, laxative
262	*Tectona grandis* Linn. f.	Saag (Teak)	Verbenaceae	Tree	Root oil	Ringworm and itches, hair tonic
263	*Tephrosia purpurea* (Linn.) Pers.	Unhaali (Wild indigo)	Fabaceae	Herb	Whole plant	Astringent, diuretic, laxative, anthelmintic, antipyretic, as blood and cordial purifier, bleeding piles, boils
264	*Terminalia arjuna* (Roxb) W & A	Arjun (Arjun tree)	Combretaceae	Tree	Bark	Astringent, blood pressure, cardio protective
265	*Terminalia belerica* (Gaertn.) Roxb.	Behada (Beleric myrobalans)	Combretaceae	Tree	Fruits	Tonic, laxative, digestive, diarrhea, rejuvenative, ingredient of triphala

266	*Terminalia chebula* Retz.	Harda, Haritaki (Chebulic myrobelan)	Combretaceae	Tree	Fruits	Tonic, laxative, diuretic, ingredient of triphala
267	*Terminalia paniculata* Roth.	Kinjal (Flowering murdah)	Combretaceae	Tree	Bark, flowers	Diuretic, cardio tonic, in cholera, opiom poisoning
268	*Terminalia tomentosa* W. & A.	Ain (Laurel)	Combretaceae	Tree	Bark	Astringent, antiseptic, bactericidal, detergent, in skin diseases, erysipelas, leukoderma, polyuria, shleshma,
269	*Thespesia populnea* Soland ex Correa	Bhend, Paarosa pimalla (Tulip tree)	Malvaceae	Tree	Root, fruits leaves, bark, flower,	Astringent, acrid, light, astringent, tonic, skin diseases, dysentery, piles, diabetes, hemorrhoids, scabies, in painful joints
270	*Tinospora cordifolia* (Willd.) Mers.	Gulvel (Giloi)	Menispermaceae	Woody climber (Liana)	Stem, leaves	Anti-diabetic, jaundice, fever, gout, pile, general debility
271	*Tinospora malabarica* (Lam.) Miers.	Amrutvel, Sudarshana (Giloe)	Menispermaceae	Woody climber (Liana)	Leaves, stem	Uses almost in the same way as *Tinospora cordifolia*

272	*Toddalia asiatica* (Linn.) Lam.	Limri, Jangali-kali-mirchi, (Forest pepper)	Rutaceae	Shrub	Root bark, leaves, fruits	Bitter, aromatic, tonic, stimulant, aphrodisiac, stomachic, stimulant
273	*Toona hexendra* (Wall. ex. Roxb.) Roemer	Kuruk, Tuni (Toon tree)	Meliaceae	Tree	Bark and flower	Astringent, tonic, antiperiodic
274	*Trema orintalis* (L.) Blume	Ghol (Indian Charcoal tree)	Ulmaceae	Tree	Root	Central nervous system
275	*Trianthema monogyna* Linn.	Shveta (Horse perslane)	Aizoaceae	Annual herb	Leaves	Diuretic, vermifuge, laxative, asthma, amenorrhea, oedema, worms, rheumatism
276	*Tribulus terrestris Linn.*	Gokhru, Gokshur (Caltrop)	*Zygophyllaceae*	Herb	Whole plant	Cooling, aphrodisiac, appetizer, digestive, urinary, tonic, diuretic, gout,
277	*Tricholesis glaberrima* DC	Mothachor	Asteraceae	Herb	Whole plant	Leukoderma, skin diseases, nervine tonic, aphrodisiac, seminal debility
278	*Trichosanthes cucumeria* Linn.	Kadu-Padawal (Bitter snake gourd)	Cucurbitaceae	Herb	Whole plant,	Cardio tonic, alternative, febrifuge, antipyretic, purgative, in boils, intestinal worms, skin diseases, disorder of stomach

279	*Trichosanthes tricuspidata* Lour.	Kaundall, Mahaakaala	Cucurbitaceae	Climber	Fruits, seeds oil	Bitter, cathartic, abortifacient, carminative, asthma, earache, ozoena, leprosy, epilepsy
280	*Tylophora indica* (Burm. f.) Merr.	Pittamari, Jangli-Pikvam (Emetic swallow-wort)	Asclepiadaceae	Twiner	Leaves, root,	Bitter, expectorant, stimulant, as blood purifier, whooping cough, rheumatism, dysentery,
281	*Uraria picta* (Jacq) Desv. ex DC	Pithvan, Prushniparni	Fabaceae	Herb	Whole plant	Aphrodisiac, cardio tonic, cough, chills, fevers, sore mouths
282	*Ventilago madraspantana* Gaertn.	Khandavel, lokhandi (Red Creeper)	Rhamnaceae	Woody climber (Liana)	Bark	Carminative, stomachic, stimulant, tonic
283	*Vernonia cinerea* Less.	Sahadevi (Purple fleabane)	Asteraceae	Herb	Root and leaves	Febrifuge, diaphoretic, as blood purifier, bile, semen, leucorrhea and excessive, bleeding
284	*Veteria indica* L.	Safed Raal (White Dammar tree)	Dipterocarpaceae	Tree	Oil, resin	Fistula, chronic bronchitis, carminative, ringworms, arthritis
285	*Vetiveria Zizinioides* (Linn.) Nash	Khus, Vala (Vetiver grass)	Poaceae	Grass	Root	Hyperdipsia, burning, ulcer, skin, vomiting
286	*Vitex negundo* Linn.	Nirgudi (Five-leaved chaste tree)	Verbenaceae	Tree	Leaves	Arthritis, rheumatism

287	*Wattakaka volubilis* (Linn.) Stapf	Ambri, Gharphul	Asclepiadaceae	Twiner	Root, leaves, shoot	Tonic, cooling, aphrodisiac, expectorant, cures Vatta, biliousness
288	*Withania somnifera* (L.) Dunal	Ashwagandha	Solanaceae	Herb	Root, leaves	Disorder of menstruation, restorative tonic, stress, nerves disorder, aphrodisiac
289	*Woodfordia fruticosa* (L.) Kurz	Dhayati (Fire Flame Bush)	Lythraceae	Shrub	Flower	Diarrhea, dysentery, piles
290	*Wrightia tinctoria* R. Br.	Kudaa-Pandhara (Sweet indrajao)	Apocynaceae	Tree	Root, leaves, bark, seeds	Astringent, stomachic, tonic, febrifuge, in jaundice, serpent-bite, toothache
291	*Xanthium strumarium* Linn.	Shankheswar, (Burweed)	Asteraceae	Woody climber (Liana)	Root, leaves, fruits	Diaphoretic, sedative, sudorific, sialagogue, better, tonic, in malaria, strumous diseases and cancer,
292	*Zanthoxylum rhetsa* (Roxb.) DC.	Tisal/Tirphala (Indian Prickly Ash)	Rutaceae	Tree	Bark, fruits	Chest pain, stomach pain, astringent, stimulant, dyspepsia, toothache, antiseptic, disinfectant
293	*Zingiber officinale* Roscoe.	Sunth, Aale (Ginger)	Zingiberaceae	Herb	Dried rhizomes	Expectorant, improve digestion, cold, cough
294	*Ziziphus maurtiana* Lamk.	Ber (Indian Jujube)	Rhamnaceae	Tree	Bark, fruits, seeds	Astringent, pain relieving, cooling, stomachic and styptic, mild laxative and expectorant, rheumatism, gout

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CHAPTER 2

Biodiversity of Shore Crabs at Harnai Port, Tehsil Dapoli District Ratnagiri Maharashtra

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Abstract

Harnai is situated 15 km away from Dapoli. Harnai port is the main fishing village. The sandy shore of Harnai is one of the unique habitat for shore crab such as bubbler crabs, fiddler crabs etc. The rocky shore of Harnai is also abundant with green shore crabs. In the present study, we recorded 13 species of crabs from three sites. The rocky shore of Suvarndurg was highly diverse than the Harnai beach. The feasibility of culturing crabs must receive attention in our India because the high market demand and decreasing availability of crabs. From scientific point of view, it is essential that intensive investigation on improved fishing technique on farming of suitable varieties of crabs is to is to be carried out to harvest crabs.

Keywords: *Harnai, Shore Crabs, Suvarndurg, Harvest*

Introduction

India is one of the few countries in the world that are bestowed with a high degree of terrestrial and aquatic biodiversity. India's marine regimes range from Lakshadweep Islands in the Arabian Sea through the west and east

continental coast to the Andaman and Nicobar Island in the Bay of Bengal. Each of these is in turn is host to diverse ecosystems.

Studies of marine Biodiversity in India have a long tradition and cover a wide range of faunal and floral groups. The earliest works on the crabs of Indian seas were those of Milne Edwards (1834), Henderson (1882) and De man (1887-88 a, b, c). The first comprehensive study of the crabs of west was that of Borradalile (1900-1906). Other works of substantial interest are those of Pillai (1951), Chhapgar (1957) and Sankarankutty (1961).

Since 1961, there has not been notable progress in the studies of diversity of crabs of west coast of India, save for occasional reports. Within this period the taxonomic statuses of several species have also been revised. Hence there is a need to update the current knowledge of the biodiversity studies of crabs of west coast of India.

Crustacean Fishery

The crab fishery in India is yet to be recognized as a major fishery despite the abundant occurrence of edible crab all along the Indian coast. There are about 600 crab species occurring in Indian waters. However only few to them are used for human consumption, most important among these is *Scylla serrate, S. tranquedarica, Protunus pelagicus, P. sanguinolentus*, *Charybdis crusiata, C.feriata.* Among these, the *Scylla serrata* commonly called as mud crab or green crab forms the mainstay of crab fishery of India and is economically most important. It has wide distribution, occurring abundantly along both east and west coast of India. It is the popular species in Indo- pacific region because of its size, meat quality, high price and export potential.

An annual crab landing from the natural population is estimated to be 38,000 tonnes per year of which 25,000 tonnes are from marine sector and 13,000 tonnes from brackish water. Crab meat, cut crab and live crabs are exported from India to countries like Japan, U.S.A. France, Hong Kong and Malaysia. In Harnai, the crab fishery is small scale and is based mainly on capture fisheries.

Western cost, the Harnai port is located in Ratnagiri district in India. It is one of the famous port in Maharashtra. The sea adjoining the Ratnagiri district is a source of abundant marine wealth. The adjoining area is characterized by presence of the mangroves, muddy shore and prominently rocky shore.

Harnai is a cute city famed as a gateway to escape from the metropolitan life of Mumbai. It has clean beaches, so it attracts thousands of tourists. This is a coastal city in Kankan coast with softy sands and lush greeneries. The sandy shore of Harnai is a one of the unique habitat for shore crab such as bubbler crabs, mud crabs, fiddler crabs etc. Now a day's crab fishery is important in Arabian cost. The much of the work has been cited on edible clam. The very scanty research work had been accepted on the crab and squids. The research study on crabs mainly focused on different varieties of shore crab.

People have probably eaten crabs for as long as they have lived near the sea shore. They are known as a delicacy throughout the world, and both the sport and commercial crab fishery contribute to the local economy. Crabs are one of the main decomposers in the marine ecosystem. In other words, they help to "clean up" the sea bottom by harvesting, decomposing plants and

animal matter. Many fishes, birds like herons and sea mammals (e.g. sea otters) rely on crabs for food source.

Origin of research Problem

The feasibility of culturing crabs has received attention in some countries because high market demands and decreasing availability. The sandy shore is one unique habitat representative of varieties of shore crabs. Marine crabs form one of the important protein rich food sources easily available almost through out of the year. Many crabs known for their delicacy, high price and export. Crabs are members of the phylum- Arthropoda, the most diverse group of animals on earth, include ancient trilobites, the spiders and mites, the insects and the crustaceans. As members of the order – Decapoda (ten legs), they are representative of over 8,500 species all sharing common feature of a hard exoskeleton, joined appendages and the feature which gives them their name, five pairs of legs on the thorax. Crabs are extremely diverse and found all over the world, while the vast majority of crabs are marine; there are few species which have adapted to fresh water and even terrestrial habitat.

Our local shore crab's species are common, easy to collect and have a fairly high tolerance of being handled or used in laboratory experiments. Shore crabs have some interesting morphological and behavioral feature which makes them ideal subjects for an examination of concept of ecological niche. Crabs are very mobile animals and respond quickly to environmental change, making them a rewarding and fun animal to study. Some crabs are fast growing and larger sized species, they are more suitable for culture.

Konkan in Maharashtra having a large network of rivers and a long stretched coastal area is blessed with both marine as well as inland fishery

resources. Despite this abundance, these resources have been neglected so for and have not been used on a large or commercial scales. Despite their economic importance and food potential shore crabs have received very little attention.

Following table shows the different species of crabs at Harnai Port-

Sr. No.	**Family**	**Scientific Name of crab**
1.	**Portunidae**	*1)Neptunus Sanguinolentus (Herbst)* *2)Neptunus pelagicus* *3)Scylla serrata (Forskal)* *4)Charybdis Cruciata (Herbst)* *5)Scylla tranquebarica* *6)Neptunus trituberculatus*
2.	***Grapsidae***	*7)Pachygrapsus crassipes (*striped Shore crab) *8)Hemigrapsus sanguineus (*Asian shore crab*)* *9)Grapsus albolineatus (Mottled sally light foot)* *10)Grapsus longitarsus* *11) Striped shore crab – Pachyagrapsus Spp.*
3.	**Porcellanidae**	*12)Neopetrolisthes Spp. (Porcelain crab)*
4.	***Menippidae***	13)Stone Crab (Mutiya)

Materials and Methods:

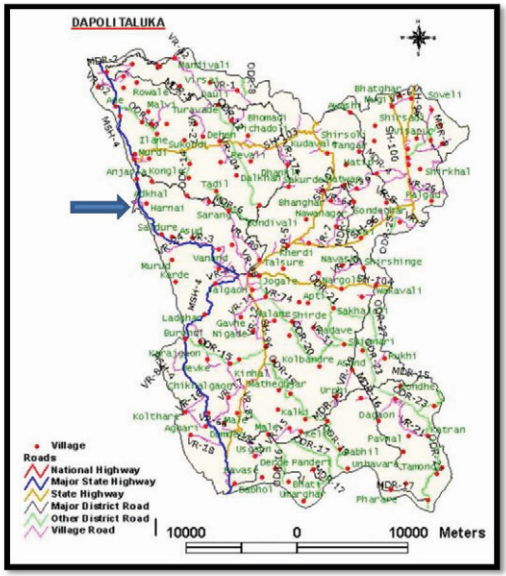
Crabs were surveyed in different location at Harnai port and near the Suvarndurg fort. The following stations were selected for the present study – Harnai Beach, Harnai fish landing center, Suvarndurg fort. The study was made from June 2017 to April 2018. During this Study no any crab is collected from the visited field and preserved. Just I had made photography in their natural habitat. Photography of some crabs also made on the landing center itself during the auction and at Suvarndurg fort.

Useful Equipment's during survey are -The plastic containers, Thermometers, Crab identification wheel, Camera, Hand gloves

In Konkan coast, the nets used for crab catching are boat seines, shore seines, gill nets, baited lines, hooks and rods. The fishing season is from August to October. The crabs were only observed and Photographed during low tide in June 2017 to April 2018. At rocky shores near the Suvarndurg, the Observation and photography involved choosing a rock haphazardly, clearing other rooks Around it, and then quickly lifting it and made the photography of crabs under it. The sediments were also probed to find any crabs that had attempted to burrow.

Harnai port is the western proximity of Maharashtra state and as stated earlier it harbors huge variety of marine fauna. The crab diversity was studied at their different stations. Selection of the stations was done on the basis of two parameters- one is habitat diversity and second is accessibility of the study site.

Arrow showing study area---- Harnai port



Sampling Method:

Belt transect methods was adopted for the study. Two belt transects (10X50m) were laid in each sampling site and whatever species encountered during the survey was collected. For the collection of wandering crabs, hand picking method was used and for burrowing crab patient wait for the crab to came out of the burrow was the only option so as not to harm the crab while collection. The collected specimens ware immediately photographed, sketched for noteworthy characters and identified tentatively in the field. After identification, all the specimens were released unharmed in their particular habitat. The identification was confirmed based on photographs, drawing and

character description and comparing them with the illustrative keys. (National Institute of Oceanography – Identification key for crabs). For further confirmation of species, all the details of the specimens were compared with the information available on marine species identification portal website (www.speciesidentification.org.com). The classification of brachyuran crab was adopted from the website www.marinespecies.org.

Observation

Harnai is situated 15km from Dapoli. Harnai beach provides a quiet and peaceful experience. It is an isolated stretch that is lined with a fort on its northern end. With natural harbor, clean waters, beautiful seascape and rocky coast, it promises to be a place for pleasurable holidays. It is becoming a popular tourist spot amongst.

Harnai port is the main fishing village. Every evening hundreds of fishing boats come back after fishing and gather to auction their catch. The fish auction is the essential trade step between fish landings and the trade. Business worth lakhs of rupees is carried out daily between 4 pm to7pm. Loads and loads of crabs, jumbo prawns, squids, sting ray and many more varieties of fish are auctioned and sent to Mumbai, Cochin as well as exported to the international market.

This is a coastal city in Konkan coast with softy sand and lush greeneries. The sandy shore of Harnai is one of the unique habitats for shore crabs such as bubbler crabs, crabs, fiddler crabs etc. The rocky shore of Harnai is full the green shore crabs are abundantly found on the rocky shore of Harnai. They are crawling on the flat surface on rocky shore in groups. They are very sensitive that when we go near them for photography, they jumped

into the water. The distance between them is about 5 to 7 meters. The sandy shore of Harnai is one of unique habitat representative of shore crabs.

Several species of tiny shore crabs can be found on Harnai beaches. Contrary to what many believe, these are not the young of larger ocean crabs, but are simply small sized species. Under most rocks and crevices you can find tiny black or brown or gray hairy shore crabs, ranging in size of half – dollar. These are mainly belonging to the *Hemigrapsus spp.* Children finds it especially fun to watch these crabs crawl and feed in tide pools. Other popular crabs of these shores are the hermit crab characterized by its tendency to use the empty shells of other intertidal creatures as it home. In present study, 13 species of different crabs from Harnai port belonging to the four families were recorded – 1*) Portunidae.2) Grapsida 3) Porcellanidae. 4) Menippidae.*

Discussion

Monitoring and baseline surveys are of great importance to know the present status of native and invading species (Melo, 1996). Along the sea coast of Konkan surveys for species diversity of coral, fishes, Mollusca, crabs are recorded but studies on Brachyuran crabs are sparse and non-definitive. (Yeragi, 2010). In the present study 13 species of brachyuran crabs were recorded from selected areas of Harnai port. By comparing different kinds of habitats like rocky shore, Sandy shore and muddy shore one can postulate the species dominancy on the habitat. Maximum diversity of Brachyuran crab was recorded from rocky and sandy shore at Harnai port.

Species of Brachyuran crabs have been recorded from open Mudflat of Mahi river estuary (Pandya, 2011). Open mudflat habitat is a dominant habitat type in Mahi estuary and species like *Uca lactea annulipes, Maeropthelmus*

depressus, M.dilatatus were dominant. Here in Harnai Port, *Scylla serrata, Portunus pelagicus, Charybdis cruciata, Neptunus sanguinolentus, Neptunus pelagicus Species* were dominant while the density of *Scylla serrata* was good.

Mangroves provide extra ordinary habitat for Brachyuran crabs as well as for other benthic fauna. However the diversity is less than the sandy and muddy shore habitat. Entire benthic fauna that dwells in mangroves, *grapsid* crabs are most important in terms of species diversity and density (Daudouh-Guebas, et al, 1997. Khan et.al (2005) has recorded 38 species of Brachyuran crabs from Pichavaram mangroves amongst them 18 species belonged to *Family-Grapsidae* while 8 to the family *Ocypodidae.*

Davie (1982) has recorded 32 Species of Brachyuran crab from mangroves of peninsular Malaysia. All above records show higher diversity of crabs as compared to the present study. Crabs play important ecological role in mangroves forest. They decompose the leaf litter and increase the availability of nutrient for other fauna and flora. Crabs always change the substratum profile as bioturaburator which drives the nutrient cycling in mudflats and mangroves (Pandya and vachhra jani, 2010, 2011).

The species diversity of Brachyuran crabs at shore depends on the density and species diversity of shore and prevailing hydro biological conditions (Davie, 1982). Rocky shore is amongst the most dynamic habitats found along the sea cost of the world. Many factors play important role in determining the nature of rocky shore communities (Bal DV, Rao KV, 1984.) Abiotic factors like wave actions, slope and Salinity of water are vital and

cause direct effect on diversity and distribution of floral and faunal communities inhabiting rocky shore habitat (Chhapgar 1957).

The animal species which live in rocky shore habitat have to develop specific kind of adaptations for the harsh conditions especially against wave or tide action because the high force of wave can detach or tare them from their home and it can take them to the sub tidal zone of the ocean. Pohle et al. (2011) have recorded 32 species of decapod crustaceans from Atlantic coast. Szechy et al. (2001) have recorded 12 species of brachyuran crabs from the rocky shore of Rio de Janeiro and Sao Paulo of Brazil and Paulo (2001); have recorded 7 species of Brachyuran crabs from rocky shore of central Portugal.

Of the total 13 species recorded in present study, the preference for rocky shore was more visible. Since only three locations were analyzed for present survey, the data may be insufficient to conclude about over all species diversity. The crab's species recorded were belonging to the Family- *Portunidae*, *Grapsidae, Porcellanidae* and *Menippidae*. As in the present study commercially important crab's landings were already reported by different authors in south east coast India.

At Harnai Port gill net, boats and shore seine as well as trawl nets are used to catch crabs. The existing crab fishery of India is not commercially developed as in other countries but from a comparison of the present exploitation and the evaluation of the potential crab resources of different regions, it would appear that there is scope for developing the fishery in to a major industry. Prerequisites for such an expansion from the commercial point of view are the extensive use of the efficient tackles to catch crabs, the development of quick transportation facilities of this extremely perishable

commodity to the consumer centers and the development of a taste for crab meat among the population. From the scientific point of view, it is essential that intensive investigations on improved fishing technique on farming of suitable varieties of crabs and on various biological aspects are to be carried out not only to harvest crabs from unexploited inshore and offshore regions but also to safeguard the stock from injudicious exploitation as it is not uncommon to see females in "berry" being extensively fished and sold in the markets.

Various commercial crab species are reported as food by the local communities and future research should focus on establishing their nutritive food value, biology and ecological relationships in their marine habitats. The primary fishing is the lifeblood of many small coastal communities often where other sources of jobs and incomes. So it is recommended the protection for the breeding stock undersized commercial valuable crabs. As well as recommended returning back to the sea of juveniles ovigerous females and recently moulted crabs as a way of preventing over fishing.

In this present survey of crabs at Harnai port, reports are important contributors in country's economy, in terms of house hold income, employment and exports.

Conclusion

Studies of marine biodiversity in India have a long tradition and cover a wide range of faunal and floral groups. But since 1961, there has not been notable progress in the studies of diversity of crabs of west cost of India. Hence there is a need to update the current knowledge of the biodiversity studies of crabs of west coast of India. The crab rearing plays an important

role in the financial condition of large number of poor people living among the Konkan coast. The study site that is Harnai Port is in vicinity of Agriculture Research University. There is a need to update the current knowledge of the biodiversity studies of crabs in Konkan region.

The crab fishery in India is yet to be recognized as a major fishery despite the abundant occurrence of edible crabs all along the Indian coast. There are about 600 crab species occurring in Indian waters. However only few of them are used for human consumption. Harnai is a small village famed as a gateway to escape from the metropolitan life of Mumbai and Pune. It has very clean beaches, so it attracts thousands of tourists. This is a coastal city in Konkan coast with softy sands and lash greeneries. The sandy and rocky shore of Harnai is a one of the unique habitat for shore crabs. Konkan in Maharashtra having a large network of river and a long stretched costal area is blessed with both marine as well as inland fishery resources, despite this abundance, these resources have been neglected so far and have not been used on large or commercial scales.

The feasibility of culturing crabs must receive attention in our India because the high market demand and decreasing availability of crabs. The local poor people in Harnai used soup or curry of crab in their daily food. Hence from the scientific point of view, it is essential that intensive investigation on improved fishing technique, on farming of suitable varieties of crabs is to be carried out to harvest crab.

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CHAPTER 3

Ethnomedicinal Investigation of Some Common Botanicals Sold By Vendors in North Maharashtra, India

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Abstract:

The present paper deals with botanical sold by the vendors in Dhule, Nandurbar, Jalgaon, and Nasik Districts of North Maharashtra (India) ethnobotanical survey was carried out few years and information was obtained through open discssions and interviews with tradipracititioners. Presently, 25 plant species 25 genera belonging to 23 families are communicated of these 09 species are belonging noted for first time from Indian region. Where as 03 species although recorded so useful, their parts are different. These are administered in various forms of recipes like paste, powder, extract, ash, decoction etc. Even they are used raw or sometimes simply warmed. In many cases, they use them as a sole drug or occasionally supplemented by other botanicals or substances like sugar, cow ghee, honey etc. These are used combat about 25 common disease such as ulcer, leucorrhoea, headache, jaundice, bile, constipation, earache, urinary, intestinal worms, Gonorrhoea, piles, urination, typhoid, impotency, redness of eyes, skin, diarrhoea, asthama,

Night blindness, heart, liver , sexual vigour., wound,Menstruation. The data accrued is assessed by cross-cultural comparisons with other Indian clams to bring out veracity and uniqueness of the claims. The objective of investigation was to gather and document information on utilization of botanicals by the tradipractitioners in the region. They must be testified on scientific line involving chemical, biological and clinical screening.

Key Words : *Ethnomedicine, Herbal Vendors, North Maharashtra*

Introduction

Medicinal plants have been crucial in sustaining the health and well-being of mankind. It is generally agreed that major section of population especially in developing and underdeveloped countries seek healthcare from sources other than conventional medicines. They also seek help of some organized systems of medicine like Ayurveda, Unani, Siddha, etc. Apart from these, every community or village has a wealth of herbal folklore. Our ancestors possessed a profound understanding of healing powers of plants. They used to try and test local plants for a range of common health problems. These ancient healing practices are still in vogue in a period when different well-thought and organized systems of medicine are being practiced all over the world. Their knowledge has been passed orally generation-to-generation since long past. India is one such country having the oldest system of healing in the world. Moreover, tribal and rural societies in India still have their own choices of indigenous drug selection and application.

A review of literature indicates the Herbal Vendors (Jadibutiwalas) and their traditional knowledge about plant drugs has remained untapped. They have been always ignored in our country. In India, Sinha (1998) attempted on

this line and studied Delhi and surrounding areas. The present authors investigated some districts of north-western part of Maharashtra. viz. Dhule, Nandurbar, Nashik, Jalgaon. Information of 25 plants species. used for human disease being communicated in this paper.

Materials and Methods

Herbal vendors wandering in north Maharashtra are tapped and enquiries w.r.t. plant drug, recipe, administration, plant names, precautionary tips and diseases treated are noted. Plants samples or products are purchased / collected and preserved scientifically. They are identified by using various regional, state and national floras in India. (Cooke, 1958; Hooker 1853; Naik, 1998; Sharma et al., 1996 Singh et al, 2000; Patil 2003, and Kshirsagar and Patil 2008) Repeated surveys were conducted in different villages, towns and cities of North Maharashtra. Information regarding remedies related especially to the human diseases was recorded. The data adduced is based on personal interviews, observations and experiences of vendors in the region. The data is compared with the classical literature to point out new reports from India (Anonymous 1948-1976; Ambasta 1986; Jain 1991; Watt 1889-1893; Bhattacharjee,1998 etc.) Asterisk to the plant species indicate reports in classical literature.

Results and Discussion

Different plant varieties observed are presented in the following Table-I.

Table – I : Enumaration of identified botanical and utilities

Sr. No.	Plant Name & Family	Vernacular Name	Plant Part Used	Utility
1	*Abitulon indicum* L. (Malvaceae)	Dabala / Atti	Roots, Leaves	1. Dried roots powder is homaginised with oil and applied on joints to treat joint ache. 2. Extract of few fresh leaves is mixed in cow ghee in equal quantity. About two spoon of it are administered daily for three days to regularize Menstruation.
2	*Abrus precatorius* L. (Fabaceae)	Gunj	Leaves	Half a cup of leaf juice is advised for three days twice daily to control urinary problem.
3*	*Acacia Chundra* Willd. (Mimosaceae)	Khair	Stem bark	1.Stem bark powder of A. Chundra Willd Emblica officinalis Gaertn (Eupherbiaceae) and ash are mixed together, and taken in water twice daily for seven days cures Leprosy. 2. Powder of stem bark is applied on wounds, is helpful in blood clotting and heals the wound.

4**	*Acalypha indica* L. (Euphorbiaceae)	Khokali	Leaves	1.Dried leaves powder 1 gram and dried Zingiber officinale L. are mixed together and is applied on tooth to cure toothache. 2.Dried leaves powder and Allium sativum L. are mixed together and is consumed at night for fifteen days to kill intestinal worms.
5**	*Aconitum ferox* Wall. Ex.ser. (Ranunculaceae)	Bacchanag	Root, Stem	1.Roots oil is applied on joints at night for fifteen days releves rheumatism, and joint pain. 2.Stem powder is advised on teaspoon for seven days at night to increase sexual vigour.
6	*Biophytum sesitivum* L. Dc. (Oxalidaceae)	Lajalu	Root, Entire plant	1.a spoonful of root extract is taken orally twice a day to root diphtheria. It is advice for a week. 2.Entire plant are crushed and decoction is prep rod one cup once daily to cure rheumatism till cure.
7*	*Bixa orellana* L. (Bixaceae)	Sheduri	Leaf, Root	1.Two teaspoonful of leaf powder is administered with water for seven days against kidney stone. 2.The root and seed are dried and powdered this powder oneteaspoon is given for three days with cow-ghee to cure gonorrhoea.
8	*Boerrhavia diffusa* L.	Punarwa	Entire	1.Entire plant is dried in

	(Nyctaginaceae)		plant, Leaf	shade and made in to powder one teaspoonful of this powder is advised with water twice daily for seven days is helpful against urinary stone and liver swelling problems. 2.Leaf juice is given orally early in morning for fifteen days against cure heart complaints.
9*	*Callicarpa macrophylla* vahl. (Verbenaceae)	Gahula	Leaves	1.Leaves are soaked in water overnight, it is crushed and strained a spoonful of sugar is added and consumed in the morning to cure urinary problems like burning sensation during urination. 2.Leaves paste is applied on joints for fourty five days to cure rheumatism.
10*	*Canna indica* L. (Cannaceae)	Kardal	Leaves	Leaves are boiled in four cups of water. It is boiled till decoction is reduced to one cup one spoonful of it is administered twice a day for eight to ten days against urinary stone.
11	*Carum carvi* L. (Apiaceae)	Kala jira	Seeds	1.Seeds of carum carvia, dried fruit powder of Emblica officinale L. and leaves of Gossypium hirsutum L. are made in to paste in water, then paste is applied on forehead daily for twenty one days cures night blindness.

				2.Roasted seed powder 5 gram is mixed in water and is given to children against diarrhoea.
12	*Citrullus colocynthis* (L.) schard. (Cucurbitaceae)	Endrayan	Fruit, Stem	1.A glassful of fresh fruit juice is given in the morning for seven days helps to releve intestinal problem and asthama. 2.Stem are dried and powdered. It is homogenized with honey and pelletes are prepared. Two pelletes are advised daily for three day is to cure ulcer.
13*	*Corchorus olitorius* L. (Tiliaceae)	Koshta	Leaves	1.Dried leaves powder about 10g is given twice daily for four days to cure fever. 2.Dried leaves powder of this plant and dried rhizome powder of zingiber officinale L. are taken in equal amount and is made in to paste in one teaspoon of honey this paste is given two or three times a day to cure diarrhoea.
14	*Dalbergia sisso* Roxb. Ex. DC. (Fabaceae)	Sisam	Leaves	1.One cupful of decoction of leaves is administered to a person suffering from skin problem like boiles and prickles. 2.Leaf juice is mixed with honey and two or three drops are dropped in eyes

				for three days at night to reduce redness of eyes.
15	*Echinops echinatus* Roxb. (Asteraceae)	Utkata	Root	1.Roots are consumed with betel leaves (Piper betel L.) for a fort night to cure impotency. 2.Root are crushed and powdered finally one spoonful of it is mixed in water and drunk at morning for twenty one days to cure fever or typhoid.
16	*Foeniculum vulgare* Mill. (Apiaceae)	Badi saup	Seeds	Seeds are soaked in water overnight. In the morning it is mixed with lump sugar and is consumed to cure burning sensation during urination.
17*	*Grewia asiatica* L. (Tiliaceae)	Falsa	Roots	1.Decoction of root about one teaspoon is administred at night to cure rheumatism. 2.Roots are soaked in water over night and one teaspoon of this water consumed in the morning for seven days to releve painful urination.
18	*Helicteris Isora* L. (Sterculiaceae)	Muradsheng	Follicles	One teaspoon of decoction of follicles is mixed in cupful of buttermilk and consumed twice daily for seven days relives piles.
19	*Hemidesmus indicus* R. Br. (Asclepidaceae)	Anantmul	Roots	One fistful of roots is washed, crushed and put in cup of water for fifteen minutes and then strained

				one cup of infusion is taken in the morning and evening for seven days to cure Gonorrhoea.
20**	*Holoptelea integritifolia* (Roxb.) Planch. (Ulmaceae)	Vavala	Leaves	1.Leaves juice about 5-10 ml is consumed with honey daily at night for seven days kills intestinal worms. 2.Leaves juice of the plant about 5-10 ml is mixed with lump sugar (Saccharum officinarum L.) and is consumed to control vomiting.
21	*Hygrophilla angustifolia* auct. (Acanthaceae)	Talimkhana	Leaves, Entire plant	1.Mixture of leaf powder and honey one tea spoon twice daily for seven days is useful against jaundice. 2.Decoction of Entire plant is prepared and cupful of this decoction in the morning for three days controlls yellow urination and other urinary problems.
22	*Jasminum auriculatum* vahl. (Oleaceae)	Jui	Leaves, Flowers	1.Leaves are boiled in seasam (Sesamum orietale L.) oil, after cooling, one to two drops of this oil is dropped in ears to cure earache. 2.Flowers are crushed and are put arounded the eyes releaves burning sensation of the eyes.
23	*Juglans regia* L. (Juglandaceae)	Akharoat	Leaves, Fruits	1.Decoction of leaves of this plant is advised are cupful daily at night for ten

				days kills intestinal warms. 2.Fruit oil 20gms is mixed in 200ml of milk and is given to a person having problems of constipation.
24	*Limonia acidissima* L. (Rutaceae)	Kauth	Fruits, Leaf	1.50gms of sugar of jagerry is added to fruit pulp is advised tea spoon twice a day for seven days in the treatment of bile problem. 2.One tea spoon of leaf juice is advised with cupful of milk twice daily for four days to cure jaundice.
25	*Luffa echinata* Roxb. (Cucurbitaceae)	Devdangari	Fruits	1. Dried fruits are soaked in water overnight and is strained 1-2 drops are dropped in both nostrils cures Migrane headache. 2. Dried root powder about 500 mg is mixed in honey and is consumed daily for one month releaves leucorrhoea.

Our investigation on botanicals sold by the herbal vendors in Nashik, Dhule, Nandurbar, Jalgaon districts of North Maharashtra revealed 25 plant species useful to cure patients suffering from ulcer, leucorrhoea, headache, jaundice, bile, constipation, earache, urinary, intestinal worms, Gonorrhoea, piles, urination, typhoid, impotency, redness of eyes, skin, diarrhoea, asthama, Night blindness, heart, liver , sexual vigour., wound, Menstruation complaints. These belong to 25 genera and 23 families of angiosperms. of these 02 species are exotic. These are advised to employ botanical in the form of various

medicinal recipes e.g. powder, Extract, juice, ash, oil, decoction, paste. The number in parenthesis indicates of use- reports for the respective parts. These are supplemented also in few cases by sugar and butter milk.

There are 09 species, which on comparison with classed literature, are being report useful for the first time from India. There are 03 species viz, *Acalypha indica*, *Aconitum ferox*, *Holoptelea integritifolia* which are reported earlier useful for the affliction under study but the parts use employed are different. The herbal vendors carry on their business traditionally especially in publics places like, railway stations, bus-stations, weekly bazaar, famous temples, pilgrims, special gatherings, courts, government, offices, main roads, etc. Even in modern period, many people purchase medicines from them. It is not scientifically verified by the vendors and hence it is advisable to testify these bioresources in laboratories. Such attempts will authenticate these claims and may add new or additional source of medicines

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CHAPTER 4

Study of Impact of Seasonal Variation in Water Quality on Planktons' Population Found in River Godavari

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Abstract:

The current study has its main focus on the variation noticed in the population of zooplankton during pre-monsoon and post monsoon season in the Godavari River water in the year 2017 in the upstream area. The objective behind studying the zooplankton population is that zooplankton are one of best bio-indicators which can help us to know the quality of the water. For this, qualitative and quantitative analysis was done. The assessment showed high amount of variation zooplankton population during the selected period. To carry out the study, two sites have been selected. The water samples have been collected from the selected sites. The samples were collected at the regular intervals to have proper comparative analysis. It has been observed that there is a lot of seasonal variation occurred in the population of zooplankton of Godavari river water during the selected time span at the designated sites. It has been noticed that the growth of zooplanktons such as Rotifera and *Cladoceda* was high in the month of May whereas it was significantly reduced when the monsoon started and its successive period. The reasons were

increase in water quantity, physiological and biological variations as well as increase or decrease in human activities.

Keywords: *Godavari River, Pre-monsoon, Post monsoon, Quality of water, Zooplankton*

Introduction

Water is considered as one of the important potions of life. Life flourishes in, on and around water. River is one of such sources, which has helped human-beings raise their settlement on its banks apart from other living beings. But, due to the human settlement and its greed to achieve or have more than required it has affected the resources to a great extent, including the water resources. In case of human activities, industrialization and urbanization are the key factors. A lot of stress has been created on the water resources because of these two factors.

The current study also has its focus on such a river, Godavari, which has been affected by such human activities. Since last few decades the river has been facing a huge water pollution problem.

The phytoplankton study is also an important and useful tool to evaluate the quality of water and to understand the very basic nature and general economy of the river. At the same time zooplanktons study helps to identify the changes in plankton communication such as their tolerance capacity, diversity in them and dominance of certain planktons; as they have short life span. Human activities have great influence on these water bodies, caused due to rapid loss of surrounding vegetation for raising settlements, industrialization etc. This leads to increase in sludge and nutrient load. Sewage

disposal and industrial waste water release, use of river water for defecation, agricultural activities involving use of chemical fertilizers, pesticides insecticides and performing various religious rites greatly increased nutrients' quantity as well as organic input into water bodies (Patil et al., 2011; Patil and Ghorade, 2012). The current study is an attempt to comparatively study eco-sustainability of Godavari River by studying zooplankton population found in river's ecosystem.

The samples were collected after regular intervals, from both the selected sites for study. This process was adopted to identify the changes. As seasonal variations have its impact on everything so is on phytoplankton, zooplankton and ultimately on the water quality. Therefore, the pre and post monsoon period was selected.

Material and Methods

The water samples have been collected from two sites selected for this study (Figure 1 Reference Image source: Google Earth).

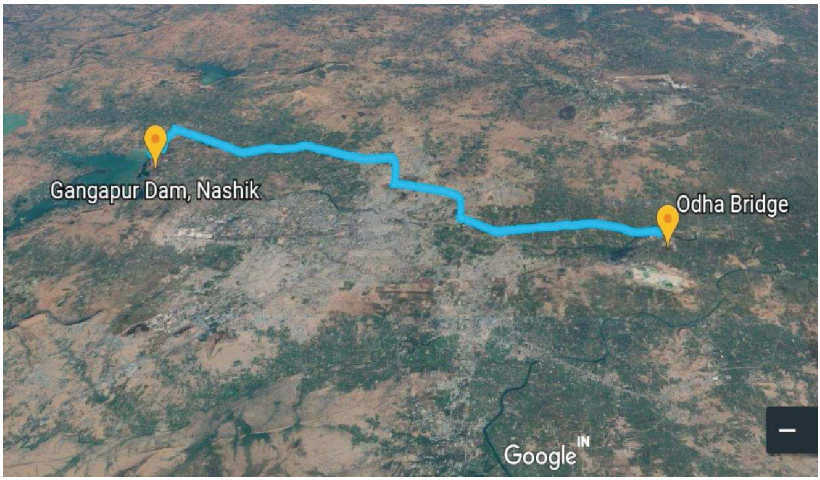


Figure 1: Reference image, Source: Google: Sites: Gangapur Dam, Nashik and Odha Village

The reason to select these sites for study was: At these sites the water either gets accumulated for various human activities or it is being utilized by human beings for various purposes and because of which the water quality changes can be significantly noticed. So the results will be more precise as compare to the other site.

The samples of Zooplanktons were collected from two designated sites for qualitative and quantitative analysis by standard methods (APHA, 2005) between 11 am to 1pm. The sampling was done for the period May 2017 to September 2017. The collected samples were immediately added in 4 % formalin to preserve them and taken to the laboratory to carry out analysis of zooplanktons. The samples were analyzed in the research laboratory. Counting and identification of zooplankton were done as per (1992) Species diversity index and by following Shannon - Weiner Species index methodology (Nath,

1997). For qualitative analysis a compound microscope was used. Standard key and other literature was used for identification of different species (Auti et al 2003), Patil et al 2008). Zooplankton were collected by using 125 mesh size plankton net by filtering 10 liters of water and it is concentrated up to 100 ml and preserved in 4% formalin.

Results and Discussion

The species which were found at the selected two sites for the period May 2017 to September 2017 are presented in table 1 and 2. The population density of zooplanktons was maximum in the month of May and June. Whereas it was noticed minimum at both sites in the month of September.

Table 1: Population composition and monthly fluctuation of Zooplankton at Gangapur dam (Species / ml) for the period May 2017 to September 2017

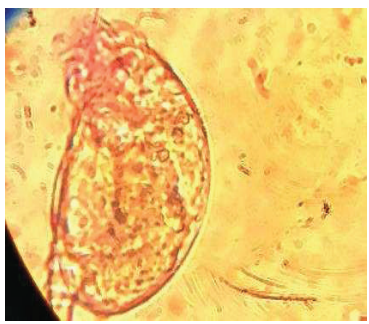
Month / Species	May-17	Jun-17	Jul-17	Aug-17	Sept-17	Mean	Percentage (%)
Rotifera	45	45	39	37	12	35.6	71.49
Cladocera	19	17	12	11	12	14.2	28.51
Total	64	62	51	48	24		

Table 2: Population composition and monthly fluctuation of Zooplankton at Odha village (Species / ml) for the period May 2017 to September 2017

Month / Species	May-17	Jun-17	Jul-17	Aug-17	Sept-17	Mean	Percentage (%)
Rotifera	57	55	34	42	35	44.6	65.98
Cladocera	23	27	25	19	21	23	34.02
Total	80	82	59	61	56		

The below figure 2 (A and B) shows the species found in the water at the selected sites.

A: Rotifiera



B: Cladocera

The figure 3 and 4 shows percentage of each species. The mean percentage composition noticed of different zooplankton groups at Gangapur dam site is: Rotifera 71.49 % and Cladocera 28.51%. Whereas at Odha village site is: Rotifera 65.98 % and Cladocera 34.02 %.

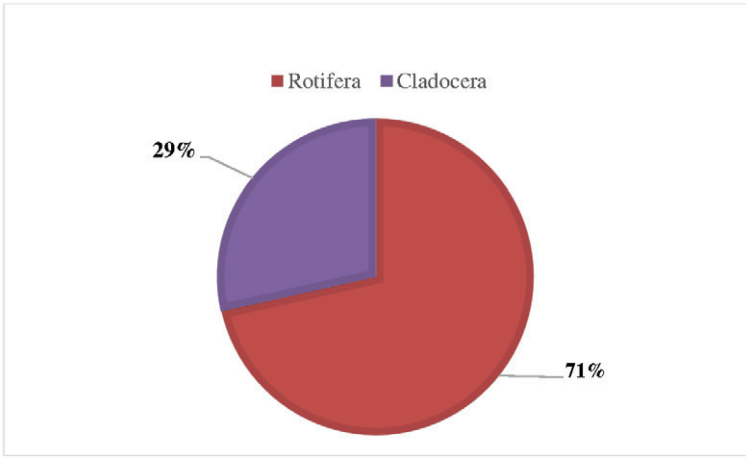


Figure 3: Gangapur dam: Zooplankton Population (in %)

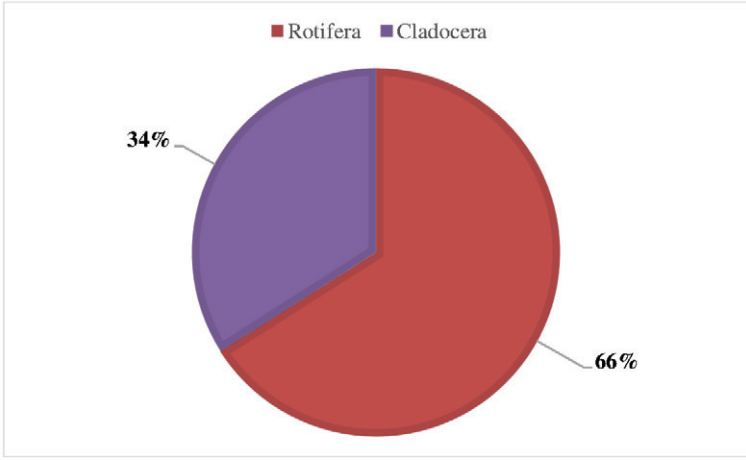


Figure 4: Odha village: Zooplankton population (in%)

Conclusion:

It can be concluded from the study that the zooplankton population of Godavari River in Nashik district especially in the vicinity of Nashik city is greatly affected by various human activities ranging from discharge of sewage water from different domestic activities as well as industrial waste water. As we can see that from the stretch of Gangapur dam to Odha village the river passes from mainland of the city as well as there are many sewage treatment plants in the city whose treated water is releases in the main river water body of Godavari river. Beside this, Nashik has two major MIDCs (Maharashtra Industrial Development Corporation) at Satpur and Ambad which releases its effluent in the river. Not only this, there is state government run thermal power generation station at Eklahare which uses substantial of water for power generation and lastly agriculture activities. Because of these factors the variation in the zooplankton population and structure occurs. The variation signifies decline in the water quality in this area. The zooplankton population was varying continuously as the increase in the water quantity as monsoon progresses but still the zooplanktons growth was not significantly changed at Odha village. The addition of rain water greatly affecting the water composition and relative changes the species occurrence in the aquatic communities (Rajshekhar et al 2010). The structure of zooplankton and groupings which greatly affects the functioning of ecosystem is due to changes in water quality of water body Sousa et al., (2008). According to Ferdous and Muktadir (2009) zooplanktons can be used as bio-indicator. Even Ramchandra et al., (2006) stressed the role of zooplankton as bio-indicator. Therefore, the

use of qualitative and quantitative study of zooplankton population is greatly helpful in the study of water quality of any water body.

Lastly, authors can conclude from this research work that, in summer i.e. pre-monsoon season, there is abundant amount of zooplankton found in the water body of Godavari river at the selected sites as compare to the during and post monsoon season due to biological factors and human interference. Water at Odha was excessively contaminated due to human interference such as domestic activities, industrial releases and farming activities. Zooplanktons are very useful for the same as they are bio- indicators of trophic condition of water and pollution indicators of water system. They check the growth of algae and other parasitic forms by feeding on them.

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CHAPTER 5

Isolation of Fungi from Different Soil of Partur, District Jalna of Maharashtra

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Abstract:

Soil contains number of microorganisms, from them some are parasitic and many of are saprophytics. These saprophytic microbes play important role in the biodegradation of waste materials and convert it into useful organic maters. Presence of these useful mycoflora in the soil increase the fertility of soil. In the present investigation an attempt has been made to isolate the fungi from different soil. For isolation soil samples were collected from the different fields in pre sterilized bags. Soil samples were cultured on the PDA & Czapac dox agar media. The culture plates were incubated for seven days at 28 ^{0}c temperature and PH was maintained 6.5. Fungi were sub cultured to obtain pure culture after getting pure culture fungi were identified with help of key and literature. In the all types of soil shows dominance of *Aspergillus, Penicillium, Fusarium* and *Trichoderma* genera.

***Key words**:* Fungi, PDA, Czapac dox agar, Identification.

Introduction

Soils are highly complex systems, it having different components playing diverse functions mainly due to the activity of soil organisms. Soil

microflora plays a pivotal role in evaluation of soil conditions and increases the fertility of soil and plant growth. Greater influence on the activity of soil microflora due to type of cultivation and crop management practices. Use of chemical fertilizers in excess dose cause imbalance in soil microflora and there by indirectly affect biological properties of soil leading to soil degradation (Manickam, and Venkataraman ,1972). Fungi play a key role in many essential processes such as organic matter decomposition and elemental release by mineralization (Christensen, 1989). Fungi are an important component of the soil micro biota (Ainsworth and Bisby, 1995). Micro fungi play a focal role in nutrient cycling by regulating soil biological activity (Arunachalam et al 1997). Maximum number of fungal colonies belongs to deuteromycotina, (Ratnakumar et al, 2015). The quantities of organic and inorganic materials present in the soil have a direct effect on the fungal population of the soil. In addition to chemical fertilizers and wide range of pesticides shows adverse effect on mycoflora which are much useful to maintain soil fertility and eco-balance in the soil atmosphere. In pesticide containing soil *Alternaria, Aspergillus Drechslera* and *Fusarium* were predominant genera, (Rohilla and Salar 2012). The members and kinds of micro organisms present in soil depend on many environmental factors such as the amount and type of nutrients, moisture, degree of aeration, pH and temperature etc. The aim of the present investigation is to isolate mycoflora from different soil, and to observe the percentage incidence of different fungal species.

Material and methods

Method for collection of soil samples:

The soil samples were collected from four different crop fields in various locations of Partur district Jalna. The soil samples were collected from different crop fields (up to 15cm depth) into a small sterilized polythene bags and brought to laboratory for further study.

Isolation of fungi from the soil samples:

The soil micro fungi were done by Soil Dilution Method,on different media such as Potato Dextrose Agar and Czapek,s Dox Agar.

Soil dilution plate method (Waksman, 1922):

1gr of soil sample was suspended in 10ml of double distilled water to make microbial suspensions (10-1 to 10-5). Dilution of 10-3, 10-4 and 10-5 were used to isolate fungi. 1 ml of microbial suspension of each concentration were added to sterile Petri dishes (triplicate of each dilution) containing 15 ml of sterile Potato Dextrose Agar and Czapek,s Dox Agar. One percent streptomycin solution was added to the medium before pouring into petriplates for preventing bacterial growth. The Petri dishes were then incubated at 28± 20 C in dark. The plates were observed everyday up to three days.

Identification of the soil fungi :

Fungal morphology were studied macroscopically by observing colony features (Colour and Texture) and microscopically by staining with lacto phenol cotton blue and observe under compound microscope for the conidia, conidiophores and arrangement of spores (Aneja,K.R.2001). The fungi were identified with the help of literature (Gilman, 2001. Nagamani 2006).

Results and Discussion

Fungal diversity of any soil depends on a large number of factors of the soil such as pH, organic content, and moisture (Alexander 1977). The different colour of soil having different organic matter , texture , pH were determined the fungal population and their diversity in agricultural fields during the investigation period. 60 fungal colonies of 13 fungal species were observed (Table: 1 & photo plate). The maximum fungal species of *Aspergillus* were observed. Among the isolates the genera *Aspergillus*, Fusarium and *Penicillium* were dominant (Table: 1).

Table No. 1. Incidence of Mycoflora From Different Soil

Fungal incidence	**Type of soil/**			
	Red soil	**Black soil**	**Gray soil**	**Rock soil**
Alternaria alternata	---	05	---	---
Aspergillus niger	10	20	10	10
Aspergillus flavus	30	30	10	10
Aspergillus fumigatus	05	05	---	---
Aspergillus terreus	--	05	---	---
Penicillium chrysogenum	10	10	05	05
Penicillium frequentans	05	--	--	--
Fusarium oxysporum	15	20	10	10
Fusarium solani.	--	05	05	---
Curvularia lunata.	05	05	---	---
Trichoderma viride	10	15	10	---
Trichoderma harzianum	10	10	05	05
Rhizopus stolanifer.	10	10	05	---

The soil Mycoflora in different soil viz Red soil, Black soil, Gray soil and Rock soil. The most common among them viz; *Aspergillus flavus* (30%) *Aspergillus niger* (20%), *Aspergillus fumigatus* (10%) *Aspergillus terreus*(5%), *Penicillium chrysogenum*(10%) *Trichoderma viride*(10%), *Trichoderma harzianum*(5%), *Fusarium oxysporum*(10%), *Fusarium solani*(5%), *Curvularia lunata* (5%) *and Rhizopus stolanifer* (10%) were isolated and characterized. Diversity was found to be higher in red and black soil than the gray and rock soil.

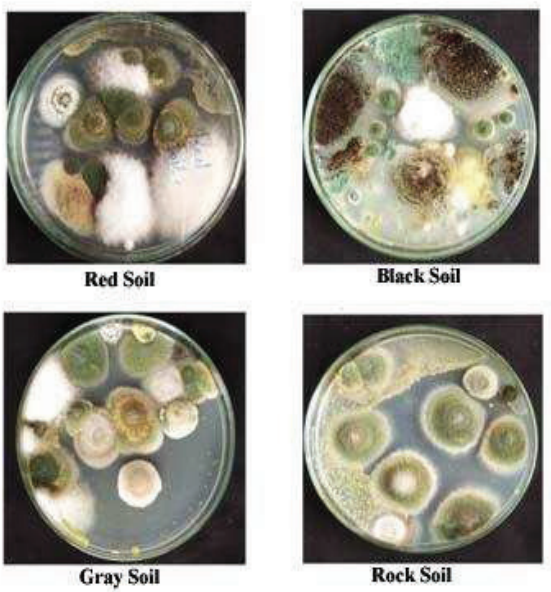
The Soil pH, organic content and water are the main factors affecting the fungal population and diversity .The organic carbon, nitrogen, phosphorus, potassium are important for fungi. In the absence of any of these the growth and sporulation of moulds as well as other microorganisms are hampered a lot (Saksena,1955). It has been reported that the density of fungal population occurred during the monsoon (rainy) season when the soil moisture was significantly high has reported that environmental factors such as pH, moisture, temperature, organic carbon ,organic nitrogen play an important role in the distribution of mycoflora.Most of species belonging to genera *Aspergillus*, (Jadhav and Shinde 2017).

Conclusion

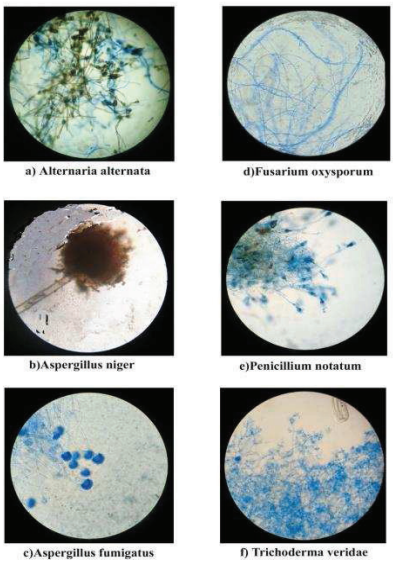
In the present study soil samples of four different soil viz., Red ,Black Gray and Rock soil were studied for screening and detection of fungal diversity. The results obtained clearly indicates that*, Aspergillus niger*, *Aspergillus flavus* and *Penicillium chrysogenum* , *Fusarium* and *Trichoderma* were of high occurrence in all type of soils some other fungi like *Aspergillus fumigates, A. terreus, Curvularia,* and *Rhizopus* were negligible. Among the

isolates *Aspergillus* and *Penicillium* were dominant in all agricultural fields due to high sporelation capacity and the *Penicillium* spp were producing fungal and bacterial antibiotics and the *Aspergillus* spp producing different kinds of toxins such as aflotoxins, achrotoxins etc. These toxins may prevent the growth of other fungal species. The frequency of mycoflora in agricultural fields were found to be regulated by many factors like temperature, humidity, vegetation , organic and inorganic materials ,soil type and texture. The fungi were mostly observed in month of June to September due to suitable temperature and humidity.

Mycoflora of different Soil



Microphotograph of Some Soil Fungi



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CHAPTER 6

Study of aero biocomponents from vegetable market at Patan, Maharashtra

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Abstract

A study on aerospora of vegetable market at Patan was carried out by using Rotorod air sampler. To find out fungal diversity in study area the sampling was done from 1st August 2017 to 30th October 2017. Meteorological data was maintained during the period of investigation. Total 22 different aerobiocomponents were recorded during the period of investigation. *Aspergillus, Curvularia, Penicillium, Alternaria, Fusarium* were found to be dominant forms and also responsible for decay of vegetables.

Key words: *Vegetable market, aerospora, fungal spores. Rotorod sampler, Patan*

Introduction

Aerobiological study includes organic and inorganic components present in air and various aerobiocomponents such as fungal spores, pollen grains, bacteria, plant hairs, protozoan cysts, unidentified spores, hyphal fragments, insect parts and mites etc. These aerobiocomponents undergo vertical and horizontal transportation through air comprising short distance or long distance travel. Study of airspora consist studies of airborne fungal

spores, pollen grains and other airborne microorganism (Jacobs, 1951). Sometimes spores passing up to thousands of kilometers in viable conditions. Fungal spores in vegetable market are the causative agents of infections and many respiratory diseases (Chandel, 2002). As there was no work on aerospora of vegetable market at Patan, hence present investigation was undertaken.

Aerobiology study includes organic particles such as fungal spores, bacteria, mites, pollen grains, and viruses which are present in air (Spieksma, 1991). aerobiology comprises two parts indoor aerobiology and 0utdoor aerobiology. Extramural or Outdoor Aerobiology comprises aerobiological study of crop fields, Playgrounds, Forests, Vegetable garden, Gardens or any outdoor locality which will be beneficial for understanding the problems of airborne plant diseases and consequences of aeroallergens on human health. Majority of fungal spores are responsible for allergic disorders, asthma and rhinitis (Shivpuri and Singh1971; Chanda and Mandal 1978 Tilak, 1991). The present study was carried out to identify fungal forms in vegetable market in Patan and to study their variation in concentration. People working in vegetable market, visiting vegetable market, expose to pathogenic fungal spores as they inhale air from that area.

Materials and methods

The work was carried out by using Rotorod sampler. The Rotorod sampler was fully designed by Dr. W.A. Perkins in 1957 and modified by Dr. S.T. Tilak for trapping of air borne particles. The work has been carried out in Vegetable market by keeping Rotorod air sampler operating for half hour early in the morning. The Rotorod sampler has been used for trapping wide variety

of airborne particles. Smaller airborne particles are deposited on narrow cylindrical oriented at right angle to high velocity of winds. The conversion factor for Rotorod Sampler is '5'. The conversion factor is constant irrespective of the location, season and weather. Daily air sampling was taken at 9 am. To 9.30 am. Meteorological data was properly maintained from day to day during the study period. After sampling the air, the cello tape was mounted on a 24 x60 mm glass slide and mounted with glycerine jelly. The tapes were scanned under research microscope. Identification of spore was done on the basis of morphological characters and with the help of available literature (Tilak and Srinivasulu, 1967).

Table 1 -Total no of spores found in each group

Sr.No	Spore type	Total no spores types	No of spores	% contribution
1	Zygomycotina	1	150	3.53
2	Basidiomycotina	2	585	13.8
3	Deuteromycotina	14	2295	54.06
4	Other types	4	1180	27.80
5	Unidentified	1	35	0.82
	Total	22	4245	

Table 2 Variation in the concentration and percentage contribution of the different spore types to the total airspora inside the vegetable market, Patan

Sr.No	spore	Total	% contribution
A	**Zygomycotina**		
1	*Rhizopus*	**150**	3.53
B	**Basidiomycotina**		
1	Rust spores	**435**	10.2
2	Smut spores	**150**	3.53
C	**Deuteromycotina**		
1	*Alternaria*	**115**	2.71
2	*Aspergillus*	**500**	11.8
3	*Bispora*	**35**	0.82
4	*Cladosporium*	**525**	12.4
5	*Curvularia*	**180**	4.24
6	*Epicoccum*	**45**	1.06
7	*Fusarium*	**125**	2.94
8	*Haplosporella*	**110**	2.59
9	*Penicillium*	**435**	10.2
10	*Periconia*	**55**	1.3
11	*Tetraploa*	**35**	0.82
12	*Torula*	**100**	2.36
13	*Trichoconis*	**15**	0.35
14	*Tetraploa*	**20**	0.47
D	**Other Types**		
1	Cellulose fibers	**310**	7.3
2	Hyphal fragments	**160**	3.77
3	Plant part	**500**	11.8
4	Pollen grain	**210**	4.95

E	**Unidentified**	**35**	0.82
	Total	**4245**	

Table 3 Month wise weather variables

Sr.No	Months	Average % of Airspora	Average Temp in ^{0}C	Total Rainfall in mm	Average Relative Humidity in %
1	**August**	**27.95**	**24.74**	**321**	**90.65**
2	**September**	**21.32**	**25.63**	**240**	**69.63**
3	**October**	**50.72**	**27.19**	**122**	**60.81**

Result and Discussion-

Airspora of vegetable market is very rich in fungal spores. The aerobio component in open environment includes their release, dissemination, deposition, and this data is of great significance to identify the health hazards and physical disorders in living beings (Kulkarni 2017). In present investigation total 22 different aerobiocomponents were recorded during preliminary monitoring over vegetable market at Patan. Ahire and Sangale (2012) recorded 17 types of fungal spores at Pimpri market. Hogale and Patil (2008) have recorded 57 fungal spores in vegetable market at Karad. The dispersal of fungal spores is influenced by season and weather parameters. In this work Spore load was recorded in the month of October. Spore load affect the health of human being working in the market as well as animals.

Verma and Sheore (1994) mentioned dominant fungal spores in the vegetable market at Jabalpur. Over all sampling revealed 4245/m^3 spores over vegetable market. The dominant fungal spores encountered during the study were *Cladosporium* 12.4%, *Aspergillus* 11.8%, and *Penicillium* 10.2%, Pollen grains 4.95%, *Curvularia* 4.24%, Plant parts 11.8%, cellulose fibers 7.3%, and hyphal fragments 3.77%. The pollen grain contributed 4.95% to the total air spora. The airborne pollen grains of different types are allergic to sensitive human being and causes distressing symptoms. Many airborne fungal spores are capable of causing allergies of different types. Other types are contributed 27.80% to the total airspora. It includes Cellulose fibers, pollen grains and hyphal fragments. The vegetable market is crowdy place scattered with sacs, dumped pant material, spoiled material and debris are present in the market helps to increase the number of cellulose fibers and hyphal fragments. (Kakde and.Kakde, 2012). Spores of some members of Deuteromycotina, Ascomycotina and Basidiomycotina are allergic in nature (Agarwal et al 1969).

Conclusion

The result generated in this preliminary aerobiological survey shows that vegetable market of Patan have remarkable high load of fungal spores and lower degree of cleanness and possess potential threat to health of people. Hence extensive air monitoring is essential and must be performed continuously in order to find out the status of various types of allergic and pathogenic spores in vegetable market and their role in causing danger to human beings.

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CHAPTER 7

Study of Phytoplankton diversity of proposed Vadhvan port at Dahanu Taluka, Maharashtra

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Abstract

Diatoms were collected for a period of 1 year from June 2017 to May 2018.The aim of present work is to study the Diatoms flora of Vadhvan coast, Maharashtra. The Vadhvan coast is situated in Dahanu Taluka of Palghar district 06 km away from Dahanu and about 140km North from Mumbai between approximate longitude $19^0$99' North and latitude $72^0$74' East. The coast is full of live Molluscan species. In all 16 genera belonging to 26 species of central and pinnate diatom were identified and listed as: *Cyclotella, Coscinodiscus, Actinocylus, Biddulphia, Fragillaria, Auriculopsis, Licmophora, Cocconeis, Navicula, Pinnularia, Rhopalodia, Amphora, Cymbella, Okedonia, Surirella and Campylodiscus.*

Keywords: *Diatom, Phytoplankton, Vadhvan, Centrales, Pinnales*

Introduction

Information on the phytoplankton of west coast of India is very little like Fluxes of diatoms in Dona Paula bay was done by Anila Garg and Bhaskar (2000). Ragothaman and Saroj Patel studied on hydrobiology of Dandi and Onjal from south Gujarat (2002). Plankton composition in two

estuaries of Konkan coast was studied by Adebixi 1981). Phytoplankton from polluted and unpolluted environments of few locations of Bombay was studied by Ram (1985). Hydrobiological study of Nandgaon and Dahanu coast was carried out by Shilpa Patel (2002). No literature is found about study of marine diatoms from Vadhvan coast of Maharashtra.

Present study was aimed at investigating the diatom flora of Vadhvan which will provide baseline information for future monitoring of the marine ecosystem considering the urbanization and industrial growth around the coast and particularly after the construction of proposed port.

Material and Metohd

The aim of present study the Diatoms flora of Vadhvan coast, Maharashtra. The Vadhvan coast is situated in Dahanu Taluka of Palghar district ,06 km away from Dahanu and about 140km North from Mumbai between approximate longitude 19^0.99', North and latitude 72^0.74', East. The coast is full of live Molluscan species.

Government of Maharashtra is planning to construct huge port on the coast. Nobody has yet studied Diatom flora of the coast. The study was done for the period of one year from June 2017 to May 2018. Water samples were collected once in month between 6.00 a.m. to 8.30 a.m. For collecting the phytoplankton conical bolting silk plankton net 20 mesh was used. Sampling spots were kept constant throughout the study.

Preservation of plankton material:

200ml of known quantity of plankton sample was preserved in 4% formalize with few drops of iodine.

Acid treatment method for clearing the diatoms:

From the preserved plankton samples, 20ml was taken in a beaker and 25 to 30 ml concentrated H_2SO_4 was added. The material was kept for 2-3 days and sample was heated. While heating fumes appeared from the beaker. A pinch of KNO_3 was added. The solution turned to colorless and after cooling distilled water was added and washed for 2 to 3 times with centrifuge machine. The centrifuge samples were preserved in 70% alcohol.

Preparation of permanent slide for diatoms:

From the preserved acid treated diatoms material in the 70% alcohol, one drop was taken on the cover glass and allowed to burn on flame of spirit lamp for drying and cooled. Added one drop of DPX mountant o the center of the slide, then cover glass having diatoms material was kept on the slide and finally the slide was kept in the incubator for removing air bubbles and this was the permanent slide for the identification of diatoms.

From the permanent slides of different collection, microphotographs of diatoms were taken on "photomicroscope – Nikon E100 (Japan)" attached with Nikon DSLR 7200 Camera.

All the plankton were identified with the help of standard books and journals: -

Cupp – 1943

Hajos – 1976

Hendey – 1964

Husted -1930.

Subramanyan – 1946

Results

In all 16 genera of belonging to 24 central and pinnate diatom species were identified and are listed as:

Cyclotella, Coscinodiscus, Actinocylus, Biddulphia, Fragillaria, Auriculopsis, Licmophora, Cocconeis, Navicula, Pinnularia, Rhopalodia, Amphora, Cymbella, Okedonia, Surirella and Campylodiscus.

All 24 species were identified and represented as Figures 1 - 24

Enumeration of Diatoms

Fig. 1. *Cyclotella caspia. Grunow*

Fig 2. *Coscinodiscus joergensenni* (Ostenfeld)

Fig 3. *Coscinodiscus lineatus* (Ehrenberg)

Fig 4. *Coscinodiscus spiralis* n. sp. (Hajos).

Fig 5. *Coscinodiscus symbolophorus*

Fig 6. *Actinocylus roperia* (de Brebission) Grunow

Fig 7. *Biddulphia heteroceros* Grunow

Fig 8. *Biddulphia mobiliensis* Baley

Fig 9. *Fragilaria brevistrata* Grunow. Forms. elongate f. nov.

Fig 10. *Auriculopsis sparsipunctata spec.nov.*

Fig 11. *Licmophora abbreviate* (Agardh)

Fig 12. *Cocconeis disculus* (Schumann)Cleve.

Fig 13. *Cocconeis disculoides* Hustedt.

Fig 14. *Cocconeis placentula* Ehrenberg var euglypta (Her.) Cleve.

Fig 15. *Navicula fimarchia* (Cleve and Grunow) Cleve.

Fig 16. *Navicula leterostrata* Hust.

Fig 17. *Navicula minima* grun var atomoides (Grun) Cleve.

Fig 18. *Pinnularia cruciformis* (Donkin) Cleve.

Fig 19. *Rhopalodia gibberula* var. producta (Grunow) Cleve

Fig 20. *Amphora coffeaeformis* (Agrardh) Kutzing var.*coffeaeformis*

Fig 21. *Cymbella marina*

Fig 22. *Okedonia inflexa* (de Brebisson ex Kutzing) de Toni

Fig 23. *Surirella hispida* (Ross and Abdin)

Fig 24. *Campylodiscus iyengarii* sp. Nov.

Diatom photographs:

Fig 1

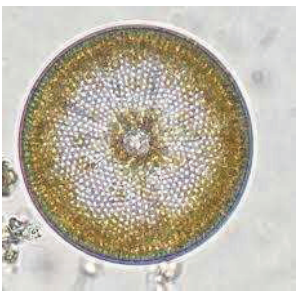

Fig 2

Fig 3

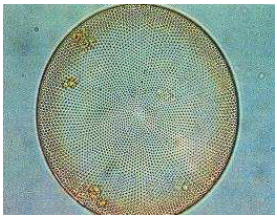

Fig 4

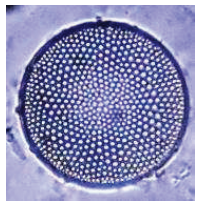

Fig 5

Fig 6

Fig 7

Fig 8

Fig 9

Fig 10

Fig 11

Fig 12

Fig13

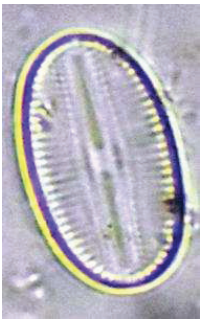

Fig 14

Fig 15

Fig 16

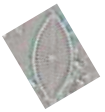

Fig 17

Fig 18

Fig 19

Fig 20

Fig 21

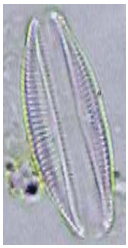

Fig 22

Fig 23

Fig 24

Scale bar represents -
Dimensions 10 µ

A

B

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CHAPTER 8

Fungi Associated with Leaf Decomposition of Mangrove Plant *Rhizophora Mucronata Lamk* at West Coast of India

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Abstract

Rhizophora mucronata Lamk is one of dominant mangrove plant at Ratnagiri coast. Experiment was carried out to study fungi associated with decomposing leaves of mangrove plant *Rhizophora*. The decomposing leaves of *Rhizophora mucronata* were collected from six different sites of Bhatye estuary (Kajvi river) Ratnagiri, Maharashtra. Then decomposing leaves were cut in to small pieces in laboratory. For culture of fungi, pieces of leaves were then placed on plates with Martin rose Bengal agar medium incorporated with an antibiotic mixture. Petri plates were incubated at room temperature (27±2 °C) for 2-6 days and the colonies were counted. Total 26 species of fungi were identified out of which 6 fungi species belong to *Aspergillus*. Ten fungal species such as *Aspergillus candidus*, *Aspergillus fumigatus*, *Aspergillus niger*, *Cladosporium fulvum*, *Fusarium oxysporum*, *Mucor sp., Lulworthia grandispora, Pontoporeia biturbinata, Spathulospora lanata* and *Trichoderma viridie* showed presence at every site. Least frequent fungi species was *Hypocrea sp.* found at only two sites. When all six sites were compared, Site No.3 showed maximum fungal diversity while site No.5 showed minimum fungal diversity.

Key Words: *decomposition, fungi, leaves, mangrove, Rhizophora mucronata,*

Introduction

Mangroves are open systems with respect to both energy and matter and thus couple upland terrestrial and coastal estuarine ecosystems (Lugo and Snedaker, 1974). Mangrove plants have morphologically and physiologically adapted to extreme habitats and establish under inhospitable conditions such as high salinity, tidal extremes, high wind velocity, high temperature and anaerobic clayey soils. Mangrove vegetation contributes to the primary production in the aquatic environment in the form of leaf and litter fall. Mangroves provide energy to marine habitats through production and decomposition of plant detritus (Ravikumar,1991). Litter biomass in mangrove forest ranges between 0.011 and 23.69 t/ha/yr.

Decomposition of this organic material by bacteria and fungi results in protein enriched fragments of detritus (Odum and Heald, 1972). The dead organic matter and the associated microorganisms form the base of the food webs of commercially important fishes and crustaceans. The undecomposed leaves are poor in nutrients, and they become nutritious due to the microbial enrichment process during decomposition (Odum 1971). Marine ecosystem consists of several distinct habitats, which harbor innumerable number of biota in that fungi form an important essential component of marine ecosystem.

Studies revealed that mangrove fungi are the second largest group among the marine fungi (Krishnamurthy *et al*., 1987). The microbial decomposition of mangrove leaves has been studied by different scientists mainly of *Rhizophora apiculata* (Raghukumar *et al.* 1994, Rajendran and

Kathiresan, 2004). The microbial decomposition various species of mangrove leaves, have been studied by many scientists. Meyers (1974) studied biodegradation of *Spartina* and other brackish marsh and vegetation accelerated by fungi. Boonruang (1978) contributed for degradation rates of mangrove leaves of *Rhizophora apiculata* (Bl.) and *Avicennia marina* (Forsk.) vierh. Cundell et al. (1979) studied Microbial degradation of *Rhizophora mangle* leaves. Fell and Master (1980) put Laboratory model of the potential role of fungi in the decomposition of red mangrove (*Rhizophora mangle*) leaf litter. In India Misra et al. (1984) studied microbial decomposition of *Avicennia officinalis* leaf litter in a mangrove forest biome. Rajendran and Kathiresan (1999a, 2000) gave ecological importance of decomposition of mangrove leaves and Biochemical changes in decomposing, Kathiresan and Bingham (2001) studied biology of mangroves and mangrove ecosystems in different regions.

Rhizophora mucronata Lamk is a mangrove plant belongs to family Rhizophoraceae. It is found in intermediate to upstream estuarine zone in the lower to mid-intertidal region, and more to the seaward side. Though it is one of common mangrove species of Ratnagiri coast, studies are not carried out to record fungi associated with leaf decomposition of this plant in this area. The present study aims to study diversity of fungi on randomly collected leaves of mangrove plant at Ratnagiri, West coast of India.

Material and Methods

The decomposing leaves of *Rhizophora mucronata* were collected from six different sites of Bhatye estuary (Kajli river) Ratnagiri, Maharashtra in the month of Nov.2017. The decomposing leaves were collected in clean and

sterile polythene bags and aseptically cut in to small pieces. These were then washed with sterilized seawater to remove debris on the leaves. Then they were dipped in 0.01 % $HgCl_2$ solution for 3 min for surface-sterilization of the pieces. The pieces were then washed with sterilized seawater to remove all the traces of $HgCl_2$ solution. For estimating fungi, the pieces were then placed on plates with Martin rose Bengal agar medium incorporated with an antibiotic mixture (chlorotetracycline-HCl10 %, chloramphenicol 2 % and streptomycin sulphate 2 %) for suppressing bacterial growth in the media. Petri plates were incubated at room temperature (27±2 °C) for 2-6 days and the colonies were counted. Fungi were identified following the keys given by Ainsworth *et al*. (1973), Raper and Fennell (1987), Kohlmeyer and Kohlmeyer (1979) and Mukadam (1997).

Result and Discussions:

Details about fungi associated with leaf decomposing of *Rhizophora mucronata* is given in Table 1. In total 26 species of fungi were identified out of which 6 fungi species belong to *Aspergillus* such as *Aspergillus candidus*, *Aspergillus chevalier*, *Aspergillus fumigatus*, *Aspergillus glaucus*, *Aspergillus niger*, *Aspergillus verrucosa*. Ten fungal species such as *Aspergillus candidus*, *Aspergillus fumigatus*, *Aspergillus niger*, *Cladosporium fulvum*, *Fusarium oxysporum*, *Mucor sp., Lulworthia grandispora, Pontoporeia biturbinata, Spathulospora lanata* and *Trichoderma viridie* showed presence at every site. Least frequent fungi species was *Hypocrea sp.* found at only two sites.

While comparing fungal diversity among six different sites, Site No.3 showed maximum fungal diversity while site No.5 showed minimum fungal diversity.. Maximum no. of colonies was found in case of *Aspergillus niger*.

The results are in accordance with Rajendran and Kathiresan (2007) who studied microbial flora associated with other mangrove plant *Avicennia marina* and *Rhizophora apiculata*. Many of the species encountered in the present study were terrestrial forms, as was also observed by other workers (Miyoshi *et al*.,1985, Venkatesan,1981). The reason might be attributed to large scale transport of fungal spores from the land through freshwater inflow in to mangrove ecosystem. Hyde and Lee (1995) suggested that the diversity of marine fungi is greater in the tropics and attributed this to mangrove tree species richness.

Ananda and Sridhar (2004) found 78 fungal taxa recovered from leaf and woody litter of *Rhizophora*. Among 13 core group fungi on mangrove litter, *Arenariomyces parvulus* and *Cirrenalia pygmea* were dominant on leaf as well as woody litter. Mycological examination of dead wood, prop roots and seedlings of *Rhizophora* spp. (*R. apiculata* and *R. mucronata*) was carried out by Ravikumar and Vittal (1996) yielded 48 fungal species belonging to 36 genera with Ascomycotina was most prevalent. According to (Rajendran and Kathiresan 2007) in *R. apiculata*, fungal counts were recorded maximum of 4464 (no. g wet tissue-1) in the 30 day decomposed leaves and minimum of 255 (no. g wet tissue-1) in the 80 day decomposed leaves. The predominant fungal species identified from decomposing mangrove leaves were belonging to the genus *Aspergillus* with 10 species. Mangrove fungi are recognized for their niche and substrate specificity.

As a result of the fast decomposition of leaf litter in mangrove habitat, colonized fungi might reproduce quickly in order to escape from the competitors and capture another substrate for colonization. Because of

persistent nature of the woody litter, colonized fungi might prefer biomass accumulation strategy than reproductive strategy (Ananda and Sridhar 2004).

Both lower fungi and higher fungi are involved in the turnover of mangrove detritus Lower fungi have the 'substrate-capture' strategy, while higher fungi have 'mass-accumulation' strategy (Newell, 1996). Newell and Fell (1997) suspected that periodical drying of the mangrove leaf litter leads to higher fungal activity.

Conclusion

Decomposing leaves of *Rhizophora mucronata* Lamk mangrove plant shows fungal diversity with 26 species out of which 6 fungi species belong to *Aspergillus*. Diversity of fungi may change from site to site in little extent. These fungi not only help in decomposition of leaves but also support nutrient cycle. Mangrove forests generate considerable amount of detritus such as leaf litter and constitute an ideal environment for many detritus dependent fungi. Diversity of mangrove fungi is dependent on the age of the mangrove, diversity of mangrove plant species, diversity of terrestrial tree flora and the physicochemical features of mangrove habitat such as temperature, salinity and tidal range. In future studies can be carried out on considering substrate specificity, seasonal impacts, and interference competition of fungi in the mangrove ecosystem.

Table 1. Total no. of colonies of fungi associated with decomposing leaf of mangrove plant *Kandelia candel* at six different sites

Fungi	Site 1	Site 2	Site 3	Site 4	Site 5	Site 6
Aigialus grandis	-	2	1	-	1	1
Alternaria alternata	2	-	1	1	-	-
Ascomycete sp	-	3	2	4	-	3
Aspergillus candidus	1	4	4	3	2	4
Aspergillus chevalier	5	2	2	4	-	-
Aspergillus fumigatus	2	1	4	3	2	2
Aspergillus glaucus	3	5	2	-	3	3
Aspergillus niger	7	9	10	11	8	9
Aspergillus verrucosa	-	-	3	1	-	-
Cladosporium fulvum	3	2	1	2	5	1
Cryptosphaeria mangrovei	4	-	3	2	-	2
Curvularia sp	1	2	-	-	3	1
Fusarium oxysporum	5	4	2	3	2	6
Halophytophthora sp.	1	1	2	-	2	4
Halosarphia fibrosa	-	1	-	1	-	2
Hypocrea sp.	-	-	-	1	-	2
Lindra marinera	1	-	3	1	-	-
Lulworthia grandispora	2	2	1	3	1	1
Mucor sp.	5	3	3	2	3	4
Ophiobolus littoralis	2	3	3	-	2	1

Penicillium notatum	3	4	-	4	6	4
Pontoporeia biturbinata	5	3	3	2	2	3
Rhizopus stolonifer	1	1	-	2	-	2
Spathulospora lanata	2	2	1	4	2	1
Trichocladium achrasporum	2	-	4	3	2	-
Trichoderma viridie	4	7	5	5	4	6

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CHAPTER 9

Diversity of Coleopterans in Gautala Autram Ghat Wild Life Sanctuary and their necessity

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Abstract

There is vast variety of Coleopterans on earth. These Coleopterans show diversity in Gautala Autramghat Wildlife sanctuary. As they have different colours and shapes they look very attractive. Due to their habitat and their size they does not easily appear. Along with other wild life they are essential to maintain ecological balance. As there are various types of beetles most of them mainly Tortoiseshell beetles, Blister beetles, Ground beetles, Darkling beetles, Woodboaring beetles, Ladybird beetles, Pathenium beetles, Six spotted ground beetles, Fire flies occur here in vast scope. Blister beetles of family Meloidae e.g. Mylabris pustulata, Darkling beetles of family Tenebrionidae e.g. Rhytinota indica, Fire flies of family Lampyridae e.g. Photuris lucicrescens. Six spotted ground beetle of family Carabidae e.g. *Anthia sexguttata*, Tortoiseshell beetles of family Chrysomelidae e.g. *Aspidimorpha miliaris,* Parthenium beetle or Mexican beetle of family Chrysomelidae *Zygogramma bicolorata*. The present study site is within the Western Ghats of India, hence the present work is an attempt to know the status of wildlife particularly the Coleopterans in Gautala-Autramghat Wildlife sanctuary. The area is practically unexplored regarding

to the study of Coleopterans and their diversity. The place is a beauty spot, with variety of species but unfortunately not studied well. Naturally the curiosity to know more about the unseen Gautala Autramghat Wildlife Sanctuary and to study diversity of Coleopterans and ecodiversity, Entomologist inspired us to study diversity and comparative studies of Coleopterans in Gautala-Autramghat Wildlife Sanctuary. To enlist variety of beetles and also their uses for society. To enlist the medicinally useful Coleopterans for making proper use to the society. To study diversity of Coleopterans to record morphological charecters. To study geographical distribution, abundance of Coleopterans by Search and Collection methods. To study habit, habitat and variations of different species. To prepare database for the sake of records. As all the beetles are of different families belongs to same order *Coleoptera* shows grater diversity in their common names according to their habitat. Due to diversity occur in Coleopterans their study is essential to know how they are beneficial for Human beings and for environment also. Their occurance is also varied from country to country hence their scientific study is necessary for maintaining ecosystem and to know their significance in various fields like Agriculture, Medical, Pharmaceutical and environmental.

Keywords : *Coleopterans, Pharmaceutical, Wild Life sanctuary, Woodboaring*

Introduction

There is vast variety of insects on earth. The earth contains about 800,000 insect species and the widest group of insects is the beetle. The

different types of beetles are classified into the same group of Kindom Animalia in Class Insecta. Among insecta the beetles are included in order Coleoptera. In the order coleoptera type of beetles is further divided into suborders, including Archpstemata, Myxophaga, Polygphaga, Adephaga.These suborders will have further extending groupings, of different types of beetle species. About 30,000 well-known types of beetles occur in Canada and the USA. There is lot of diversity among the beetles in India. Most of the diversity of beetles also observed in Gautala – Autramghat wild life sanctuary. Beetle studies mainly conducted by bellamy, C.L. & Nelson, G.H. (2002, *Bhattacharjee, Pradip; Brodell, Robert T. (2003). about "Cantharidin", Dennis S. Hill (1997). The Economic Importance of Insects.* Gardner, J. C. M. (1939) The Larva Of Anthia Sexguttata, Jolivet, Pierre; Verma, Krishna K. (2002). *Biology of Leaf Beetles*. Judy Allen & Tudor Humphries (2000). *About ladybug.,* Oudhia, P. and Ganguli, J. (1999). Outbreak of Tortoise beetle *Aspidomorpha miliaris*. For ecological studies wildlife survey is essential to know occurrence, their distribution, and relative degree of abundance of each Coleopteran species.This kind of study is very significant to provide the inputs for conservation strategy and to give priority to the species for conservation.

Present work is significant to determine the abundance, similarity and variation in Coleopteran species. To explore Gautala- Autramghat Wildlife Sanctuary to familiarize with natural resources of the area. Study of diversity of Coleopterans in Gautala-Autramghat Wildlife Sanctuary will help for analysis of beetles and to plan practically oriented programmes for growth and development of Coleopterans for the future generations for their

advance significance. Coleopteran analysis is essential to know economically important species for utilization purpose.The study will be useful to researchers in various branches of Zoology and its applied aspects as Entomology, Physiology.For conservation of Coleopterans the present study is essential.

Material and Methods

The project work is categorized under two heads for the sake of convenience.

Field Work: For the purpose of field work to study diversity and morphological charecters of beetles various explorations were made in different localities of Gautala – Autram ghat wildlife sanctuary. The field work is well planned for collection of beetle species for project work.

Laboratory work: Some specific species observed in Gautala Autramghat Wildlife Sanctuary.After the collection of beetles, the specimens neatly kept in bottles by adding alcohol. The beetles dried to absorb moisture and to avoid their dekay. After complete drying these species arrange in a box. The identified species of beetles of different families noted with their Scientific classification, Common names, Geographical distribution, morphological charecters, damage they cause and their economic importance. Photographs of identified species also added.

Mylabris pustulata

Kingdom : Animalia

Phylum : Arthropoda

Class : Insecta

Order : Coleoptera

Family : Meloidae

Genus : Mylabris

Species : *M. pustulata*

Common Name : Blister beetles

Geographical Distribution : About 7,500 species of this beetle distributed throughout the world.

Morphology : Blister beetles are beetles of the family Meloidae. They are called as Bristle beetles due to their defensive secretion of a blistering agent. The size of Blister beetle is 2-3 cm. Their body colour is dark black with one paired red or yellow spots with two red or yellow strips. Body is elongated spindle shape. Body is covered with hard exoskeleton and bears paired symmetrical wings. Head is semicircular with paired antenna and trunk bears paired appendages. Blister beetle is not an obligatory parasitoid, but rather a facultative parasitoid, or simply predatory. The adults sometimes feed on flowers and leaves of plants of such different families as the Amaranthaceae, Asteraceae, Fabaceae, and Solanaceae.

Damage : Cantharidin is the principal irritant in "Spanish fly", a folk medicine prepared from dried beetles in the family Meloidae.Blister beetles are attracted to alfalfa and weeds during bloom.

Economic importance : Cantharidin, a poisonous chemical that causes blistering of the skin. It is used medicinally to remove warts and is collected for this purpose from species of the genera *Mylabris* and *Lytta*, especially *Lytta vesicatoria*, better known as "Spanish fly". A derivative of blister beetle Cantharidin being used in treating skin disease.

Rhytinota indica

Kingdom : Animalia

Phylum : Arthropoda

Class : Insecta

Order : Coleoptera

Family : Tenebrionidae

Genus : Rhytinota

Species : *R. indica*

Common name : Darkling Beetles

Geographical Distribution : Distributed at different sites in Melghat Tiger Reserve.

Morphology : These beetles found in rotten wood, under bark, stones and logs, feeding on decaying vegetation, dung, seeds, cereals, fungi, roots etc. They are varied in shape and size about 2 - 3.5 cm in length.Their body cover is generally smooth, brown or black. These beetles have vestigial wings, and the elytra are frequently immovable. Many of the wood feeding species have ample wings. Tenebrionidae is the large family which can be characterized by the characters like hard exoskeleton, triangular head,larger eyes, paired antenna hidden under frons, elytra usually completely covering the abdomen, abdomen with five visible sternites and first three segments connate, front coxal cavities closed, tarsal segments with simple claws.

Damage : Comparatively few of its species are pests of stored grain products.

Economic importance : Beetles of family tenebrionidae are sensitive indicators of biodiversity change. Many tenebrionids also secrete a layer of

wax that coats the exoskeleton, reflecting some of the sun's radiation and protecting beetles from water loss, abrasion and microorganisms.

Photuris lucicrescens

Kingdom : Animalia

Phylum : Arthropoda

Class : Insecta

Order : Coleoptera

Family : Lampyridae

Genus : Photuris

Species : *P.lucicrescens*

Common Name : Fireflies

Geographical Distribution : About 2,100 species of fireflies are found in temperate and tropical climates distributed in Eureshia, America, India.

Morphology : These beetles have size of 4 - 5 cm. Their body colour is mostly brown. They are soft bodied often with the elytra or front wings. These wings are more leathery than other beetles. They have hard exoskeleton. Head triangular with paired eyes and paired antenna. The most commonly known fireflies are nocturnal, although numerous species are diurnal.

The Light production in fireflies is due to a type of chemical reaction called bioluminescence as this process occurs in specialized light-emitting organs. This light-emitting organ usually present on a lower abdomen of fireflies.

Economic Importance: Lampyridae is a family of the beetles in order Coleoptera. They are winged beetles, commonly called fireflies or lightning bugs. They use of bioluminescence during twilight to attract mates

or prey. Fireflies produce a cold light with no infrared or ultraviolet frequencies. This chemically produced light from the lower abdomen may be yellow, green, or pale red, with wavelengths from 510 to 670 nanometers.

A firefly is the only type of beetle which produces light. Fireflies are good flagship species to attract public attention. They are essential for good investigation by the effect of light on nocturnal wildlife.They act as bioindicators due to their sensibility and rapid response to environmental changes for artificial night lighting.

Anthia sexguttata

Kingdom : Animalia

Phylum : Arthropoda

Class : Insecta

Order : Coleoptera

Family : Carabidae

Genus : Anthia

Species : *A. sexguttata*

Common Name : Six - spot ground beetle

Geographical Distribution : The species of Anthia occurs in the drier parts of South Asia. It is common in the scrub forests of southern India.

Morphology : The size of *Anthia sexguttata* is approximately 4 cm. They are black in colour with hard exoskeleton .Head is elongated triangular and thorax and abdomen are divisible.Head bears paired eyes and paired antenna. Dorsal surface have six relatively large, white, dorsal spots. Four spots over the elytra and two spots are present on the thorax. Thorax and abdomen

bears three strong paired appendages. The body pattern is always symmetrical. The larva has a flattened form, a large head capsule, and prominent mandibles. Adult *A.sexguttata* feed on other insects and snails.

Aspidimorpha miliaris

Kingdom : Animalia

Class : Insecta

Order : Coleoptera

Family : Chrysomelidae

Genus :Aspidimorpha

Species : *A. miliaris*

Common Name: Tortoise beetles or Tortoiseshell beetles. Geographical Distribution : They are distributed throughout Africa, Southern China, Southeast Asia.

Morphology : Aspidimorpha miliaris is called as Tortoise beetles as the shape is tortoise like. The size of the beetle is about 1.5 - 2 cm. Body color is orange or yellow or brown or white. Body is short spindle shape with triangular head and paired antenna. Body is covered by membranous covering with hard exoskeleton. A paired wings are present at thoracic region.Dorsal surface of the body has dark black coloured spots. Trunk region bears paired appendages. The life cycle consist of developmental stages such as egg, larva, pupa and adult beetle.

Damage : The young larvae scrape on the surface of the leaves leaving a pale or brown translucent membrane. Older larvae produce round holes on leaves. When these larvae feeding in groups, irregular holes are formed on leaves and they can totally defoliate the plant. Adults also produce round holes in the

leaves. Occasionally attack of these beetles cause severe damage to the leaves, defoliate the plant and peel the stems. However, usually damage does not affect yield of crops.

Economic importance : Tortoise beetles can cause considerable defoliation during severe infestation. In cases of Severe damage at the vegetative and root initiation stages may reduce yield of storage roots.

Zygogramma bicolorata

Kingdom **:** Animalia

Phylum **:** Arthropoda

Class **:** Insecta

Order **:** Coleoptera

Family **:** Chrysomelidae

Genus **:** Zygogramma

Species **:** *Z. bicolorata*

Common Name : Parthenium beetle or Mexican beetle

Geographical Distribution :

It is a species of leaf beetle in the subfamily Chrysomelidae, native to Mexico. *Z. bicolorata* is native to Mexico, but has been introduced to parts of India and Australia

Morphology : *Z. bicolorata* is a small leaf beetle about 1-2 cm in size.They are ash or brown or grey coloured. Their body shape is oval with semicircular brown head with paired eyes and paired small antenna. They have brown and yellow graduated pronotum and yellow elytra. The elytra is marked with characteristic elongated brown stripes. The pattern on the

elytra is greatly variable in different species of leaf beetles with middle dark black line with paired black spots at anterior and posterior end and wavy bold marking.

Economic Importance :

Adults and larvae of these beetles are used as a form of biological pest control in India in order to control the weed *Parthenium hysterophorus* .

Mylabris pustulata

Rhytinota indica

Photuris lucicrescens

Anthia sexguttata

Aspidimorpha miliaris

Zygogramma bicolorata

Results and Discussion

As all the beetles are of different families belongs to same order Coleoptera shows grater diversity in their common names according to their habitat. Due to diversity occur in Coleopterans their study is essential to know how they are beneficial for Human beings and for environment also.

As there are various types of beetles most of them mainly Tortoiseshell beetles, Blister beetles, Ground beetles, Darkling beetles, Woodboaring beetles, Ladybird beetles, Pathenium beetles, Six spotted ground beetles, Fire flies occur here in vast scope. These beetles are of different families belonging to same order Coleoptera. Tortoiseshell beetles of family Chrysomelidae e.g. *Aspidimorpha miliaris*, Blister beetles of family Meloidae e.g. *Mylabris pustulata*, Ground beetles of family Carabidae e.g. *Gnathaphanus* sps., Darkling beetles of family Tenebrionidae e.g. *Rhytinota indica*, Woodboaring beetles of family Buprestidae e.g. *Chrysochroa* sps., Ladybird beetles of family Coccinelidae e.g. *Coccinella transversalis*, Parthenium beetles of family Chrysomelidae e.g. *Zygogramma bicolorata*, Six spotted ground beetles of family Carabidae e.g. *Anthia sexguttata*, and Fire flies of family Lampyridae e.g. *Photuris lucicrescens.* As all the beetles are of different families belongs to same order Coleoptera shows grater diversity in their common names according to their habitat. Due to diversity occur in Coleopterans their study is essential to know how they are beneficial for Human beings and for environment also.

Conclusion

Relating with greater abundance of Coleopterans most of them are unknown. Their detailed study is essential. Their occurrence is also varied from country to country hence their scientific study is necessary for maintaining ecosystem and to know their significance in various fields like Agriculture, Medical, Pharmaceutical and environmental.

Acknowledgement

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CHAPTER 10

Exotic Genus Kalanchoe. (Crassulaceae) from Maharashtra

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Abstract

Author has presently engaged with survey of exotic plants of Maharashtra, while the field survey at Maharashtra, some specimens of Genus kolanchoe were collected. Here provided Key and deep study about kolanchoe in Maharashtra.

Key word*: Crassulaceae, Exotic, Kolanchoe, ornamental plant.Maharashtra*

Introduction

Kalanchoe a genus belongs to crassulaceae Family of dicotyledons, made up mainly succulent herbs, but to be miniature shrubs, or trees in certain genera and species. Most member of family are xeromorphic structure water storage tissue in the leaf and stem, kalanchoe genus is one such which has many species a medicinal used and plants large used in folk medicine for the treatment of pulumonary infection, ulcer and kidney stone. Family crassulaceae is widely distributed horticulture and Agriculture kalanchoe comprises one hundred twenty five species that are native to tropical area, Africa and brazil Tropical area several are seen in greenhouse (Baily1951). Amongst which are species *Kalancho pinnat*a Lam Kolancho *brasilliens* Larranga; Kolanchoe *diagermontiana* R.Hamet; Kalanchoe tubilora (Harvey)

R. Hamet in Beih. Bot. *Kalanchoe. verticillata* Kalanchoe laciniata (L.) DC. *Kalanchoe lanceolata* (Frosk.) Pres The different studied species from kalanchoe plants to use and as taxonomic characters to identify kalanchoe species in this study.

Crassulaceae A. P. DC.,

Kalanchoe Adans.

1a. Leaves all simple ----------2

1b. Leaves simple and pinnate on the same plant ----------*K. pinnata*

2a. Leaves opposite, petiolate, ---------- 3

2b Leaves opposite or whorled; sessile ---------- *K. tubilora*

3a. Leaves entire or crenate, not lobed; petals not yellow ---------- 4

3b. Leaves alternate, deeply lobed; petals yellow or reddish orange----------*K.laciniata*

4a. Inflorescenceverticillate type ----------*K. verticillata*

4b. Inflorescencenot as above ----------5

5a. Leaves lanceolate, 15-20 cm or more long; glaucous green and blotched with purple ----------*K. daigremontiana*

5b. Leaves oblong-spathulate or obovate, upto 8 cm long, green; petals scarlet----------*K. blossfeldiana*

Kalanchoe blossfeldiana Bailey, in Man. Cul. PL., 466,1949, Naik, in Fl. Marathwada 1:364. 1998; Almeida, Fl. Mah., 2: 237. 1998; N. P. Singh et al., Fl. Mah. St., 1:842. 2000.

A perennial, glabrous herb. Leaves oblong-spathulate, 3-8 cm long entire or shallowly crenate, green with red marginal line. Flowers in dense terminal cyme, petals 4, scarlet, exceeding the calyx.

Fls. & Frts.: Oct-Dec.

Exsiccata:VRJ,Aurangabad,2120;Parbahni1679.

Distribution: Aurangabad, Nagpur, Nasik, Parbhani.

Native : Madagascar.

Note: It is cultivated as an ornamental plant in gardens.

Kalanchoe diegremontiana Hamet & Perr. in Ann. Mus. Col., Marseille, Ser. 3, 2:128. 1914; Bailey, in Man. Cult. Pl., 467. 1949; Naik, Fl. Marathwada 1:364. 1998; Almeida, Fl. Mah., 2: 237. 1998; N. P. Singh et al., Fl. Mah. St., 1:843. 2000.

Perennial, succulent herb, glabrous, up to 1 m tall. Leaves coarsely dentate, produce several plantlets from the dentations; petiole stout, broad at base. Flower 2-3 cm long, drooping from trichotomously branched corymbs; pedicel slender; calyx tubular, acute; corolla pink turning purple, much exserted, lobes ovate, acute.

Fls. & Frts.: Oct-Nov.

*Exsiccata:*VRJ,Nasik,897;Aurangabad,2173.

Distribution: Aurangabad, Amravati, Nasik, Jalgaon, Dhule.

Native : Madagascar.

Kalanchoe laciniata (L.) DC.,Succ.Pl., & Grsses t, 100. 1802; C. B. Cl., in Hook., f. in Fl. Brit. India 2: 415. 1878; Cooke, Fl. Pres. Bombay 1:497. 1958 (Repr.); Almeida, Fl. Mah., 2: 238. 1998; Naik, Fl. Marathwada 1:364. 1998

N. P. Singh et al., Fl. Mah. St., 1:840. 2000. *Cotyledon laciniata* L., Sp. Pl. 430. 1753. '*Parabij'*.

A large succulent herb, glabrous more or less pubescent, 1-3 m high; stems stout, slightly branched. Leaves numerous, large, succulent, 8-10 cm long, very variable. Segments of leaves usually narrow, linear, entire or crenate serrate. Flowers in paniculate cymes; bracts narrow, linear. Calyx 3-5 mm long, glabrous or glandular pubescent; corolla yellow, 7 mm long, tube 1 cm long, lobes lanceolate. Follicles 8 mm long, glabrous.

Fls. & Frts.: Nov-Jan.

Exsiccata: VRJ,Buldhana,1785

Distribution: Aurangabad, Pune, Satara, Wai.

Native : South Africa.

Note: It is grown in garden as an ornamental plant.

Kalanchoe lanceolata (Frosk.) Pres. Syn. Pl., 1:446, 1805; Srinivasan Fl. Tamilnadu 1:145. 1983. *Cotyledon lanceolate* Forssk. F., Aeg. Arb. 89. 1775

Erect perennial herb, up to 1 m high. Upper part of the stem and cymes with glandular hairs; lower branches of cymes alternate, upper long racemiform. Leaves obovate-elliptic, crenate, cauline leaves 5-8 cm long; petiole short. Cymes with many flowers. Sepals oblong, acute, spreading from the base. Corolla yellow tube glabrous.

Fls. & Frts.: Dec-Jan.

Exsiccata:VRJ,Aurangabad,2117;Jalna 1711.

Distribution: Aurangabad, Amravati, Bombay Jalna, Nagpur, Pune, Satara.

Native : Madagaskar

Note: Cultivated in gardens.

Kalanchoe pinnata (Lam.) Pres. Syn. 446.1805. *Cotyledon pinnata* Lam. Encycl., 2:141. 1786; Lakshmin. & B.D. Sharma, Fl. Nashik Dt. 211. 1991; Naik, Fl. Marath. 1: 365. 1998; Godbole & Das Das in N.P. Singh et al., Fl. Maharashtra St. Dicot. 1: 842. 2000. '*Panphuti, Ghaymari'.*

Succulent, glabrous herbs. 30-120 cm tall. Leaves variable, the lower usually simple, the upper often 3-7 foliolate, long petioled; leaflets ovate or elliptic. Flowers pendent from terminal corymbose cymes; pedicles slender; calyx 2-3 cm long, green with red lines; corolla reddish, swollen at base. Follicles enclosed in persistent calyx and corolla.

Fls. & Frts.: Jan.-April

Exsiccata:VRJ,Parbhani,1695;Aurangabad,1948.

Distribution: Aurangabad, Nagpur, Amravati, Nashik, Jalgaon, and Parbhani.

Native : Tropical Africa.

Kalanchoe tubiflora (Harvey) R. Hamet in Beih. Bot. Centralba., 29 (2): 41. 1912. *Bryophyllum tubiflorum* Harvey in Harv. & Sond.Fl. Cap. 2: 380.1862; Naik, Fl. Marath. 1: 365. 1998; Godbole & Das Das in N. P. Singh et al., Fl. Maharashtra St. Dicot. 1: 843. 2000.

Perennial herbs, succulent, glabrous 30-90 cm tall; stem simple often with purple spots. Leaves sessile, linear, mottled with violet brown, producing plantlets from the tip. Flowers pendent; calyx triangular acute; corolla salmon to scarlet coloured. Fruits not seen.

Fls. & Frts.: Dec.-Jan.

Exsiccata: VRJ,Dhule, 2805

Distribution: Aurangabad

Native : South Africa.

Kalanchoe velutina Welw ex. Oliver, Fl. Trop., Afrc. 2:396. 1868. Almeida, Fl. Mah., 2: 240. 1998.

A succulent, erect herb, 0.5-1 m tall., leaves oblong-ovate, blunt, crenate, 10 cm long. Flowers pink to yellow in terminal cymes.

Fls. & Frts.: dec-March.

Exsiccata:VRJ,Aurangabad, 2191.

Distribution: Aurangabad, Bombay.

Native : Tropical Africa

Kalanchoe veritcillata Elliot, Journ. Linn. Soc. Lond. 9:14, 1891; R. N. Sutaria Syst. Bot. ed. 3, 227. 1962; Almeida, Fl. Mah., 2: 240. 1998; Naik, Fl. Marath. 1: 365. 1998.

A succulent herb. Leaves simple, fleshy, cylindrical, with small bulbils at the apical region. Flowers scarlet red, in terminal cymes.

Fls. & Frts.: March-July

Exsiccata:VRJ,Ahemadnagar1043

Distribution: Aurangabad, Bombay Nagpur.

Native: South Africa

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CHAPTER 11

Arbuscular Mycorrhizal (AM) Fungal Diversity in Selected Medicinal Plant Species from Western Ghat region of Canacona Taluka - South Goa, India

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Abstract

In the present study, a total of twenty one AM fungal species were identified and documented from the rhizosphere soil samples of 16 commonly occurring Medicinal plant species of Goa, viz., *Andrographis paniculata*, *Justicia adhatoda*, *Holarrhena antidy-senterica*, *Centella asiatica*, *Rauvolfia serpentine*, *Calotropis gigantea* , *Hemidesmus indicus*, *Ageratum conyzoides*, *Artemisia indica*, *Eclipta prostrate*, *Calycopteris floribunda*, *Leucas aspera*, *Lawsonia inermis*, *Naregamia alata*, *Ixora coccinea*, *Vitex negundo*. Maximum AM root colonization was found in *Justicia adhatoda* (96.66%) while minimum was observed in *Ageratum conyzoides* (58%). The highest spore density was recorded in *Naregamia alata* (210.51 spores $100g^{-1}$soil spores) and the least was reported in *Leucas aspera* (52 spores $100g^{-1}$soil spores). The genus *Glomus* (12) was dominant followed by *Acaulospora* (6), *Racocetra* (1), *Dentiscutata* (1) and *Gigaspora* (1) with species number given in parentheses. *Acaulospora scrobiculata* was common in the site. This study records the predominance of *Glomus* and *Acaulospora* species in the

rhizosphere soils of medicinal plant species. Species richness was maximum in the *Centella asiatica* (7) respectively.

Key words: *AM root colonization, dominant, rhizosphere soil sample, species richness, spore density*

Introduction

India is a place of great bio-diversity with its rich source of Medicinal Plants distributed among the different geographical and ecological environment within the country. Though the country has an enriched history of the medicinal plant species, peninsular Indian forests and the Western Ghats are highly significant with respect to varietal richness.

Medicinal plants play a significant role in the treatment of a number of diseases and are not only a major resource base for the traditional medicine and herbal industry but also provide livelihood and health security to a large segment of Indian population (Radhika and Rodrigues 2010). Medicinal plants are important for pharmacological research and drug development, not only as plant constituents used directly as therapeutic agents, but also as starting materials for the synthesis of drugs or as models for pharmacologically active compounds (Mukherjee 2003).

In India, it is reported that traditional healers use more than 2500 plant species and 100 species of plants serve as regular source of medicine (Pie 2001). Medicinal plants are gaining importance in the fields of research, especially in the field of genetics and biotechnology. Hence it is becoming economically more important due to the growing demand for herbal products in the domestic and global market (Radhika and Rodrigues 2010). Increasing

demand for medicinal plants in both developing and developed countries is due to increasing identification of natural products, non-toxicity, no side effects, and easy availability and at economical price. Due to growing demand for medicinal plants and to a loss of natural habitats, about 300 species of Indian medicinal plants have been assessed as under threat in the wild (based on International Union for Conservation for Nature (IUCN) Red List Criteria). Around 1,000 species are estimated to be facing various degrees of threat across different biogeographic regions in the country (Seth and Sharma 2004).

Arbuscular mycorrhizal fungi (AM) are widespread and are geographically ubiquitous**,** monophyletic group of mutualistically obligate symbiotic, multikaryotic and asexual soil fungi in natural ecosystems (Wang and Shi 2008), occurring in the roots of about 80% of the extant terrestrial plant species (Wang and Qui 2006). They play significant role in the restoration of nutrient cycling especially of P in the soil. With increasing concerns about cultivation of medicinal plants, the use of AM symbiosis technology can help to promote better plant growth by increasing their medicinal effect while reducing the inputs of fertilizers and pesticides. This technology may have great potential for Medicinal Plants.

The Western Ghats, major repositories of medicinal plants, is one of the 34 mega diversity hot spots of the world. It harbours around 4,000 species of higher plants of which 450 species are threatened. Currently, the number of species added to the red list category in this region is increasing, and the valuable genetic resources are being lost at a rapid rate.

It contains 4000 of the country's plant species, of which 1500 species are endemic. The high biodiversity of the Western Ghats could be attributed to

its varied habitat types ranging from semi-arid grasslands to tropical rainforests. The species diversity and composition of Arbuscular mycorrhiza fungal communities from medicinal plants of the Western Ghats of Goa region is largely unknown and very few work has been reported by Khade et al. (2002) and Radhika and Rodrigues (2010). Therefore, the present work was undertaken to study the AM fungal diversity in medicinal plant species of Western Ghat region of Canacona-south, Goa.

Materials and methods

Rhizosphere soil and root samples of 16 selected Medicinal Plant species belonging to 11 families were collected from 4 different sites of Canacona taluka, south Goa of Western Ghats region *viz*., Gaondongri (S-I), Cotigao (S-II), Piguinim (S-III) and Amona (S-IV), during 2016-2017 (Fig. 1). The climate is tropical with short dry season, warm and humid with lateritic, clayey-loamy soil. Average temperature range from 27.3^{o}C with average rainfall of 2995mm.

Soil samples were collected from a depth of 0-25cm from the selected study sites. Soil pH was measured by pH meter in a 1:1 H_2O solution (LI 120 Elico, India). Root samples were processed for AM fungal colonization using the method of Koske and Gemma (1989). The stained roots were examined using an Olympus research micros-cope BX 41 (100X - 1000X) for AM fungal structures and percent root length colonization was determined following the slide method (Giovannetti and Mosse 1980). AM fungal spores were isolated by wet sieving and decanting technique (Gerdemann and Nicolson 1963).

Intact and unparasitized spores were used for the quantification of spore density and Am fungal taxonomy. The identification of AM spores was based

on morphotaxonomic criteria using available literature (Schenck and Perez 1990; Morton and Benny 1990; Almeida and Schenck 1990; Rodrigues and Muthukumar 2009). Diversity studies were carried out for AM fungal species richness (species richness of AM fungi is the number of different species present in a particular site), species evenness (the measure of the relative abundance of the different species making up the richness of an area). Identification of the plant species was carried using the flora of Rao (1985) and Mathew (1991).

Results and Discussion

Results of soil analysis depicts that the soil PH was found to be acidic and ranged from 5.7 to 5.8. All sixteen Medicinal plant species undertaken for the study, showed AM fungal colonization (Table 1). The Arbuscular mycorrhizal colonization was characterized by arbuscules and/or vesicles and intraradical hyphae. Maximum root colonization was observed in *Justicia adhatoda* (96.66%) and minimum in *Ageratum conyzoides* (58%) (Table 1). Highest spore density was found in *Naregamia alata* (210.51 spores $100g^{-1}$soil spores) and the least recovered in *Leucas aspera* (52 spores $100g^{-1}$soil spores). Highest numbers of AM fungal species were recovered from *Centella asiatica* (7) and the least number isolated from *Artemisia indica* (2).

A total of 21 AM fungal species belonging to five genera *viz*., *Glomus* (12) was the dominant genus followed by *Acaulospora* spp.(6), *Racocetra* spp. (1), *Dentiscutata* spp. (1) and *Gigaspora* spp. (1) were recovered from the rhizosphere soil samples (Plate 1. a-f) of Canacona taluka of Western Ghat region Goa (Table 1). Species richness was more in the *Centella asiatica* (7) respectively. *Acaulospora scrobiculata* was common in the site. This study

records the predominance of *Glomus* and *Acaulospora* species in the rhizosphere soils of medicinal plant species.

The Arbuscular mycorrhizal fungal colonization showed considerable variations in percent root colonization and number of different AM fungal spores associated with rhizosphere soil but no definite correlation could be established between them, which are in agreement with the findings of Kalita et al. (2002). The presence of mycorrhizal colonization indicates that the plant species are dependent on mycorrhizae for their growth and nutrient supply. The variations in AM fungal root colonization and spore density could be due to the fact that Arbuscular mycorrhizal fungal sporulation is dependent on a wide range of host fungal and environmental factors, and their germination potential varies at different times of the year (Gemma and Koske 1988). It may be also due to habitat differences, environmental factors, soil fertility, or soil disturbance in the sites (Dessai and Rodrigues 2012).

In the present study *Glomus* spp. (12) was the dominant genus which may be due to the fact that it possesses the ability to germinate in a wide range of temperature and pH (Wang and Tschen 1997) followed by *Acaulospora* spp. (6) which are often associated with acidic soils (Abbott and Robson 1991), *Racocetra* (1) *Gigaspora* spp. (1) and *Dentiscutata* spp. (1). This study also showed that Arbuscular mycorrhizal (AM) fungi exhibits little or no host specificity indicating that AM fungi may have preference for certain habitats. Dominance of genus *Glomus* from medicinal plants has been reported earlier Selvaraj et al. (2001).

Twenty one Arbuscular mycorrhizal fungal species belonging to five genera from the rhizosphere soil of Medicinal plant species were recorded in

the present study. Similar work was reported by Francis and Read (1994) and Allen et al. (1995) on greater AM fungal species diversity in medicinal plants. However Muthukumar and Udaiyan (2001) reported only 35 Arbuscular mycorrhizal fungal species from 329 medicinal plant species from Western Ghats.

Large variation in spore number (52−210.51 spores 100 g^{-1} soil) recorded in the rhizosphere soil indicates that there occurs competition between fungi associated with host plants, and environmental factors and these influences spore production in natural communities (Gemma and Koske 1988). Species richness was more in the *Centella asiatica* (7) respectively. This may be due to the fact that species richness index is reported to be dependent on the sample size, as more number of samples are collected, spores of more species are likely to be recovered (Sturmer and Bellei 1994). Increase in species richness was accompanied by an increase in plant diversity and ecosystem productivity. It is necessary to identify AM fungal species in medicinal plants from Western Ghat region as it is known to provide P benefits with other essential nutrients to the plants enhancing the growth as well as productivity of the medicinal plant species.

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Fig. 1: Map of Goa showing the study sites.

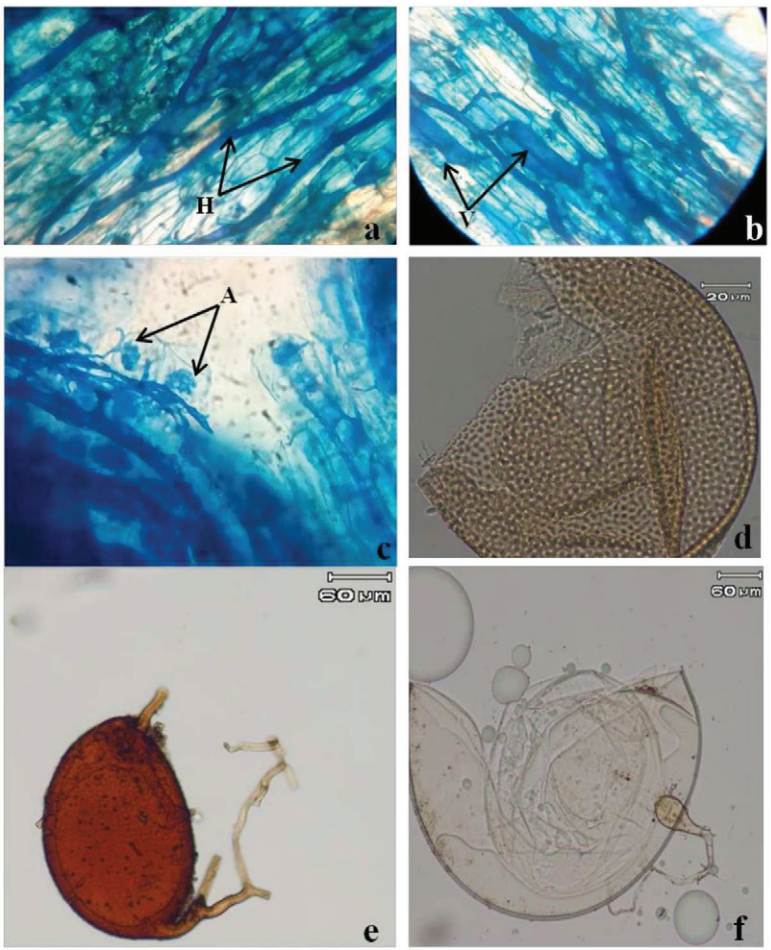

Plate 1: Root Colonization in Medicinal Plant species: a, b, & c.

a. Justicia adhatoda L.– showing hyphal colonization **(H)**, **b.** *Centella asiatica* (L.)Urban – vesicular colonization **(V)**, **c.** *Rauvolfia serpentine* (L.) Benth. ex Kurz.– showing arbuscular colonization (A)

AM fungal spores in Rhizosphere soils of Medicinal Plant species: d, e & f.

d. *Acaulospora scrobiculata*, **e.** *Glomus multicaule*, **f.** *Gigaspora albida*.

Table 1. Arbuscular mycorrhizal fungal colonization and Spore density in selected Medicinal Plant species of Canacona taluka, Goa

Sr. No	Medicinal plant species	Family	AM fungal colonization	Percent root colonization	AM species/Spore density $100g^{-1}$soil spores
1	*Andrographis paniculata* (Burm.f.) wall.	Acanthaceae	H, V	78%	*Acaulospora nicolsonii*, *A. scrobiculata, G. fasciculatum, G. sinuosa* (112)
2	*Justicia adhatoda* L.	Acanthaceae	H,V, A	96.66%	*Acaulospora elegans, A. foveata, A. nicolsonii, A. scrobiculata*, *Glomus geosporum* (120)
3	*Centella asiatica* (L.)Urban	Apiaceae	H, V, A	93%	*Acaulospora elegans, Glomus fasciculatum*, *G. formosanum, G. geosporum, G. maculosum, G. taiwanensis, Racocetra gregaria* (141)

4	*Holarrhena antidy-senterica* (L.) Wall.	Apocynaceae	H, V, A	69%	*Acaulospora nicolsonii, A. scrobiculata, Glomus coremioides*, *G. diaphanum*(191)
5	*Rauvolfia serpentine* (L.) Benth. ex Kurz.	Apocynaceae	H,V	78%	*Acaulospora denticulata*, *A. dilatata*, *A. foveata*, *A. icolsonii*, *A. scrobiculata*(121)
6	*Calotropis gigantea* (L.)W.T.Aiton	Asclepiadaceae	H,V, A	63%	*Glomus constrictum, G. fasciculatum, G. macrocarpum, G. multicaule*(130)
7	*Hemidesmus indicus (*L.) R.Br	Asclepiadaceae	H,V	66%	*G. maculosum*, *G. pachycaulis, G. taiwanensis*(171)
8	*Ageratum conyzoides* L.	Asteraceae	H,V, A	58%	*G. fasciculatum, G. formosanum, G. maculosum, G. multicaule* (101)
9	*Artemisia indica* L.	Asteraceae	H,V, A	62%	*G. taiwanensis, Dentiscutata nigra* (131)
10	*Eclipta prostrate* (L.) L.	Asteraceae	H,V, A	65%	*G. geosporum, Gigaspora albida, Dentiscutata nigra* (104)

11	*Calycopteris floribunda* (Roxb.) Lam.ex Poir.	Combretaceae	H,V	67%	*Acaulospora dilatata, A. scrobiculata, Glomus coremioides, G. formosanum*(112)
12	*Leucas aspera* (Willd.)Linn.	Lamiaceae	H,V, A	64%	*G. geosporum, Gigaspora albida, Dentiscutata nigra* (52)
13	*Lawsonia inermis* L.	Lytheraceae	H, V	60%	*Acaulospora denticulata*, *A. dilatata*, *A. foveata* (79.12)
14	*Naregamia alata* Wight& Arn.	Meliaceae	H,V, A	68%	*Acaulospora nicolsonii, A. scrobiculata, Glomus coremioides* (210.51)
15	*Ixora coccinea* L.	Rubiaceae	H,V, A	66%	*Acaulospora scrobiculata, G. fasciculatum, Dentiscutata nigra* (66)
16	*Vitex negundo* L.	Verbenaceae	H,V	59%	*Acaulospora nicolsonii, A. scrobiculata, Glomus coremioides, G. geosporum, G. macrocarpum* (110.56)

Legend: *A*= *Acaulospora*, *G*= *Glomus,* H = hyphal, A = arbuscular colonization, V = vesicular colonization.

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CHAPTER 12

Diversity of Zooplanktons and its importance for fish production on fresh water reservoir on Sindphana river, Maharashtra, India

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Abstract

Majalgaon Dam was constructed on the River Sindphana which is a tributary of River Godavari, in Beed District (Maharashtra, India) in 1987.The River Sindphana has been under constant threat of pollution by sewage and industrial wastes, disposal of dead bodies, deforestration, excessive use of fertilizers and pesticides, bathing and water development programmes. The dam has a catchment area is 3840 sq. km. It is of great Importance for the region because its water is used for human and cattle consumption, power generation, fish production and irrigation. The importance of plankton in fisheries is well established. It has been clearly demonstrated that the zooplankton constitute the only food for the fish fry and the adult fish not only eat them, but also select them as a delectable item. Thus zooplankton have a direct bearing in the fish industry. In India, several studies were conducted in reservoirs elucidating the characteristics of zooplankton. The zooplankton peak was found during summer followed by winter and rainy season. Micro fauna (zooplankton) has observed about four groups as Rotifera, Copepoda, Cladocera and Ostracoda observed number of species on reservoir. The macro fauna or fish fauna were abundance at the Majalgaon Dam reservoir. There are

cultures of fish with quick growing varieties of fishes including Indian Major Carps, exotic species have been popular in recent time. There is abundance of the species such as *Labeo rohita, Cirrhina mrigal, Catla catla, Cyprinus carpio, Silver carp, Wallago attu, Mystacenbelus armatus, Notopterus chital, Puntues ticto, Channa staitus, Mystus seenghala, Mystus cavaassius, Eutroplus suratensis, Belon concila, Chela, Tilapia Mossambica, Gobius giuris,* etc. Fish is economically a very important group of animals beside being used as food. Fish liver is an important source of oil containing Vitamins A and D, several minerals and protein.

Key words: *Copepoda, Majalgaon Dam, fish production. Rotifera, Zooplanktons*

Introduction

Plankton act both as predators and consumers play an important role in transformation of energy from one tropic level to the next highest ultimately leading to fish production which is final product of the aquatic environment. The zooplankton populations in a small water bodies are subjected to extreme fluctuation, the cause of which is not adequately understood even though exhaustive literature on plankton studies are available. The Indian notable contributions to the knowledge of zooplankton are of Arora (1931) Sewell (1934) who studied on planktonic rotifers. Gouder and Joseph (1961) documented detailed information on copepods. George (1961) has worked on the distribution of zooplankton in pond and lake. Applied limnology has great scope in healthy existence of natural and manmade water bodies and to harvest the natural resources at sustainable level, Goldman and Horn (1983).

In order of utilize a fresh water body successfully for fish productions its very important to study a abiotic and biotic factors influencing the biological productivity of the said water body.

According to Jhingran (1975) the total man made reservoir area in India is about 10, 94,960.616 hectare, out of which 40 percent is formed by small reservoirs and tanks. In Maharashtra state out of 1,51,114.71 hectare area of total fresh water bodies about 98 percent area in constituted by small reservoir and tank. Such small shallow fresh water bodies have been found to be much more productive than large impoundment (Holts, 1996).

Hence the present work is an attempt to accumulate information pertaining to biological aspect as zooplankton of standing water bodies from this part of peninsular India. The present investigation has been carried out on 'Majalgaon Dam' located on river Sindphana (Godavari Basin) near 2 Km. U/s from Majalgaon city (Taluka place) of Beed districts in Maharashtra State. Which falls 16° 16^8 N latitude and longitude 73° 26 E. It is multipurpose type like irrigation and power production (Hydro Electric Project). As a representative of these 'Majalgaon Dam' was selected for the zooplanktons studies. The present study is aimed to investigate some of the important zooplankton quantitatively of the reservoir. To find out what type of exotic fishes can be introduced in the reservoir in future so as to utilize the water body successfully for fish production.

Material and Methods

Study Area: Majalgaon Dam Reservoir

Majalgaon Dam is located at Majalgaon in Dist. Beed (M.S.). The second stage of 'Nath Sagar' at river Godavari valley at Paithan District

Aurangabad (M.S.). The river Godavari is one of the greatest most important rivers in India. It is the main river in Maharashtra State and actually it flows in Marathwada region. It originates at Trimbakeshwar (hill) in Nashik District in Maharashtra state and after travelling some 1500 km., join the Bay of Bengal. It has a catchment area of 312.812 sq. kms of which 63.3% lies in Maharashtra. Its main tributaries are Pravara, Purna, Penganga, Wainganga, Manjara, and Sindphana.River. Sindphana is the main tributaries of the Godavari river on the right bank its origin in the Balaghat range 40 to 50 km away from Majalgaon city. It merges in Godavari river near Manjarath village on the river Sindphana the well known dam has been built near 2 km U/s from Majalgaon city Beed district in Maharashtra State which falls under 16^0 16^8 N latitude and longitude 73^0 26 E. It is a multipurpose type of project like irrigation and power production (Hydro Electric Project). In 1977 Dam construction was started and completed in 1987. The catchment area is about 3840 sq. km. River Bindusara is the tributary of Sindphana River which is considerably important river.

Climatological Condition

The climate of Beed District is on the whole dry except in the south west monsoon season. There are three seasons; winter (Oct-Jan), summer (Feb-May), Monsoon (June-Sept). The cold weather commences towards the end of November when air temperature beginning to fall up to 12 °C in an average and it rises from March and goes up to 39 to 42 °C. May is the hottest month.

Sampling Sites

The water samples were collected from four selected sites (S_1, S_2, S_3, and S_4) from the reservoir. The following aspects were considered while selecting the sampling sites - the shape and size of the reservoir, human activities at different four sites and the vegetation and position of inlets and outlets of the reservoir.

Biological Characteristics (Plankton Studies)

Fresh water habitats occupy only a small percentage of the earth surface. Both plants and animals are well represented in aquatic communities. The zooplankton is found at all depth of water since they have power of movement. Which though feeble help them to move up and down? In many of the zooplankton species such vertical movement is regular and rhythmic and occurs daily. There migratory forms lives at certain depth during the day and rise to the surface towards the evening sinking back to their normal depth in the morning. Horizontal variation in the distribution of fresh water plankton is caused by the action of local current and wind. The plankton are floating organism whose movement are more or less dependent on currents, while some of the zooplankton exhibit active swimming movement that aid in maintaining vertical positions. Plankton as a whole is unable to more against appreciable current.

Methods

For the study of limnological to the biological aspect fauna or plankton studies to selected four sites at Majalgaon Dam reservoir on the river Sindphana. Samples collected from different four sites and investigated in the laboratory with the help of latest technical instruments and observe and finally

the result are recorded as the every month in the year research period. The sample collected from the surface water by filtering 100 liter of water with a planktonic net having a mesh size of 30 micron. While taking the sample, care was taken that water is not disturbed and the samples were transferred into wide mouth bottle and preserved in 4 % formalin. For zooplankton analysis, sample of zooplankton were taken into Sedgwick Rafter Cell and identification of zooplankton carried out and the counting done following the work of Edmondson (1965), APHA, AWWA and WPCF (1985), Trivedy and Goel (1984), Tonapi (1980), Standard key & other literature were used for identification of different species and the identified species were expressed in no. per liter.

Results and Discussion

Rotifers showed superiority over other groups both in terms of species and genera and population density. Dominance of Rotifera over other groups has been reported in water bodies from different parts of the world (Pennak, 1944; Alikunhi, 1957; Michael, 1968; and Singh and Sahai, 1978).According to George (1966), the abundance of rotifers followed by Cladocera is an indication of the eutrophic nature of the water bodies. The dominance of Rotifera may be attributed to their dependence on phytoplankton detrial nature and bacterial as food (Sarwar and Praveen, 1995). The annual range of zooplankton richness in fort lake are higher reported by Zutshi et. al. (1980), Patil and Goudar (1985), Kaushik and Sharma (1994) and Patil and Karikal (2001). The present study depicted considerable variation in overall community structure within limnetic zooplankton. Dominance of rotifers in the lake could be attributed to the continuous supply of food material (Singh,

2000), which in turn indicates eutrophic nature of the lake. Several studies of freshwater zooplankton have revealed strong links between the genetic structure of aquatic populations and habitat size, diapause stages, inter-specific hybridization, selection pressure and ecological divergence of coexisting genotypes in course of time. Mort (1991) reported that the pattern of aquatic animals communities observed in nature are the result of interactions among various biotic and abiotic factor, various direct and indirect interaction occur among fishes, zooplankton and phytoplankton in diverse aquatic communities.

According to Reid and Wood (1976) high diversity is low in oligotrophic systems factor that are conducive to high ecological diversity of high environmental stability, predictability and high productivity.The zooplankton peak was found during summer followed by winter and rainy season. Dominance of Rotifera in seasonal data were reported in the findings of Michael (1968), Saha et. al. (1971), Pandey et. al. (1992) and Sarawar and Praveen (1995). The peak value of zooplankton during summer might be due to optimal thermal and nutritional condition and higher concentration of oxygen (Singh, 1991). The lowest zooplankton recorded during winter may be related to low temperature. Marshall and Orr (1972) also observed minimum zooplankton population at lower temperature.

In the Majalgaon Dam reservoir, Rotifera, Cladocera, Copepoda and Ostracoda recorded maximum density and species richness during the pre-monsoon and post-monsoon period respectively. When condition were relatively stable, they recorded low diversity and low species richness during the monsoon period. This concurs with Hawkes (1979) suggestion that low diversity is a reflection of environmental stresses. Margalef (1968) recorded

that higher diversity is a clear indication of longer food chains. Evenness index of rotifer species were higher during the pre-monsoon period in the reservoir while that Cladocera species were higher during the post-monsoon period.

Fish Production on Reservoir

Water is the basic element in fish culture and its specific properties as a cultural medium of great significance in the productivity of a pond or reservoir. In water of lakes and reservoir fishes are reared more as a part of a general fishery improvement programme than as pure fish culture. The relational management of lake and reservoir is of great significance in food production. The improvement of lake and reservoir is a recent development in fishery management and is still in its infancy. In India we have 13,671 acres of lakes and reservoir waiting for development so far as fisheries programme is concerned, since the present average fish yield from Indian reservoirs is low i. e. less than 10 kg/ha./annum. Only 61.3 % of the readily cultivatable water area in the country is presently utilized for culture with regard to inland fish culture. It is well known that unless the water is stocked with quick growing varieties, which are compatible, it may not lead to any sizeable quantity of fish production.

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CHAPTER 13

Biodiversity, It's sustainable Uses, Threats and Coservation

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Abstract

Every organization of living world is unique and this uniqueness of individuals is the basis of biodiversity. The term biodiversity refers to variability among living organisms on the planet earth. There are three hierarchical levels of biodiversity viz. genetic diversity, species diversity and ecosystem diversity. Biodiversity is essential for continued survival of species and natural communities. India is a seventh largest country in the world as regards its geographical area. The country is endowed with rich biodiversity spread over ten bio geographical zones due to varying physical conditions, climate soils topography and species grouping of flora and fauna conservation. Biodiversity is concerned with the protection of genes and species and their number in population, ecosystems or habitats. It is important to conserve numerous varieties of plants and animals. The challenge lies before individuals, organizations, government-agencies, nations enhance biological diversity, while continuing to meet peoples' need for natural resources. Sustainable development has three key dimensions – economic, social and environmental system. Each system has its distinct driving force and objectives. The goal is to make development more sustainable with continuous

improvement in the present quality of life at lower intensity of resources utilization.

Keywords: *Biodiversity, sustainable Development, Ecosystem, Environment*

Introduction

Biodiversity refers to the variety of life form on earth. The term encompasses three categories viz. Genetic diversity, Species diversity and ecosystem diversity. The increasing interest in biodiversity is a result of concerns regarding species extinction, depletion of genetic diversity and disruptions to the atmosphere, water supplies, fisheries and forests (Joseph, 2006). This diversity is a condition for the long term sustainability of the environment and the maintenance of its integrity is therefore recognised as being indispensable to sustain human life (Saxena, 2006). India has a rich heritage of species and genetic strains of flora and fauna. Due to unsustainable resource use and development activities biodiversity is a threat in the entire world as well as in each ecological region. Several measures have been taken at the international as well as national level for the conservation of biodiversity. Sustainable development has three key dimensions: economic, social and environmental system. It is a process which leads to a better quality of life while reducing impact on the environment.

Concept of Biodiversity

Biological diversity deals with the degree of nature's variety in the biosphere. The term biodiversity refers to the variability among living organisms on the planet earth. There are three hierarchical levels of biodiversity viz. Genetic diversity, species diversity and ecosystem diversity.

Biological diversity relates with the degree of nature's variety in the biosphere. Biodiversity provides a various environmental services from its species and ecosystems that are essential at the global, regional and local levels. The production of oxygen, reduction of carbon-dioxide, maintaining the water cycle and protecting soil are some important services. Biological diversity is also essential for preserving ecological processes viz. fixing and recycling of nutrients, soil formation, circulation and cleansing of air and water, global life support maintaining the water balance within ecosystem watershed protection, erosion control and local flood reduction. Food, clothing, housing energy, medicines are all resources that are directly or indirectly linked to the biological variety present in the biosphere (Bharucha, 2005). It has become obvious that preservation of biological resources is essential for the well being and long term survival of mankind.

Biological diversity has been the backbone of human food health and livelihood security systems ever since human civilization started. Interaction between the living world and human society led to the domestication of a wide range of plants and animals. Expansion of human settlements and increasing specialization of agriculture led to destruction of habitats rich in biodiversity and the narrowing of the composition of the food basket. The loss of biodiversity has to be seen against a greater need to produce food and other commodities under conditions of expanding biotic and abiotic stresses and shrinking perception availability of arable land and irrigation water (Pandey and Misra, 2011). Under such circumstances the loss of every species and gene limits our options to shape our future.

Sustainable Development

Sustainable development is defined as development that meets the needs of the present without compromising the ability of future generations to meet their own needs. It includes social development and economic opportunity on the one hand and the requirements of the environment on the other. It is a process which leads to a better quality of life while reducing the impact on the environment (Manoharachary and Jayaramareddy 2009).Sustainability of resources require stable climate maintaining diversity of ecosystem and exploitation of means within limit of tolerance. Sustainable development is using conserving and enhancing the community resources so that ecological processes on which life depends are maintained world business council for sustainable development, a condition of 170 international companies of more than 35 countries and 20 major industrial sectors united by shared commitment is taking an active interest in sustainable development via the three pillars namely economic growth, ecological balance and social progress. India is a unique country with tremendous natural diversity associated with all kinds of climates and rich flora and fauna. The country has to follow old traditions and has still to go a long way in implementing sustainable consumption oriented development. India faces many challenges in context of natural resources. The demand from sheer number of people affect land use dynamics at a local level leading to resource degradation (Sharma and Sangha, 2006). India needs to lay emphasis on framing a well planned strategy for the development activities which may increase economic growth.

Sustainable Use of Biodiversity

Biodiversity is a source of natural resources which provide safer and more secure livelihood. Natural resources like energy resources and plant, minerals etc. are essential for the survival of human being.

1. Ecological Services

Different ecosystem can serve as potential source of different marketable products with remarkable services of biodiversity. Agro ecosystem can be source of fibre crop, food crop and crop genetic resources which can serve to provide habitat for human, soil organisms important to agriculture. Coastal ecosystem can be a source of salt. Forest ecosystem can be a source of timber, fuel wood, and drinking and irrigation water.

2. Organic Agriculture Market

Organic Agriculture Market provides consumers with products in which no or strictly limited chemical inputs are used. Such types of products are preferred by consumers because of their natural and non-genetically modified nature organic agriculture imposes a positive impact on biodiversity by enhancing diversity of cultivated species.

3. Forestry

Overexploitation of forest resources has imposed a serious threat on biodiversity. Forestry needs to be sustainable. Sustainable forestry ensures conservation of biodiversity soil fertility renewable resources and genetic biodiversity. Sustainable forest management activities contribute to the preservation of biodiversity of providing an alternative to the more harmful conventional practices (Manjhi, 2006.).

4. Biosphere Reserves

Biosphere reserve and national parks are basically maintained for conservation of biodiversity. They also serve to provide economic benefits in terms of ecotourism and extraction of valuable products for the survival of tribal community.

5. Recyclable Products

Natural and recyclable products provide economic benefits along with biodiversity conservation. Industrial and agriculture sector needs raw materials from nature which imposes a pressure on existing resources which can be reduced by managing production practices. Such practices should serve to save raw material cost and thus providing benefits to biodiversity (Kumar, 2009).

6. Market Information

Information plays a key role in determining choices of market. It can be obtained by private sector, public sector and civil society. They can aware consumers for the use of only environment friendly product and thus can impose a pressure on industrial sector for the enhanced production of eco friendly products.

Biodiversity Convention

The objectives of this convention are the conservation of biological diversity (UN Convention 2010), the sustainable use of its components and the fair and equitable sharing of the benefits arising out of utilization of genetic resources. Agenda 21 and conventions on Biodiversity and climate change are considered as passport to a better common future for mankind. However, the

following five areas need priority attention if we are to achieve the goals which prompted the convening of Earth submit:

1. Population
2. Poverty.
3. Pollution.
4. Protection of life-support system.
5. Public policy and action.

So the survival and well-being of a nation depends on sustainable development. It is a process of social and economic development, betterment that satisfies the needs and values of all groups without foreclosing future options.

Threats to Biodiversity

Due to unsustainable resource use and development activities, biodiversity is at threat in the entire world as well as in each ecological region. The primary threat to biodiversity is due to habitat loss because the growth of human population, industrialization and changes in land use pattern (Basu and Xavier, 2016). The loss of habitats, due to rapid human population growth and economic development is the major contributor to the rapid global destruction of biodiversity. The main causes of the loss of biodiversity are (Cunningham et al, 2001):

- Habitat Loss
- Changing Agricultural Practices
- Environmental Pollution
- Global Climatic Change
- Poaching of Wildlife

- Invasion by Introduced Species
- International Trade etc.

Conservation of Biodiversity

The earth is home of rich and diverse array of living organisms whose genetic diversity and relationship with each other constitutes planets biodiversity (Maheshwar, 1996). It is well known fact that the ecosystem are undergoing change due to pollution, invasive species, climate change and many other reasons. More knowledge is required to conserve biodiversity in perspective of reduced space under increased pressure of human activities. Conservation of biodiversity in concerned with the protection of genes and species and ecosystems or habitat. It is important to conserve numerous varieties of plants and animals. The diversity of genes within a species increases its adaptability to pollution, diseases and other environmental changes (Singh et al 2014). Biodiversity conservation refers to the efforts to maintain or enhance biodiversity involving protection upliftment and scientific management at its optimum level in order to desire sustainable benefits for the present as well as for the future. Thus conservation of biodiversity is one of today's most pressing environmental issues. The challenge lies before individuals, organisations, government agencies and the world as a whole to protect and enhance biological diversity.

Measures

The measures for sustainable development may be different in developed and developing countries according to their level of technological and economical development but developing countries like India can focus attention on the following measure:

1. Ensure clean and hygienic working and living conditions for the people.
2. Conduct a research on environmental issues pertaining to the region.
3. Introduction of environmental education as a part of school and college curriculum.
4. Encourage use of non conventional sources of energy, especially solar energy.
5. Use of organic fertilizers and other bio techniques should be popularised.
6. Environment management is a key for sustainable development, it should include
monitoring and accountable.
7. Ensure safety against industrial hazards and find economical methods for salvaging
hazardous industrial wastes.
8. Encourage industries for production of environment friendly products.

Conclusion

Sustainable development is a universal challenge; many practical responses can only be defined nationally and locally (Stephen Bass and Barry Dalal). Nations are challenged with implementing and developing strategies in sustainable development. All countries should promote sustainable development at the national level by inter-alia, enacting and enforcing clear and effective laws that support sustainable development. It can be concluded that conservation and proper harnessing of biodiversity is essential to sustainable development. It needs the involvement of not only the governmental organisations but local people also. Developing countries in

collaboration with developed countries can take various effective measures and thus can set up a milestone in sustainable harnessing of biodiversity.

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UN Convention on Biological Diversity (2011-2020) as the UN Decade on Biodiversity.

CHAPTER 14

Diversity of fungi associated with leaf litter from sacred grove of hasane, radhanagari tehsil (dist. Kolhapur)

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Abstract

Sacred Groves are considered as natural store houses which represent a diverse spectrum of ecosystem. Sacred groves shows rich plant diversity therefore, the area of Sacred Groves always rich with leaf litter which undergoes a process of decomposition by various organism among which fungi play crucial role in leaf litter decomposition. Diversity of fungi studied associated with decomposing leaf litter of some plants of Gangoba sacred grove, Hasane from Radhanagari district Kolhapur. The slides were prepared by scraping of the material with fine needle and also culture method is used for isolation of leaf litter fungi which associated with *Mangifera indica* Linn. Ten species isolated which belonging to genus *Aspergillus, Rhizopus, Mucor ,Curvularia, Beltrania, Colletotrichum, Ardhachandra*. These fungi play important role in nutrient recycling in sacred groves forest.

Key words: *Fungal Diversity, Leaf Litter, Radhanagri, Sacred Groves*

Introduction

Kolhapur district is located at the extreme south of Maharashtra state between 17° 17' to 15° 43' N latitudes and 73° 40' to 74° E longitudes.

Accordingly Kolhapur district has 37 sacred groves, out of these sacred groves were visited from Radhanagari , Bhudargad, Ajara, Malkapur area (Anonymous, 1983-86). Pioneer inventory of sacred groves from Maharashtra state and Kolhapur district was carried out by Gadgil and vartak (1981).These sacred groves forest specially reserved in the name of deity and it proved to play role in preserving vegetation since their existence.

A detail record of flowering plants include 2227 species , 5 subspecies and 30 varieties belonging to 1023 genera and families; as mentioned in flora of Kolhapur district (Nipunge , 2010). From Radhanagari Tehsil Gangoba Sacred Grove was carried out for fungal diversity which is situated at Hasane village and near about 8 h. areas covered. Geographical coordinates of Hasane 16˚20'45.75" N and 73˚ 51' 19.55" E and Altitude -600 meters above msl, Temperature -28 ˚C, Humidity-90˚ %. Its weather is moist and salty during September to November. It is well preserved patch of natural evergreen forest because it is not affected by human disturbance. Therefore, the plant diversity is always rich which possess diverse spectrum of ecosystem and Sacred Groves forest possess rich leaf litter which successively decomposed by fungal communities.

Litter is an important source of dead organic matter in terrestrial ecosystem with inputs of tons litter per year. In deciduous forest, during autumn senescent leaves start to fall down and create the first stratification of the litter. The presence of this litter layer has multiple important functions in the forest floor (Alessia et al. 2018). Prevents the erosion, decreases and prevents the destruction of the aggregates of the soil by raindrops, provides protection against microclimate fluctuations and soil compaction (Sayer,

2006). The studies on microorganisms suggest fungi to be the main contributors to leaf litter decomposition (Akare et al. 2016). The decomposition of litter and deadwood is a key step in carbon (C) and Nitrogen (N) cycles, as it contributes to Co_2 release (Van Geffen et al. 2010) and is the main source of mineral N in terrestrial ecosystem (Hobbie,2015). Leaf litter decomposition is an important process of nutrient recycling in forest ecosystem, playing a major role in the transfer of energy and nutrients (Shanti and Vittal 2010).

Material and Methods

Collection of the leaf litter samples of numerous plant species was made randomly during March to September months respectively from Hasane, forest floor of Gangoba sacred grove and sterilized polythene boxes were used for deposition of samples in the laboratory for further study. Identification of host samples was done with the help of relevant literature (Yadav and Sardesai 2002; Pascal 1987; Lakshminarsinhan 1996).

For isolation of fungi from leaf litter was done by culture method (Sharma et al. 2011).Washing disk culture method was apply for collected leaf litter samples respectively, 5 leaf disks were prepared by using 4 No. stem borer, then these leaf disks were washed serially using sterilized distilled water and allow to air dry in chamber. Dried Leaf disks placed into Potato Dextrose Agar (PDA) containing Petri plates and it incubated at 25±1˚C for 7 days. Variety of fungal colonies observed on PDA medium, these colonies were mounted in lactophenol and cotton blue in lactophenol on glass slide (Patil and Patil 2002). Identification was done by using relevant literature (Subramanian 1971; Barnett 1997; Thom 1945; Tsuneo1937; Ellis 1971).

Leica Dm 2000 Fluroscence Microscope equipped with digital camera was used for Photomicrographs. Identified samples with accession number are deposited in the mycological herbarium of college.

Results and Discussion

Taxonomic identification for leaf litter fungi associated with leaves of *Mangifera indica* Linn. showed the occurrence of 10 species the details of taxonomic description are as follows.

Ardhachandra Subram. and Sudha

Fig.a

Sooty moulds on decomposed leaf surface; conidiophores solitary, subhyaline, simple, septate; conidiogenous cells polyblastics, sympoidal, terminal, denticulate; conidia mostly bearing to apical fertile denticulate portions ,conidia solitary pointed ends.

Beltrania Penz.

Fig.b

Colonies saprophytic, effuse, dark brown; setae of two types: primary setae, straight, erect, smooth, dark brown, broad at the base and tapering at the apex; secondary setae spiral, smooth, towards the base, verrucous above, broad at base and tapers at the apex, brown to light brown; conidiophores arising from the base, septate, light brown; separating cell present, sub hyaline; conidia biconic, brown to dark, transverse subhyaline band at centre.

Colletotrihum Corda

Fig.c

Dark brown to black acervuli scattered on decomposed leaf, these acervuli consist of dark setae , acervuli are rounded , separate superficial ;

dark pigmented setae ; conidiophores are hyaline , single –celled , fusiform , spindle shaped with acute apices; setae dark brown swollen base and pale rounded at apex; conidia sickle shaped, single celled.

Curvularia pseudolunata Da cunha, Madrid and Gene

Fig.d

Colonies grown on PDA, grayish brown to brown ,cottony; conidiophores arises terminal and laterally on hyphae, pale brown , simple, erect, flexous, septate, unbranched, giniculate near the apex, 100-200× 2-4.7 µm in diam.; conidiogenous cells 20-26× 4.7-9.9 µm in diam.; conidia 4-celled , curved 17.3- 20.5×7.9 - 9.9 µm in diam.; third cell from base unequal, larger and darker than other cells; second and end cells sub- hyaline to pale brown; chlamydospores like cells found.

Mucor plumbeus Bonarden

Fig. e

Colonies grown on PDA, grayish; sporagiophores arising from aerial hyphae, erect, branched; sporangia 33.9 µm in diam., brown to black colour ; columellae oval or pear shaped with spines at the apex, brown , 14.2×12.6 µm in diam.; chlamydospores 15.8×17.8 µm in diam.

Rhizopus stolonifer (Ehrenb; FR) Linder

Fig.f

Colonies spread on PDA with loose gray mycelium. Stolons hyaline becoming brown towards nodes; Rhizoids short, brown; sporangiophores arises single and in group on the stolons. They are brown, smooth, nonseptate, 350-3500 µm long in length and 16.9-22.5 µm in width; sporangia spherical 100-340 µm in diam. and like umbrella shaped when dehisced;

sporangiospores yellow to brown in color, spherical or ova, longitudinally striped and 11.3×7 µm diam.

Rhizopus oryzae Went and Prnisen Geerligs

Fig.g

Synonym - R. *arrhizus* A. Fisher

Colonies spread on PDA, grayish color grown; sporangiophores erect, simple or branched ,yellowish to dark brown, 1147-1500 µm in diam.; rhizoids connected directly to sporagiophores, bearing sporangia terminally; sporangia globose, dark brown to black,107-200 µm in diam.; columellae globose, brown ,77-125×90-115 µm in diam.; sporangiospores, pale brown, with bluish stripes 7.9-11.3×3.1 µm in diam.; chlamydospores 105-125×35-50 µm in diam.

Rhizopus sexualis (G.Sm.) Callen

Fig.h

Colonies grown on PDA , at first white, then dark gray, reverse dirty white , stolons smooth , well developed , hyaline, 7-16 µm in diam.; rhizoids present ,simple , fingerlike , hyaline to brown ; sporangiophores arising from aerial mycelia, solitary or 2-8 in groups, simples, 1200-3750 µm in long , 15 µm in diam.; sporangia globose ,59-177 µm in diam.; columellae elliptical – ovoid ,59-129×49-106 µm in diam., subglobose 82-141 µm in diam. and roundish conical 14-117×31-114 µm in diam.; sporangiospores ovoid to irregular 7.9×5.5 µm in diam., subglobose 6.3-10 µm in diam. chlamydospores absent , zygospores subglobose to broadly ovoid , 58-155 µm in diam.

Aspergillus effuses Tiraboschi.

Fig.i

Colonies spread on PDA cottony white becoming dirty yellowish; conidiophores with pitted wall, 100 µm in length and 5 µm width ; conidial head columnar, small , a few of them rarely large ; vesicles11-17 µm in diam.; sterigmata single series in small heads either one or two in larger heads, sterigmata 6.3×2.3 µm in diam.; conidia globose 3.1µm in diam.

Aspergillus versicolor (Vull). Tirabschi

Fig. j

Synonym – *S. versicolor* Vuillemin. Mirsky, B.

Colonies grown PDA, compact, in some strains velvety and consisting closely crowded conidiophores arising from the substratum; conidiophores fluccose hyphae bearing more or less abundant conidiophores as short aerial branches; conidiophores smooth, colorless, 600-780 µm in length and 15 µm in diam.; conidial heads roughly hemispherical radiate up to 103.6-36.3 µm in diam.; fertile area hemispherical, sterigmata in two series primary 9.4×3.1 µm in diam., secondary 7.9×2.3 µm; conidia globose, delicately echinulate 2.5-3.7 µm in diam. borne in loosely radiating chains.

Plate-1

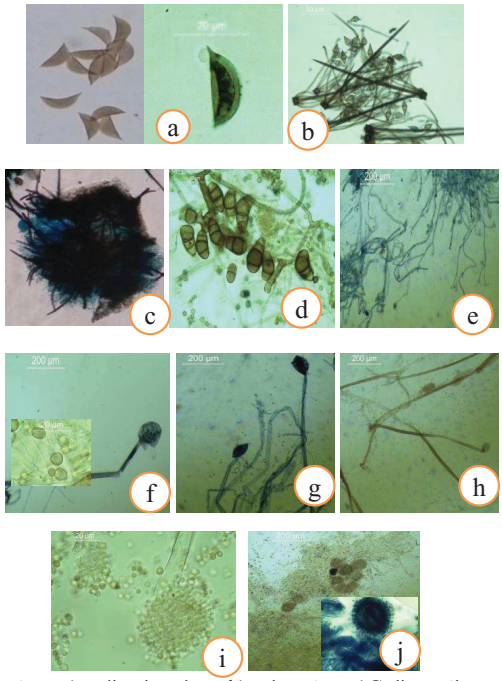

Fig. a)*Ardhachandra* b)*Beltrania* c)*Colletotrihum,* d)*Curvularia pseudolunata* e) *Mucor plumbeus* f) *Rhizopus stolonifer* g) *Rhizopus oryzae* h) *Rhizopus sexualis* i) *Aspergillus effuses* ,j) *Aspergillus versicolor*

Conclusion

Diversity of leaf litter fungi was studied from Gangoba Sacred Grove of Kolhapur district, these leaf litter fungi play important role in decomposition of forest litter like that of reserved forest of sacred groves. Ten species of fungal communities occurred on leaf litter of *Mangifera indica* Linn. such as 4

species belonging to Ascomycotina, 4 species from zygomycotina and 2 species from Deuteromycotin.

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CHAPTER 15

Biodiversity and Environmental Sustainability

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Abstract

This paper explores understand about biodiversity and environmental sustainability, Biodiversity refers to the variety of all forms of life on earth, including the different plants, animals, micro-organisms, the genes they contain and the ecosystem they form. It is considered at three main levels including species diversity, genetic diversity and ecosystem diversity. Despite the benefits from biodiversity, today's threats to species and ecosystems are the greatest recorded in recent history and virtually all of them are caused by human mismanagement of biological resources often stimulated by misguided economic policies, pollution and faulty institutions in-addition to climate change. To ensure intra and intergenerational equity, it is important to conserve biodiversity. Some of the existing measures of biodiversity conservation include; zoological gardens, botanical gardens, seed banks and national parks and Biosphere Reserves. "The Concept of Environmental Sustainability "environmental sustainability as the maintenance of natural capital" and as a concept apart from, but connected to, both social sustainability and economic sustainability.

Key words: *Environment, Biodiversity and Sustainable Development*

Introduction

The term biodiversity was coined as a contraction of biological diversity by E.O. Wilson in 1985. Biodiversity may be defined as the variety and variability of living organisms and the ecological complexes in which they exist. In other words, biodiversity is the occurrence of different types of ecosystems, different species of organisms with the whole range of their variants and genes adapted to different climates, environments along with their interactions and processes. Biodiversity includes the genetic variability (for which different varieties of spices have appeared in the course of evolution) and diversity of life forms such as plants, animal microbes, etc. living in a wide range of ecosystems (Spellerberg and Hardes1992).

Objectives

To understand the concept of Environmental and Ecology.

To understand the concept of Biodiversity.

To understand the Biodiversity Conservation.

To understand the sustainable development.

To create awareness among the people.

Materials and Methods

This paper represent our current views on the concept of Biodiversity and Environmental Sustainability, There are numbers of techniques and methods are available to collect the detail information on the subject " Biodiversity and Environmental sustainability" There are so many research paper, research journals, Newly published articles and books on " Biodiversity

and Environmental sustainability, Also the information in Science Magazines and Newspaper articles. Research methodologies and data sources can be useful for studying "Biodiversity and Environmental Sustainability"

Types of Biodiversity: There are three interrelated hierarchical levels of biodiversity namely, genetic diversity, species diversity and community or ecosystem diversity (Tilman and Pacala, 1994). According to Whittaker (1965), the community diversities are of three types:

(i) α-Diversity: (ii) β-Diversity: (iii) γ -Diversity:

Biodiversity Hot Spots: Hot spots are the areas with high density of biodiversity or mega diversity which are most threatened at present. There are 16 hot spots in world, out of which two are located in India namely North-East Himalayas and Western Ghats (Agarwal et al.,2011). Biodiversity of India: As per available data, the varieties of species living on the earth are 1753739. Out of the above species, 134781 are residing in India although surface area of India is 2% of the earth's surface. Wild life Institute of India has divided it into ten biogeographically regions and twenty five biotic provinces (Prakash 2007).

Bio geographical regions are: (i) Trans Himalayas, (ii) Gangetic plain, (iii) Desert, (iv) Semiarid zone; (v) Western Ghats;(vi) Deccan peninsula, (vii) North eastern zone, (viii) Coastal lands (ix) Himalayas, (x) Islands.

Importance of Biodiversity:

1. Productive values:
2. Consumptive value:
3. Social value:
4. Aesthetic value:

5. Legal values:

6. Ethical value:

7. Ecological value:

8. Economic value:

Uses of Biodiversity:

Biodiversity has the following uses for the development humanity:

(i) It provides food of all types.

(ii) It provides fibers, sources for the preparation of clothes.

(iii) It provides different types of oil seeds for the preparation of oils.

(iv) It provides new varieties of rice, potato etc. through the process of hybridization.

(v) It provides different drugs and medicines which are based on different plant products.

(vi) It is very essential for natural pest control, maintenance of population of various species,

Threats to Biodiversity:

1. Habitat destruction: 2. Habitat fragmentation:3. Pollution: 4. Over exploitation:

5. Introduction of exotic species:6. Diseases:7. Shifting or Jhum cultivation:8. Poaching of wild life:

Conservation of Biodiversity:

Mainly the conservation of biodiversity has three basic objectives (Wanju 2003):

(a) To maintain essential ecological processes and life supporting systems.

(b) To preserve the diversity of species.

(c) To make sustainable utilization of species and ecosystems.

Conservation Methods:

There are two types of conservation methods namely in-situ and ex-situ conservations

(a) In situ conservation:

The conservation of species in their natural habitat or natural ecosystem is known as in situ conservation. In the process, the natural surrounding or ecosystem is protected and maintained so that all the constituent species (known or unknown) are conserved and benefited. The factors which are detrimental to the existence of species concerned are eliminated by suitable mechanism.

(b) Ex-situ conservation:

Ex-situ conservation involves maintenance and breeding of endangered plants and animals under partially or wholly control-led conditions in specific areas like zoo, gardens, nurseries etc. That is, the conservation of selected plants and animals in se-lected areas outside their natural habitat is known as ex-situ con-servation.

Sustainability- Siegel, D. S. (2009) express his views regarding Environmental Sustainability. Sustainability is the process of maintaining change in a balanced fashion, in which the development and institutional change are all in harmony and enhance both current and future potential to meet human needs and aspirations. For many in the field, sustainability is defined through the following interconnected domains or pillars: environment, economic and social.

Sustainable development- Sustainable development is the development that meets the needs of the present without compromising the ability of future generations to meet their own needs. Brundtland Report for the World Commission on Environment and Development (1987) introduced the term of sustainable development (Sen, 1999).

Environmental sustainability-Environmental sustainability is the rates of renewable resource harvest, pollution creation, and non-renewable resource depletion that can be continued indefinitely

Environmental dimension- Healthy ecosystems provide vital goods and services to humans and other organisms. There are two major ways of reducing negative human impact and enhancing ecosystem services and the first of these is environmental management. This direct approach is based largely on information gained from earth science, environmental science and conservation biology. However, this is management at the end of a long series of indirect causal factors that are initiated by human consumption, so a second approach is through demand management of human resource use (Siegel, 2009).

Economic dimension- Sustainability economics represents: "a broad interpretation of ecological economics where environmental and ecological variables and issues are basic but part of a multidimensional perspective. Social, cultural, health-related and monetary/financial aspects have to be integrated into the analysis. "However, the concept of sustainability is much broader than the concepts of sustained yield of welfare, resources, or profit margins (Misra, 2000).

Social dimension- Sustainability issues are generally expressed in a social challenge that entails, among other things, international and national law, urban planning and transport, local and individual lifestyles and ethical consumerism. "The relationship between human rights and human development, corporate power and environmental justice, global poverty and citizen action, suggest that responsible global citizenship is an inescapable element of what may at first glance seem to be simply matters of personal consumer and moral choice (Kassas, 2002).

Food clean water medicine and protection from natural hazards is essential for successful survival and living with quality. If we are able to maintain the biodiversity species natural habitats and ecosystems only we can also survive. Biodiversity underpins the health on our planet and direct impact on all our live. Reduce biodiversity means reduce future. Increase participation of people, Create awareness among the people. There is more respect toward the conservation of biodiversity, Various programmes are also undertaken by people of conservation of biodiversity by eco club, nature club, nature park etc.

Conclusion

Human activities threaten many species and ecosystem. Biodiversity Conservation and Environmental Sustainability is one of the most important global challenges of 21st century. So conservation efforts necessary priories saving them. However conservation should clearly be proactive wherever possible. We have to save Biodiversity for Environmental Sustainability for future generations.

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CHAPTER 16

Some Fresh Water Fungi from two water bodies of Nagpur District of Maharashtra, India

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Abstract

In the present study a survey of two water bodies namely Khekaranalla Irrigation project (Tal. Parseoni) and Khindsi Lake/ Ramtek (tal.Ramtek) of Nagpur District was conducted. Partially decomposed wood, submerged leaf litter and foam were collected and observed in the laboratory for the presence of fresh water fungi. Five species of fungi were found on the samples collected, which includes *Aquaphila albicans*, *Flabellospora acuminata*, *Flabellospora multiradiata, Helicomyces colligatus* and *Helicomyces torquatus* . All these species are reported for the first time from Nagpur District.

Key words: *foam, fresh water fungi, leaf litter, Nagpur*

Introduction

Aquatic fungi and fungus-like organisms can be found in water reservoirs where they colonize leaves, branches, stems, coastal grassy plants, and animal material fallen into water, thus contributing to the mineralization

of the organic matter found in various types of water reservoirs (Bożena (2004). The occurrence of water-borne fungi has been reported from various parts of Europe, Africa, America, Asia and Australia (Ingold,1975; Subramanian,1971). To India, the aquatic hyphomycetes were studied by Ingold and Webster (1973), Subramanian and Bhat (1981), Galiah and Manoharachary (1987), Agrawal *et al*. (1991), Sati *et al*.(2002). In Maharashtra, these fungi were recorded by Thakur (1977), Patil and Kapadnis (1980), Patil (1998), Borse and Patil (2006), Borse and Patil (2007).

Material and Method

Submerged woody debris was collected at random from various freshwater habitats in Nagpur region. Samples were placed in double seal plastic bags and then brought to laboratory. In the laboratory, samples were placed in moist chambers (sealable plastic boxes lined with moist paper towels) and incubated at room temperature (~25°C) and 12/12 hr light/dark conditions Within one week of arrival at the laboratory and periodically thereafter for 6–12 months samples were examined for fungal reproductive structures. The fungal taxa present on the wood samples were recorded, identified and isolated.

The slides were made permanent according to Volkmann-Kohlmeyer and Kohlmeyer (1996). Voucher slides of the fungi reported were deposited in the mycology herbarium, P. G. Department of Botany, S.S.V.P. Sanstha's L. K. Dr. P. R. Ghogrey Science College, Dhule, M.S.

Results and Discussion

Aquaphila albicans Goh, K.D. Hyde & W.H. Ho, *Mycol. Res*., **102:** 587-592 (1998a).

Colonies: on natural substratum , translucent or pale yellowish, chalky white when dried. *Mycelium*: partly immersed in the woody substratum and partly superficial, consisting of septate, branched, hyaline, smooth, 4-5 µm wide, repent hyphae. *Conidiophores*: hyaline, arising singly as lateral branches from procumbent hyphae, 9-54 x 3-4 µm, simple or branched, thin-walled, smooth, indistinctly septate, flexuous or geniculate. *Conidigenous cells*: denticulate, monoblastic or polyblastic, sympodiallly proliferating; denticles cylindrical, *ca* 1.5-2 x 2-2.5 µm. *Conidia*: 47-84 x 7-9 µm, holoblastic, solitary, borne acrogenously on conidiogenous denticles, becoming lateral after proliferation of the conidiophore, hyaline or very pale yellowish, predominantly fusoid to sickle-shaped, sometimes sigmoid, very rarely straight and obclavate, thin-walled, smooth, closely 6-15 euseptate, not constricted at the septa, heavily guttulate, conically rounded at both ends, slightly broaded at the base, basal cell obconical but not pedicellate. Conidial secession is schizolytic.

Habitat: Conidia in foam samples. Khekaranalla Irrigation project (tal. Parseoni) Nagpur 12 June 2017, Leg R.T.Jadhav

Remark: The measurements and descriptions of conidia are completely agreed with that of ***Aquaphila albicans*** Goh, K.D. Hyde & W.H. Ho, *Mycol. Res*., **102:** 587-592 (1998a). Therefore it is assigned to that species.

Flabellospora acuminata Descals & J. Webster, *Trans. Br. Mycol. Soc*., **78:** 411 (1982).

Conidia: acrogenous, solitary, staurosporous, main body clavate, apex capitate, 4-5 µm diam, base pedunculate, 5-12 µm long, branches (4)-5-(7), budding out before relese, synchronous, (30)-74-125 x 8-11 (-15) µm, one branch apical, the rest raditing slightly retrorsely, straight, fusiform (-obclavate), apex greatly extended, cells 3-10, released as a strangulation at the base, dispersaed singly or as interlocked pairs.

Habitat: conidia in foam samples. Khekaranalla Irrigation project (tal. Parseoni) Nagpur 12 July 2017, Leg R.T.Jadhav

Remark: The measurements and descriptions of conidia are completely agreed with that of ***Flabellospora acuminata*** Descals & J. Webster, *Trans. Br. Mycol. Soc*., **78:** 411 (1982).Therefore it is assigned to that species.

Flabellospora multiradiata Nawawi, *Trans. Br. Mycol. Soc.*, **66:** 543 (1976c)

Conidia: holoblasic, hyaline, multi-radiate, main axis 10-13 µm long x 2-3 µm at the base, expands above and forms a globose structure 5-6.5 µm diam., from around this, which is usually demarcated from the narrow stalk by a septum, 13-26 µm long, slender, fusiform arms arise, each arm is markedly constricted at its point of origin and thereafter broadens to 1.5-2 µm at the widest point and finally tapers to 1.5-2 µm at the apex which is acute to accumulate and lacks septation in the parts 14-20 µm from the tip, the arms are 92-139 µm long, 11-17 septate and slightly constricted at the septa especially along the basal half, at maturity the cells become vacuolated and

impart a pearly appearance to the whole conidium, conidia in foam samples usually have a blob of mucilaginous material at the tip of each arm.

Habitat: conidia in foam samples. Khindsi Lake/ Ramtek (tal.Ramtek) Nagpur 14 June 2017, Leg R.T.Jadhav

Remark: The measurements and descriptions of conidia are completely agreed with that of ***Flabellospora multiradiata*** Nawawi, *Trans. Br. Mycol. Soc.*, **66:** 543 (1976c).Therefore it is assigned to that species.

Helicomyces colligatus R.T. Moore, *Mycologia*, **46:** 89 (1954).

Conidia: loosely coiled 1-2 times, hygroscopic, multiseptate at maturity, each cell containing one large vacuole or two smaller ones; filament tapering at both ends, the basal end 3.5 µm broad, filament enlarging to 8 µm broad in the middle and brcoming slightly less at the distal end, easily broken into segments; diameter of coils (32-) 50-60 µm.

Habitat: Conidia in foam samples. Khindsi Lake/ Ramtek (tal.Ramtek) Nagpur 14 June 2017, Leg R.T.Jadhav

Remark: The measurements and descriptions of conidia are completely agreed with that of ***Helicomyces colligatus*** R.T. Moore, *Mycologia*, **46:** 89 (1954). Therefore it is assigned to that species.

Helicomyces torquatus L.C. Lane & Shearer, *Mycotaxon.* **19:** 291-294 (1984).

Conidia: Solitary, hyaline attached eccentrically 75-125 µm in diameter. Conidial filament 4.8-7.5 µm. in diameter, multiseptate, 1 ½ - 3 times coiled, basal cell bears attachment scar.

Habitat: Conidia in foam samples. Khindsi Lake/ Ramtek (tal.Ramtek) Nagpur 14 June 2017, Leg R.T.Jadhav

Remark: The measurements and descriptions of conidia are completely agreed with that of ***Helicomyces torquatus*** Lane and Shearer 1984. Therefore it is assigned to that species.

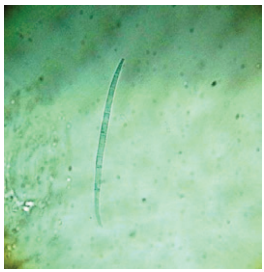

Fig.1

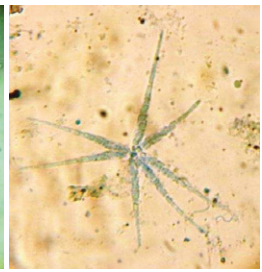

Fig.2

Fig.3

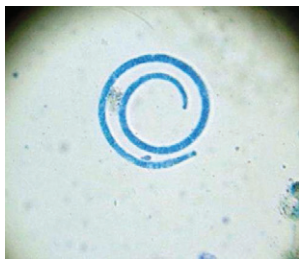

Fig.4

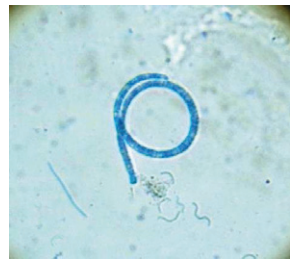

Fig.5

1) ***Aquaphila albicans*** Goh, K.D. Hyde & W.H. Ho
2) ***Flabellospora acuminata*** Descals & J. Webster,
3) ***Flabellospora multiradiata*** Nawawi

4) ***Helicomyces colligatus*** R.T. Moore

5) ***Helicomyces torquatus*** Lane and Shearer

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