1.3.3 Percentage of students undertaking project work/field work/internship (Data for the latest completed academic year) (10)

Programme name	Program Code	List of students undertaking project work/field work/internship	Link to the relevant document
Bacheolor of Science	Botany	101	
Bacheolor of Science	Zoology	207	
Bacheolor of Science	Biotechnology	49	
Bacheolor of Tourism Management	Tourism	60	
Bacheolor of Arts	Geography	94	
PG Diploma	Guidance Counselling and Psychotherapy	28	
	total	**539**	

* To check with SOP if the same student can be counted more than once

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Botany

PAPER -III PRACTICALS

Max. Marks- 80+20
Time- 6 Hrs. (2 Sessions)

Biology and Diversity of Seed Plants, Plant Anatomy and Plant Embryology

1. Describe/compare the given flowers A and B in semi-technical language giving V.S. of flowers, T.S. of ovaries, Floral Diagrams and Floral Formulae. Identify and assign them to their respective families giving reasons. 20
2. Identify, classify and write morphological notes on the given specimens C and D '(from Gymnosperms) 10
3. Cut Transverse Section and prepare a double-stained permanent mount of the given material (from angiosperms/gymnosperms). Identify giving reasons and show it to the examiner. 12
4. Identify, giving the important characters of identification, the spots 1 and 2 (one material/slide each from gymnosperms and embryology of angiosperms). 10
5. Write morphological notes on the specimens E and F (from angiosperms). 10
6. Dissect out the globular/heart-shaped embryo from the given material. 4
7. Note-book, Collection and Collection Report. 12
8. Viva-voce. 12

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SEMESTER-V

Paper-III Practicals : Plant physiology, Biochemistry, Biotechnology, Ecology, & Economic Botany.

Int. Assessment-20
Max. Marks - 80
Time- 6 hrs. (Two Sessions)

1. Devise an experiment to demonstrate the physiological process (as per the list). Perform it and show it to the examiners. 15

2. Comment on the physiological/Biochemistry experiment (Specimen/ set-up / Model / Chart). 10

3. Test for carbohydrates / Proteins / Fats / Peroxidase activity. 5

4. Ecological experiment/Ecological Specimens A & B (as per the list) 10

5. Identify and Classify spots 1, 2, 3, and 4 from the point of view of economic importance and morphology of the plant part used. 20

6. Applied Botany experiment (as per the list). 8

7. Note Book, Collection and field report. 6 + 6 = 12

8. Viva-voce. 10

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Zoology

B.Sc. Part-II

Paper-III :

Guidelines/instructions for practical

Max. Marks : 100

Time allowed : 6 Hours
(2 Sessions M&E)

Note : Following exercises will be set in the examination as per marks assigned for each.

1.	Internal Anatomy – One (exposition, labeled diagram)	:	12
2.	Temporary Mountign – One (staining, identification, sketch)	: 06	
3.	Museum specimens – five (identification, classification)	: 15	
4.	Ecological note – one specimen	:	05
5.	Permanent slides – Three (identification with reasons)	: 09	
6.	Bone – Two pieces (Identification & sketch)	: 10	
7.	Physiology (Two exercises)	: 10	
8.	Field excursion and report	: 08	
9.	Practical record & slides	: 10	
10.	Viva-voce	: 15	

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B.Sc. Part-III

Guidelines/instructions for practical (Paper-III)

Max. Marks : 100
Time allowed : 6 Hours
(2 Sessions M&E)

1.	Chemical analysis of water/soil	:	10 marks
2.	Identification and Classification of specimens (Eight)	:	16 marks
3.	Ecological note on economically important specimen (two)	:	10 marks
4.	Identification of histological and embryological slides with Reasons of identification (Two): feet and beaks of birds	:	8 marks
5.	Identification with reason feet/beaks of birds	:	3 marks
6.	Permanent preparation of histological slides (a) Section cutting and stretching (b) Staining, mounting, (c) identification & sketch	:	18 marks (6,6)
7.	Field Report	:	10 marks
8.	Practical note book	:	10 marks
9.	Viva-voce	:	15 marks

Note: Field report to be submitted alongwith answer books.

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SCHEME OF EXAMINATION W.E.F. 2011-12
B.Sc. (Biotechnology)

Paper No.	Title of Paper	Internal Assessment	Marks	Total Marks	Time
		Ist Year			
		SEMESTER I			
I	Introduction to Biotechnology	10	40	50	3 hrs.
II	Biochemistry I	10	40	50	3 hrs.
		SEMESTER II			
III	General Microbiology	10	40	50	3 hrs.
IV	Biochemistry II	10	40	50	3 hrs.
V.	Practical (Semester I + Semester II)		100	100	3 hrs.
		IInd Year			
		SEMESTER III			
VI	Immunology	10	40	50	3 hrs.
VII	Molecular Biology	10	40	50	3 hrs.
		SEMESTER IV			
VIII	Recombinant DNA Technology	10	40	50	3 hrs.
IX	Bioinformatics	10	40	50	3 hrs.
X	Practical (Semester III + Semester IV)		100	100	3 hrs.
		IIIrd Year			
		SEMESTER V			
XI	Animal Biotechnology	10	40	50	3 hrs.
XII	Plant Biotechnology	10	40	50	3 hrs.
		SEMESTER VI			
XIII	Microbial Biotechnology	10	40	50	3 hrs.
XIV	Practical (Semester V + Semester VI)		100	100	3 hrs.
XV	*Project Work (In House)		50	50	
			Total =	**900**	

*Project work will be carried out during summer vacations after IInd year and project reports will be evaluated by external examiner by viva voce at the end of IIIrd year.

Note: There will be four theory periods per paper per week.

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Bachelor in Tourism Management (BTM) – Course Structure-2014-15

SEMESTER – I

Paper No.	Paper title	Marks	
		Internal	External
*BTM 101	English (Compulsory)	20	80
*BTM 102	Hindi (compulsory)	20	80
BTM 103	Business Environment for Tourism	20	80
BTM 104	Introduction to Tourism	20	80
BTM 105	Tourism Product of India (Natural)	20	80
BTM 106	Tourism Product of India (Cultural)	20	80
TOTAL MARKS		600	

SEMESTER – II

Paper No.	Paper title	Marks	
		Internal	External
*BTM 201	English (Compulsory)	20	80
*BTM 202	Hindi (compulsory)	20	80
BTM 203	Geography of Tourism	20	80
BTM 204	Transport Management	20	80
BTM 205	Tourism Documentation	20	80
BTM 206	Haryana Tourism	20	80
TOTAL MARKS		600	

FIELD TRIP

SEMESTER – III

Paper No.	Paper title	Marks	
		Internal	External
*BTM 301	English (Compulsory)	20	80
BTM 302	Tourism in India	20	80
BTM 303	Hotel Business	20	80
BTM 304	HRM in Tourism	20	80
BTM 305	Computer Applications in Tourism	20+30	50
BTM 306	Communication Skills & Personality Development	20+30	50
FIELD – TRIP REPORT & VIVA-VOCE		100	
TOTAL MARKS		700	

*BTM-English and Hindi in all semester is same as B.A. General (English & Hindi Compulsory)

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SEMESTER – IV

Paper No.	Paper title	Marks	
		Internal	External
*BTM 401	English	20	80
BTM 402	Pilgrimage Tourism	20	80
BTM 403	Principles of Management	20	80
BTM 404	Tourism Marketing	20	80
BTM 405	An Introduction to Travel Agency & Tour Operation Business in India	20	80
BTM 406	Communicative English	20	80
TOTAL MARKS		600	

ON – THE- JOB – TRAINING

SEMESTER – V

Paper No.	Paper title	Marks	
		Internal	External
*BTM 501	English	20	80
BTM 502	Impacts of Tourism	20	80
BTM 503	Accounting for Tourism	20	80
BTM 504	Sustainable Tourism	20	80
BTM 505	Entrepreneurship in Tourism	20	80
BTM 506	International Tourism	20	80
On – the – job training Report & Viva – Voce		100	
TOTAL MARKS		700	

SEMESTER – VI

Paper No.	Paper title	Marks	
		Internal	External
*BTM 601	English	20	80
BTM 602	Tourism Administration in India	20	80
BTM 603	Economics of Tourism	20	80
BTM 604	Adventure Tourism	20	80
BTM 605	Tourist Guiding	20	80
BTM 606	Salesmanship in Tourism	20	80
TOTAL MARKS		600	

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Paper 304 – Introduction to Remote Sensing and Field Survey Report
(Practical)

Maximum Marks: 30
Time: 3 Hours

I - Remote Sensing Practical -15 Marks

Marks Breakup
Exercise = 9
Record book = 3
Viva-voce = 3

Note: There will be four questions in all and candidate has to attempt three exercises.

1. Demarcation of Principal Point, Conjugate Principal point and Flight line on Aerial Photographs – 1 Exercise
2. Determination of Scale of Aerial Photographs – 1 Exercise.
3. Interpretation of Single Vertical Photographs – 1 Exercise.
4. Use of Stereoscope and Identification of Features – 1 Exercise.
5. Identification of Features on IRSID, LISS III imagery (Mark copy of FCC) -1 Exercise.

II Socio-economic Survey and Report Writing -15 marks.

Marks Breakup
Field Survey Report = 10 marks
Viva-voce = 5 marks

Suggested Readings:-

1. John R. Jensen, Remote Sensing of the Environment; An Earth Resource Perspective, Pearson Education, (India Edition) New Delhi, 2009.
2. Lillesand and R.W.Kiefer, Remote Sensing and Image Interpretation, John Wiley and Sons, 1994.

Dr. Jamil Ahmad

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PG DIPLOMA IN GUIDANCE, COUNSELING AND PSYCHOTHERAPY

Scheme of Examination
(From 2018-19)

There shall be three theory papers and one practical-cum-field work of 100 marks each. All the four papers are compulsory.

Paper	Nomenclature	Marks	Time
Paper-I:	GUIDANCE	100	3 Hour
Paper-II:	COUNSELLING PSYCHOLOGY	100	3 Hours
Paper-III:	PSYCHOTHERAPY	100	3 Hours
Paper-IV (i)	PRACTICAL	50	3 Hours
(ii)	FIELD WORK	50	3 Hours

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Paper-IV (ii) Field Work **Max. Marks: 50**

Field Work

To provide hands on experience in acquiring the necessary skill and competency in selecting, administering, scoring, and interpreting psychological tests and treating the individuals suffering from Psychological problems, the candidates need to engage themselves in active training under supervision.

Submission of Psychodiagnostic and Psychotherapy records.

- Four full-length Psychodiagnostic records to be prepared and submitted by the candidate. The records should include a detail clinical history and a discussion on a) rationale for testing b) areas to be investigated c) tests administered (d) test findings and e) Impression.

- Four full-length counseling and Psychotherapy records to be prepared and submitted by the candidate. The records should include a) reasons for interventions (b) short-term and long term objectives (c) type and techniques of intervention used with rationale d) Process of therapy (e) changes occurred during therapy and (e) final outcome.

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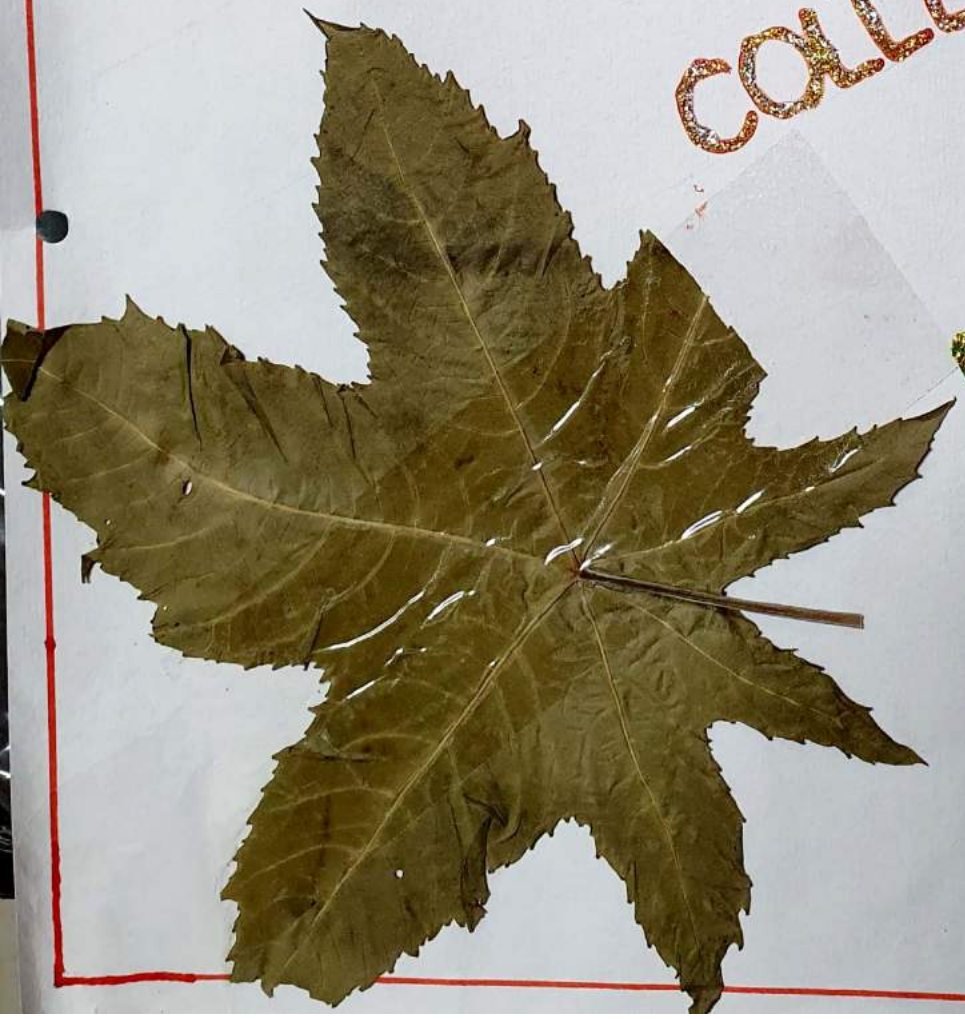
2019-2020

HERBARIUM COLLECTION REPORT



Submitted to :-

1. Dr. Rekha Jangra
2. Dr. Laxmi Biban

Submitted by :-

Deepanshu Bansal
B. Sc. Biotech IInd Year
Roll No. 2143410012

HERBARIUM

Herbarium is a collection of well dried and nicely preserved plants which are carefully identified and arranged according to an approved system of classification. These things may be whole plant or plant part, they will usually lie in dried forms mounted on sheets but depending upon material many also lie kept in alcohol or many lie other preservative. So, based on this collection, it is of two types.

Dry collection

1) Collection of plants
2) Pressing and drying
3) Poisoning
4) Mounting and labelling on herbarium sheets.
5) Storing of herbarium sheets.

Wet collection

1) Collecting of plants
2) Washing with tap water
3) Preservation in bottles filled with formaldehyde acetic alcohol (FAA)

Purpose of Collection of Herbarium.

1) To serve as reference material
2) To provide scientific information
3) To serve as national plant wealth repositaries
4) For the training of graduates in botanical studies.

PROCEDURE OF COLLECTION

Collection of plant specimens includes the specimen type.

1) **Slection** :- Fundomental part of plant collection which need keen and sharp observation of the collector.

2) **Maintainance** :- Maintainance of dry collection specimen which is devoid of any damage and pathological damage is preferred.
Then, the extra part of plant specimen is incised.

3) **Preservation** :- In dry collection the specimen are dried in between the newspapers or blotting paper after the proper stretching any changing the paper.

4) **Identification** :- In the process of identification of dry specimen, first of all we compare the morphological features of plant collection with the aspected plant and assign the proper position of plant collection.

5) **Labelling** :- In dry collection, the dried specimens are firstly placed on neat and clean sheet and labelled as per standars. Labelling is done after the proper identification.

INDEX

No.		Botanical name	Family
1		Ricinus communis	Euphorbiaceae
2		Vicoa radiata	Asteraceae
3		Vicia sativa	Fabaceae
4		Foeniculum vulgare	Apiaceae
5		Leonurus japonicus	Lamiaceae
6		Cenchrus aliasis	Poaceae
7		Saccharus spontaneum	Poaceae
8		Achyanthes aspera	Amarantaceae
9		Roheo discolor	Commelinaceae
10		Rumex crispus	Polygonaceae
11		Cannabis sativa	Cannabaceae
12		Acacia nilotica	Fabaceae
13		Dichanthium annulatum	Poaceae
14		Melilotus indicus	Fabaceae
15		Digera arvensis	Amaranthaceae
16		Cynodon dactylon	Poaceae
17		Lahonopus didymus	Brassicaceae
18		Carthamus spp.	Asteraceae
19		Cirsampelas spp.	Menispermaceae
20		Erigeron spp.	Compositae
21		Phalaris minor	Poaceae
22		Zizipus mauritiana	Rhamnaceae
23		Parthenium hysterophorus	Asteraceae
24		Ageratum conyzoides	Asteraceae
25		Conyza bonariensis	Asteraceae
26		Solanum nigrum	Solanaceae
27		Solanum tuberosum	Solanaceae
28		Malva neglecta	Malvaceae
29		Chenopodium	Amaranthaceae
30		Calotropis	Asclepiadaceae
31		Euphorbia heliascopia	Euphorbiaceae
32		Oxalis corniculata	Oxalidaceae
33		Anagallis arvensis	Primulaceae
34		Xanthium strumarium	Asteraceae
35		Spagneticola	Asteraceae
36		Bougainvillea glabra	Nyctaginaceae

	Botanical Name	Family
	Ocimum basilicum	Lamiaceae
	Bryophyllum pinnatum	Crassulaceae
	Thuja	Cupressaceae
	Dracaena	Asparagaceae
	Psidium guajava	Myrtaceae
	Melia azedarach	Meliaceae
	Dalbergia	Fabaceae
	Araucaria spp.	Araucariaceae
	Dracaena reflexa	Asparagaceae
	Capsicum annum	Solanaceae
	Trigonella foenumgraecum	Fabaceae
	Bauhinia spp.	Fabaceae
	Morus alba	Moraceae
	Ficus religiosa	Moraceae
	Manilkara Zapota	Sapotaceae
	Coriandrum sativa	Apiaceae
	Eucalyptus globulus	Myrtaceae
	Phyllanthus emblica	Phyllanthaceae
	Ficus benghalensis	Moraceae
	Cuminum cyminum	Apiaceae
	Mangifera indica	Anacardiaceae
	Solanum melongena	Solanaceae
	Epipremnum aureum	Araceae
	Dracena	Asparagaceae
	Calliandra haematocephala	Fabaceae
	Albizia	Fabaceae
	Triticum aestivum	Poaceae
	Chrysanthemum	Asteraceae
	Polyalthia longifolia	Annonaceae
	Punica granatum	Lythraceae
	Brassica campestris	Brassicaceae
	Gossypium sp.	Malvaceae
	Syzygium cumini	Myrtaceae
	Citrus limon	Rutaceae
	Capsella bursa	Brassicaceae
	Sonchus	Asteraceae
	Spinacia oleracea	Amaranthaceae

SESSION - 2019-20

Project report of BOTANY

Topic - Agriculture waste management

Submitted to :-

Mrs. Richa gupta

(Botany teacher)

Submitted by :-

Anshul Chauhan
B.Sc - Med - II
0006362669

CERTIFICATE

I, Anshul Chauhan, would like to take this opportunity to sincerely express my gratitude to Mrs. Richa Gupta for her guidence This is to certify that the work presented by Anshul Chauhan, Roll no -0006362669 is project reported entitled as "Agricultural waste management" for the partial fulfillment of the requirement for the degree of Bachelor of Science in Medical at Pt. C.L.S Govt P.G. College, Karnal, Haryana is an authentic record of her work during Semester-6 2018 under the supervision of Mrs. Richa Gupta, Lecturer of Botany department.

1/4/19

INDEX :-


Waste
Management

AGRICULTURAL WASTE MANA-GEMENT :-

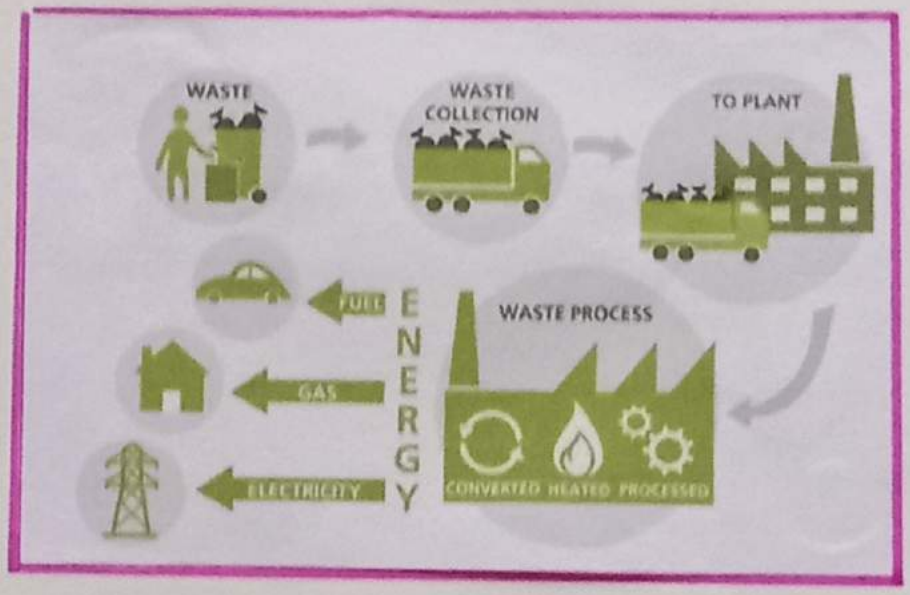
AGRICULTURE :-

- Agriculture waste is composed of organic waste (animal excreta in form of slurries & farmyard manures, spent mushroom compost, salted water & silage effluent)

Include :-

- Natural waste
- Animal waste
- Plant waste

- Agriculture is the largest contributer of any resource sector, to the economy.
- It is also a large generator of waste.
- Agriculture is also called as farming which is the cultivation of animals, plants, fungi & other life forms for food, fibres biofuel, drugs & other product used to sustain & enhance the human life.

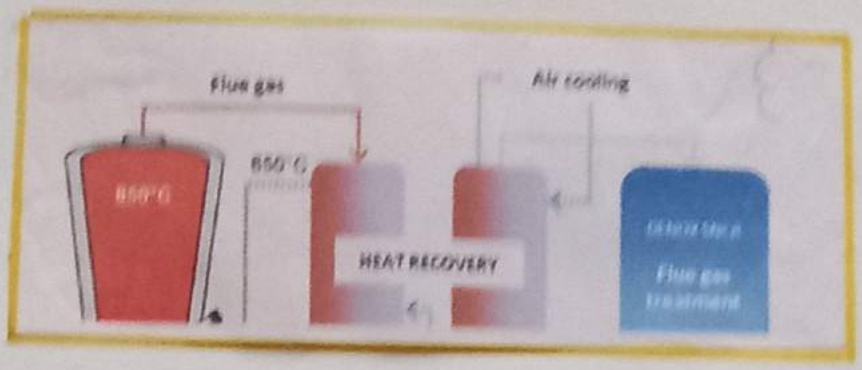

WASTE
WASTE COLLECTION
TO PLANT
WASTE PROCESS
FUEL
GAS
ELECTRICITY
ENERGY
CONVERTED HEATED PROCESSED

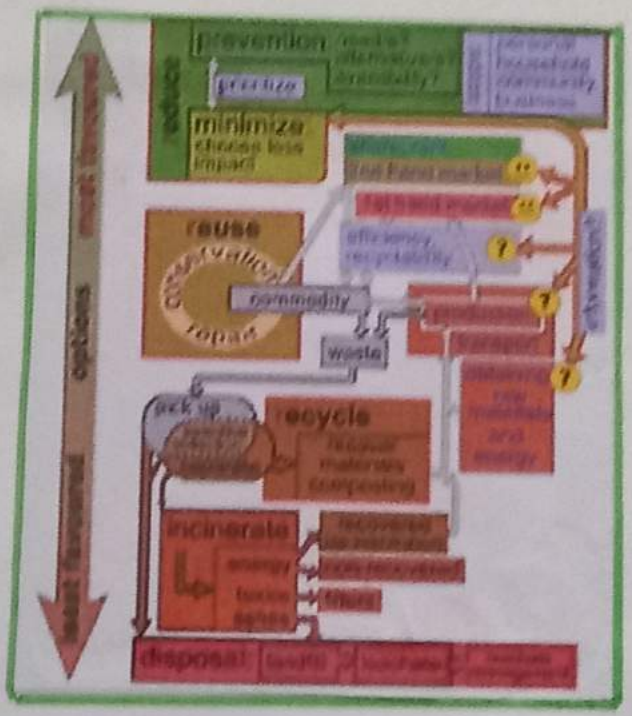
WASTE MANAGEMENT :-

- If wastes are not handled properly, they can pollute surface & groundwater & contribute to air pollution.
- The proper management of waste from the agric-ultural operations can contribute in a significant way to farm operations.
- Waste management helps to maintain a healthy env. for farm animals & can reduce the need for commercial fertilizers which providing other nutrients needed for crop production.
- The waste which is reduce, recycle & make it usable for different purpose is a waste mangement.

MANAGEMENT PROCESSES :-

- Source
- Generation
- Collection
- Transportation
- Treatment processes
- Disposal


Flue gas
Air cooling
850°C
850 °C
HEAT RECOVERY
Flue gas
treatment

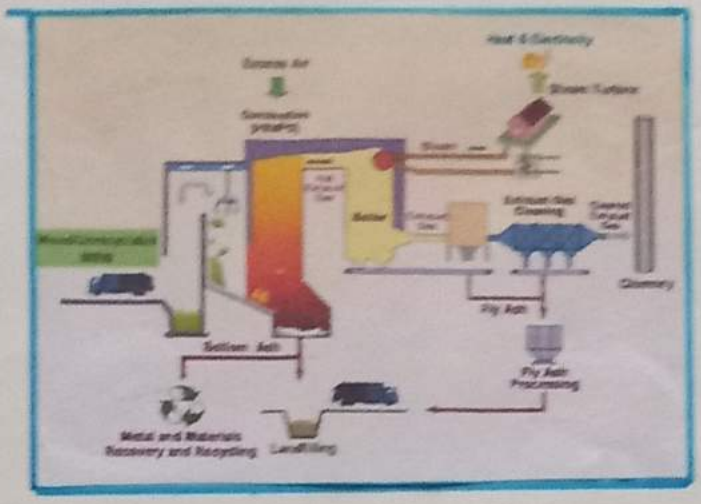

prevention
minimize
reuse
commodity
waste
recycle
incinerate
disposal

COLLECTION :-

- Waste like fruit & vegetable waste are collected from house, called domestic waste.
- Waste collected from road, street or side.
- Collected waste like dry, refuse & green waste, animal dung from agricultural field.

TRANSPORTATION PROCESS :-

- Waste collected from the side of roads, agricultural field all are transported to decomposed site & further treatment by trucks, trailer, carts.
- Different type of waste are collected & then transported for further treatment & the waste which is not used is directly disposal to the sanitary land.
- Waste are not burn in open air so it is transported to incineration.


Heat & Electricity
Steam Turbine
Boiler
Chimney
Fly Ash
Bottom Ash
Fly Ash Processing
Metal and Materials Recovery and Recycling
Landfilling

2. DECOMPOSITION

Waste is decomposed by three ways :-

- Nadep system
- Vermiculture decomporition
- Anaerobically decomporition

LANDFILL :-

- A landfill site (rubbish dump or dumping ground) is a site for the disposal of waste material by burrial have been most common method.
- Some land fills are also used for waste management purpose, such as sorting, treatment or recycling.

SANITARY LANDFILL :-

- Waste is compacted.
- Covered with soil
- When disposal site has reached its capacity. a final layer of 2 ft is applied.


UMass Amherst RECYCLES
SINGLE STREAM GUIDELINES
BOTTLES/ CANS
YES!
METAL
PLASTIC
GLASS
PAPER
MIXED PAPER
YES!
HAZARDOUS WASTE
ALL IN ONE BIN
FOOD WASTE
PLASTIC BAGS


Waste recycling
INFOGRAPHIC

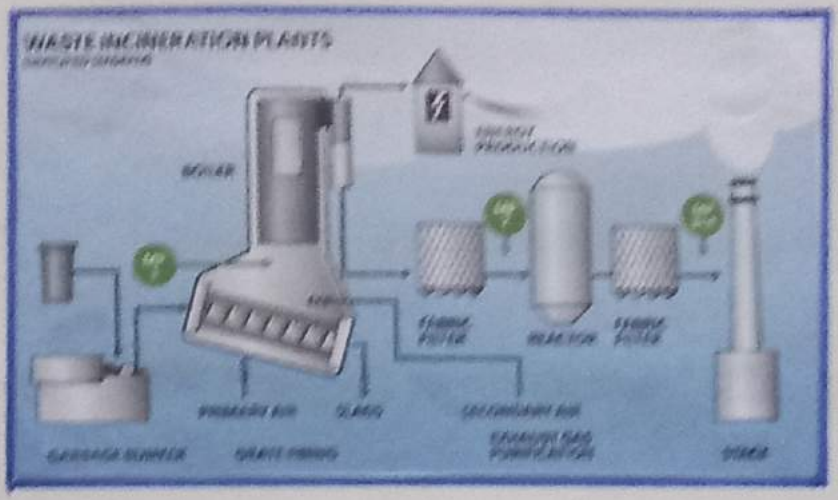
2. AGRICULTURAL WASTE RECYCLING

Tradebe operates state of the art plastic recycling facilities that accept a wide range of plastics & polymers from all types of businesses across the UK.

The plastic recycling process at our facilities involves cleaning, shredding & pelletising for onward use.

- Tradebe parent company of Avant Environmental Automotive Waste Services, is the largest recycler of automotive waste in the UK
- Solid waste material may be spread out over the soil surface, usually on pastures.

Earthworms are important contributor to the burial & decomposition of the waste material.


WASTE INCINERATION PLANTS


Drawbacks of Improper Agro-Waste Management

3. INCINERATION :-

- Incineration is a modern & most hygienic method of disposal of dry refuse.
- It is widely used in western countries, like USA, UK. etc & in India this is gradually popular especially for large cities.
- The method consist of burning the dry refuse in incinerator.

CONCERN ABOUT AGRICULTURAL WASTE MANAGEMENT :-

- If is not managed properly, agricultural waste can pollute the environment.
- The degradation of waste quickly can impact adjacent water ways & ground water both onsite & offsite.
- The degradation reduces the ability of their resources to support aquatic life & creates for human & animal consumption.
- Nitrates can found in fertilizers & agricultural waste runoff, can seep into ground water.

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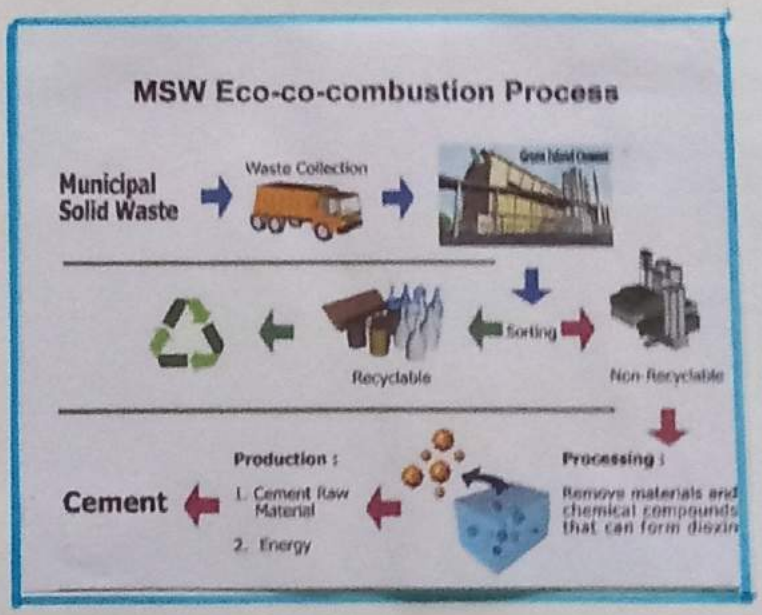
GetWell
Guide
Your One-Stop for Wellness


MSW Eco-co-combustion Process
Municipal Solid Waste
Waste Collection
Sorting
Recyclable
Non-Recyclable
Production :
1. Cement Raw Material
2. Energy
Cement
Processing :


GetWell
Guide


MSW Eco-co-combustion Process
Municipal Solid Waste
Waste Collection
Recyclable
Non-Recyclable
Production :
Cement
Processing :

BENEFITS OF AGRICULTURAL WASTE MANAGEMENT :-

- The reuse of animal waste in farming operations can reduce the quantity & having costs of commercial fertilizers.

- The contribution of animal waste increases the organic matter content of soils, which increases nutrient availability for crops & improves the water holding capacity.

- Good waste management reduces the instances of water contamination & minimizes surface the water pollution.

IMPLEMENTING WASTE MANA-GEMENT STRATEGIES:

① Set diversion & disposal targets for solid waste

② Promote waste reduction & reuse - Eg- through public education & promotion of material exchange facilities & programs.

③ Provide educational resources on recycling practice & service.

④ Work to expand & enhance collection service.

⑤ Ban recyclable waste from the landfill, in the conjunction with enhancing recycling service.

⑥ Work with adjacent / regional governments to develop shared solutions.

BSC.MEDICAL 2nd YEAR
NAME:-MANOJ KUMAR
ROLL NO:-2162310021

ACKNOWLEDGMENT

I would like to express my special thanks to my zoology teacher (PARVEEN SIR and SUVIDHA MAM) as well as our principal who gave me the golden opportunity to do this wonderful report on the topic (COMMON BIRDS),which also helped me in doing a lot of research and I came to know about so many birds.

1. HOUSE CROW
2. RUFOUS TREEPIE
3. BLACK DRONGO
4. LONG-TAILED SHRIKE
5. LARGE GREY BABBLER
6. PURPLE SUNBIRD
7. OUSE SPARROW
8. WIRE-TAILED SWALLOW
9. BLACK-BREASTED WEAVER
10. GREY HERON
11. INDIAN POND HERON
12. CATTLE EGRET

1. House crow

- Kingdom:Animalia
- Phylum:Chordata
- Class:Aves
- Order:Passeriformes
- Family:Corvidae
- Genus:*Corvus*
- Species:***C. splendens***
-

General Characteristics

- Corvus species are all black with little white or grey plumage
- They are stout with strong bills and legs
- Sexual dimorphism is limited
- Crows are large to very large, robustly built birds, with tails that are short or medium length
- The tail are primary feathers are stiff. The bill varies in shape from species to species, but is relatively long, although it can be stout or slender

2. Rufous treepie

- Kingdom:Animalia
- Phylum:Chordata
- Class:Aves
- Order:Passeriformes
- Family:Corvidae
- Genus:*Dendrocitta*
- Species'. ***vagabunda***

General characteristics

- The sexes are alike and the main colour of the body is cinnamon with a black head and the long graduated tail is bluish grey and is tipped in black.
- The wing has a white patch. The only confusable species is the grey treepie which however lacks the bright rufous mantle
- The bill is stout with a hooked tip
- A long and stiff-tailed bird with primarily rusty-brown upperparts and dull organish under parts.
- The desert from is paler and called pallida

3. Black drongo

- Kingdom:Animalia
- Phylum:Chordata
- Class:Aves
- Order:Passeriformes
- Family:Dicruridae
- Genus:*Dicrurus*
- Species:***D. macrocercus***

General characteristics

- Black drongo has glossy blue-black or green-black plumage, with semi-translucent primaries visible in flight
- Adults usually have a small white spot at the base of the gape and the iris is dark brown in colour
- The tail is long and deeply forked, and curves out at the end of outer tail feathers
- It is an black bird with a distinctive forked tail and measures 28 cm (11 in) in length
- It feeds on insect

4. Long –Tailed Shrike

- Kingdom:Animalia
- Phylum:Chordata
- Class:Aves
- Order:Passeriformes
- Family:Laniidae
- Genus:*Lanius*
- Species:***L. schach***

General characteristics

- The long-tailed shrike is a typical shrike, favouring dry open habitats and found perched prominently atop a bush or on a wine
- The dark mask through the eyes is broad and covers the forehead in most subspecies and the whole head is black in subspecies tricolor and nastus
- Adults have a dark mask and a light gray upper back with a variable amount of orange on lower back.
- Long-tailed Shrike has dark grey head and mantle and chestnut back and rump. Wings are blackish and small white primary patches, conspicuous in flight

5. Large Grey Babbler

- Kingdom:Animalia
- Phylum:Chordata
- Class:Aves
- Order:Passeriformes
- Family:Leiothrichidae
- Genus:*Argya*
- Species:***A. malcolmi***

General characteristics

- The species is found in small flocks which keep in contact with loud nasal calls.
- They are mostly seen in open scrub country where they forage on or close to the ground.
- They feed mainly on insects but also feed on small lizards , moluscus and arachnids
- They also feed on seeds , grains and berries
- They are known to breed through the year but mainly during the rainy season from March to September

6. Purple Sunbird

- Kingdom:Animalia
- Phylum:Chordata
- Class:Aves
- Order:Passeriformes
- Family:Nectariniidae
- Genus:*Cinnyris*
- Species:***C. asiaticus***

General characteristics

- This small sunbird has a relatively short bill, a dark and short square ended tail with distinctive sexual dimorphism
- Less than 10 cm long they have a down-curved bill with brush –tipped tubular tongues that aid in nectar feeding
- They have a fast and direct flight and can take nectar by hovering like a hummingbird but often perch at the base of flowers
- The males can appear all black in harsh sunlight but the purple iridescence is visible on closer observation or under good light conditions

7. House sparrow

- Kingdom:Animalia
- Phylum:Chordata
- Class:Aves
- Order:Passeriformes
- Family:Passeridae
- Genus:*Passer*
- Species:***P. domesticus***

General characteristics

- The House Sparrow is a stout, stocky sparrow with shorter legs and a thicker bill than indigenous American sparrows
- Members of both sexes are brown backed with black streaks throughout this area
- Its underside is pale buff. Males have white cheeks and a black bib, while females do not
- Large aggregations around buildings produce annoying noise and large quantities of feces

8. Wire-Tailed Swallow

- Kingdom:Animalia
- Phylum:Chordata
- Class:Aves
- Order:Passeriformes
- Family:Hirundinidae
- Genus:*Hirundo*
- Species:***H. smithii***

General characteristics

- The wire-tailed swallow is a small swallow, measuring 18 cm (7.1 in) in length
- It has bright blue upperparts, bright white underparts and a chestnut cap
- Immature birds lack tail wires, and have dull brown caps
- A very distinctive swallow with two long, thin feathers on its outer tail from which it gets its name

9. Black-Breasted Weaver

- Kingdom:Animalia
- Phylum:Chordata
- Class:Aves
- Order:Passeriformes
- Family:Ploceidae
- Genus:*Ploceus*
- Species:***P. benghalensis***
-

General characteristics

- The male in breeding plumage has a brilliant golden-yellow crown and a variable amount of black on the head and breast
- Some males have a entirely black head and breast, while others have a white throat or an entirely with face with a black
- It is polygynous and colonial, and on the whole similar to that of the baya and streaked weavers
- Male construct the nest single-handedly with a group of females visiting it during late construction stage, jumping on the helmets, tugging and testing , presumably for strength

10. Grey Heron

- Kingdom:Animalia
- Phylum:Chordata
- Class:Aves
- Order:Pelecaniformes
- Family:Ardeidae
- Genus:*Ardea*
- Species:***A. cinerea***
-

General characteristics

- The grey heron is a large bird, standing up to 100cm (39 in)tall and measuring 84-102cm (33-40in)long with a 155-195cm (61-77in)wingspan
- The plumage is largely ashy-grey above, and greyish-white below with some black on the flanks
- Adults have the head and neck white with a broad black supercilium that terminates in the slender, dangling crest, and bluish-black streaks on the front of the neck
- The scapular feathers are elongated and the feathers at the base of the neck are also somewhat elongated

11. Indian Pond Heron

- Kingdom:Animalia
- Phylum:Chordata
- Class:Aves
- Order:Pelecaniformes
- Family:Ardeidae
- Genus:*Ardeola*
- Species:***A. grayii***

General characteristics

- They appear stocky with a short neck, short thick bill and buff-brown back
- In summer, adults have long neck feathers. Its appearance is transformed from their dull colors when they take to flight, when the white of the wings makes them very prominent.
- It is very similar to the squacco heron Ardeola ralloides, but is darker-backed
- During the breeding season, there are records of individuals with red legs.

12. Cattle Egret

- Kingdom:Animalia
- Phylum:Chordata
- Class:Aves
- Order:Pelecaniformes
- Family:Ardeidae
- Genus:***Bubulcus***
- Species:***B. ibis***

General characteristics

- It is a white bird adorned with buff plumes in the breeding season
- It nests in colonies usually near bodies of water and often with other wading birds
- The nest is a platform of sticks in trees or shrubs
- Cattle egrets exploit drier and open habitats more than other heron species

Pt. Chiranji Lal Sharma Govt.
College, Karnal

ZOOLOGY REPORT
ON
FISH FARM VISIT

Submitted to

Dr. J.S. Chillar

Submitted by
Ghanishta
Roll No-1403220041
B.Sc. Biotech final year

Certificate

This is to certify that "Ghanishta" is student of class B.Sc. Biotech final year has successfully completed the project on fish farm visit under the guidance of "Dr. Jainder Singh Chillar". This project is absolutely genuine.

Dr. Jainder Singh Chillar
Dept. of Zoology

Acknowledgement

I would like to express my deepest appreciation to all those who provided me the possibility to complete this report.

A special gratitude I gave to our subject professor Dr. Jainder Singh Chillar whose contribution in stimulating the suggestion and encouragement helped me to coordinate the project report in writing.

Gharishta
B.Sc Biotech VIth Sem

Topic _____ Date _____

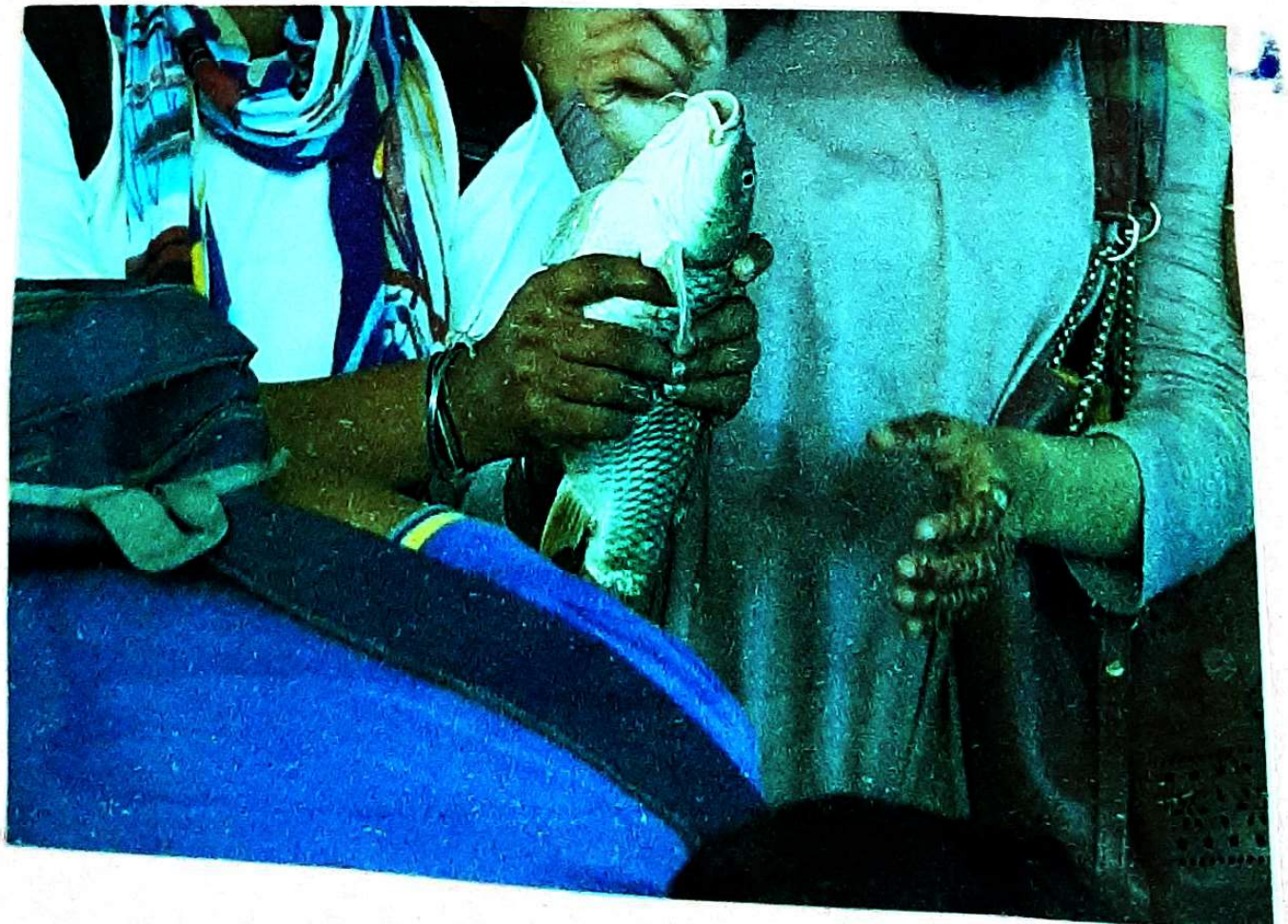
Objectives for visit to Sultan Fish Farm

- To gain knowledge of fish farming/pisciculture
- To know about Induced Breeding in fishes
- To see various stages in development and production fishes ie spawn, fry, fingerlings and yearlings.
- To know about management of waste material in aquaculture.
- To study various fishing crafts.
- To study various fishing gears.

About Sultan Fish Farm

Sultan fish farm is situated in village Butana It covers area of about 29 acres. It is very reputed fish farm in India

In 1984, Mr. Sultan Singh was I^st person in Haryana and also in the whole North India to establish this farm on scientific scales & brought blue revolution in Haryana. Sultan Singh fish farm consists of a fish hatchery covering about two acres of the farm. There are two large ponds



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situated in centre & in right side, there are three stocking ponds present. Three nursery ponds are also present anterior to breeding pool. This farm mainly cultures ÷

Indian carps ÷

Rohu (Labeo rohita)
Catla (Catla catla)
Mrigal (Cirhinus mrigala)

Recently he has been awarded with Padam Shri award.

Aquaculture

It is also known as aqua farming and include farming of aquatic animals such as fishes, crustaceans, molluscs etc. Aquaculture involves cultivating fresh water and marine water organisms in controlled way

Fish culture

Fish farming includes the cultering of fishes in a provided space.

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In Sultan Fish Farm, fish seed or spawn is allowed to grow by providing artificial environment. When they grow & become adults then they are allowed to reproduce. It is done by two method which are as follows :-

1. Natural Breeding :-

It includes the reproduction in fishes by means of natural ways. During breeding seasons, fishes are allowed to breed naturally & thus collecting their spawn & by providing proper nutrition they are grow

2. Induced Breeding :-

It is the technique of collecting eggs & milt by inducing desired fish at desired time by mechanical or chemical means.

Modern method of induced breeding primarily forces on using pituitary intract that stimulates natural breeding conditions.

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Techniques of Induced Breeding :-

1. Stimulation of natural breeding conditions :-

a) Change in water
b) Using specific light & temprature condition
c) Using flowing or rippling water
d) Using specific sites for egg laying & attachment
e) By simulating natural breeding (rainy) sedson.

2. Hypophysation :-

This method involves preparing pituitary extract in organic solvent from a donar fish & injecting it into desired breeder fish.

a) Selection of donar fish :-
- Donar fish should be fully mature
- It should be of same species as of breeder.
- Preferably living or well preserved fish

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b) Use of Pituitary Hormone :-

Pituitary hormone extract is obtained biologically from fishes are chemically in lab.

Now-a-days, it is easily available in market. This pituitary extract can be stored by use of freezing acetone or 1-1. glycerine.

(c) Selection of Breeders :-

Successful induced breeding process requires sufficient stock of good breeders. Healthy mature fish (2-4 years of age, 2-4 kg in weight) of medium size are selected after the beginning of monsoon. A fully mature male releases melt on gently pressing its abdomen while a fully mature female has soft, rounded, bulging, reddish abdomen

d) Injection to Breeders :-

The breeders are caught with drag net or hand net, the male & female are identified & seggregated & kept in a moist & cool water containes inside hand net

The dose of pituitary extract depends on size & maturity of recipient fish.

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Injection	Male	Female
I^st injection	No injection if melt ooze out on touching abdomen or 1-3 mg/kg of body weight	2-3 mg/kg of body weight
II^nd injection	2-3 mg/kg of body weight	5-8 mg/kg of body weight

→ Spawning occurs within 3-6 hours of 2nd injection
→ The injections can be given Intramuscular or Intraperitonial

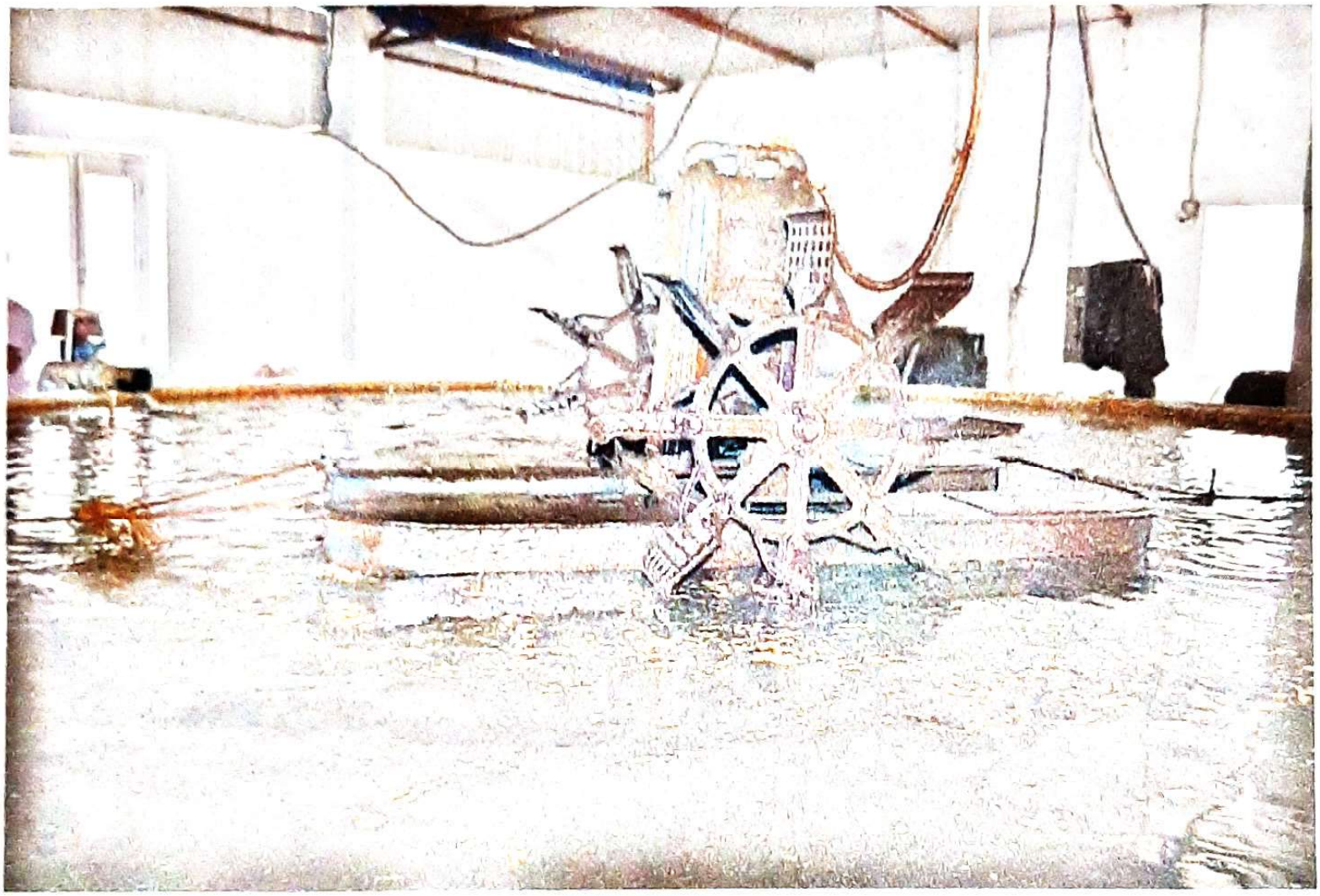
Breeding Hapa :-

It is a rectangular cage made up of fine mesh cloth having dimensions 1 x 1.5 x 3 m.

It is fixed in water by firmly tying to 4 bamboos. It should not touch the bottom of water body & should project out upto 15-20 cm. Injected breeders are introduced into hapa and flap is closed.

Spawning :-

The breeders spawn



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about 3-6 hours after 2nd injection & eggs swell up in water. Fertilized eggs appear transparent & pearl like white unfertilised eggs are opaque and white

Polyculture

Stocking of cultivated fishes of different species that differ in their feeding niche & habitat niche in same water body is called Composite fish culture or Polyculture or Mixed fish farming.

Principle behind polyculture :-

When several species belonging to different ecological niches are cultivated together, the available food & space has optimum utilisation increasing productivity

Objectives of polyculture :-

- All available niches are fully utilised.
- The fishes don't harm each other.
- No competition among different species
- Proper utilisation of food
- Increased production 5 to 8 times.

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Polyculture in India

Polyculture of Indigenous / native / resident Major carps

(i) Catla catla - surface feeder, zooplankton feeder

(ii) Labeo rohita - column feeder feeding on algae, macrophytes & decaying plants.

(iii) Cirrhinus mrigala - bottom feeder consuming decaying plants and detritus

Exotic Carps :-

(i) Cyprinus carpio - omnivorous, scavenger

(ii) Grass carp (Ctenopharyngodone idella) - feed on macrovegetation

(iii) Silver carp / Chinese carp - feed on phytoplankton

Process of Fisciculture

Fisciculture involves following steps :-

(i) Collection, transport & introduction of fish seed.
(ii) Caring of hatchlings
(iii) Nursing of fry
(iv) Rearing of fingerlings
(v) Production of marketable fish
(vi) Harvesting of the crop.

(i) Fish seed :-

Procurement of fish seed is the first requirement of fish culture. Fish seed is a commercial term used for fertilised ovum & other development stages of young fish seed :-

a) Natural source b) Artificial source

(ii) Caring of Hatchlings :-

Spawn is transferred into Hatching Hapa. Eggs of Indian carps hatch in 14-20 hours after fertilisation at 21-40°C. Hatching releases tiny 4-5 mm young ones called Hatchlings. They escape the inner hapa & grow undisturbed in outer hapa for 3 days.

Hatchlings are collected on 3rd days counted & transferred into Nursery pond.

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(iii) Transport of Spawn & Fry :-

Spawn and fries are transported in air light metal containes with oxygen 50,000 fries can be transported in 20-25 litres of water. For long distance transport, water is changed at intervals.

(iv) Nursing of fries :-

The young fries are nursed in nursary pond for about 15 days The nursary ponds should have high growth of phytoplanktons before hatchlings are stocked. Where they become 25-30mm long fingerlings then they can be collected so transferred to rearing ponds.

The fingerlings are conditioned before transport

(v) Production of fish for marketing :-

Two months old fingerlings can be used to stock rearing / stocking ponds for mono polyculture.

3000-4000 fingerlings per acre is the stocking density of stocking or rearing ponds. The fishes are allowed to grow for 6 months to 2 years depending on whether

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the fish has to be sold in market for food or needs to be matured

The fish between 1½ Kg - 6 Kg varies in length from 1½ feet - 3½ feet are marketable based on the economy. Usually in Haryana the fishes are collected & sold between 6 months - 1 years

(vi) Harvesting & Marketing :-

Catching of fish from a stocking pond for marketing is called Harvesting. Matured fish fitch poor price so harvesting should be done within 1st year of stocking

Fishes are caught during morning hours using drag net & fishes less than 1 feet are released back.

Depending upon the fish farm the collected or harvested fish is either sent to the market to be cold or is processed, packaged & then exported.

Optimization of substrate for production of edible mushroom *'Pleurotus florida'* (Oyster)

A

PROJECT REPORT SUBMITTED TO THE DEPARTMENT OF BIOTECHNOLOGY

Pt. CLS GOVT. COLLEGE

FOR THE DEGREE OF

BACHELOR OF SCIENCE

IN

BIOTECHNOLOGY

Supervisor:

Dr. Vikas

Pt. CLS GOVT. P.G. COLLEGE

Submitted by:

Ghanishta

Roll:-1403220041

B.Sc. III[rd]

DEPARTMENT OF BIOTECHNOLOGY

Pt. C.L.S. GOVT. COLLEGE, KARNAL

Pt. CLS GOVT. College, Karnal

Ref No……

Dated……..

CERTIFICATE

This is to certify that Miss Ghanishta has completed her project report entitled **"Study of edible mushroom *Pleurotus florida* (Oyster)"** under my supervision and guidance and has submitted it to Pt. CLS GOVT. COLLEGE, Karnal for the award of the Degree of Bachelor of Science in Biotechnology. The report is an original research work and fit for evaluation for the award of B.Sc. degree of Biotechnology.

Head of Deptt.

(Dr. Sarla)

Supervisor

(Dr. Vikas)

Acknowledgement

At first I wish to thank the almighty for giving me powers to complete my entire course and project report.

I am pleased to acknowledge my sincere thanks to ***Dr. Sarla, Assistant Professor and Head of Department of Biotechnology, Pt. CLS GOVT. COLLEGE, Karnal*** *for her valuable suggestions, encouragement and a very cooperative attitude towards me throughout the research work.*

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It gives me immense pleasure to mention names of my classmates whose constant help and collective efforts have been reflected in the completion of this venture. I would also like to express my sincere thanks to ***Dr. Priyanka, Dr. Ranjeet*** **and** ***Dr. J.S. Chhillar*** *helped me during my project work.*

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(Ghanishta)

Contents

Chapter-1

Introduction

CLASSIFICATION:

Kingdom **Fungi**

Phylum **Basidiomycota**

Class **Agaricomycetes**

Order **Agaricales**

Family **Pleurotaceae**

Genus ***Pleurotus***

Species ***florida***

1.1. Background information:

Mushrooms, also called 'white vegetables' or 'boneless vegetarian meat' contain ample amounts of proteins, vitamins, fibers and medicines. Mushroom contains 20-35% protein (dry weight) which is higher than those of vegetables and fruits and is of superior quality. It is considered ideal for patients of hypertension and diabetics. Mushroom offers prospects for converting lignocellulose residues from agricultural fields, forests into protein rich biomass. Such processing of agro waste not only reduces environmental pollution but the byproduct of mushroom cultivation is also a good source of manure, animal feeds and soil conditioner. Mushroom has a huge domestic and foreign market. There are exporters in the market who are willing to supply the spawn (seed material) and also buy the dried mushrooms. Mushrooms with their flavor, texture, nutritional value and high productivity per unit area have been identified as an excellent food source to alleviate malnutrition in developing countries (Eswaran & Ramabadran 2000). The practice of mushroom cultivation not only produces medicinal and nutritious food but also improves the straw quality. This takes place by reducing lignin, cellulose, hemicelluloses, tannin and crude fiber content of straw making it ideal for animal feed (Ortega et al.

1992). Oyster mushroom (***Pleurotus sp***.) belonging to Class Agaricomycetes and Family Pleurotaceae is popularly known as **'kanye chyau'** in Nepal and grows naturally in the temperate and tropical forests on dead and decaying wooden logs or sometimes on dying trunks of deciduous or coniferous woods. It may also grow on decaying organic matter. The fruit bodies of this mushroom are distinctly shell or spatula shaped with different shades of white, cream, grey, yellow, pink or light brown depending upon the species. It is one of the most suitable fungal organisms for producing protein rich food from various agro-wastes or forest wastes without composting.

1.2. History: Empirical cultivation of ***Pleurotus*** started around 1917 in Germany, using natural spawn for inoculation of wood logs and stumps. The first large-scale cultivation on logs was achieved in Hungary in 1969. Later, a variety of lignocellulosic by-products from agriculture or forestry were also found to be good growing substrates, and several species were brought into cultivation throughout the world, such as the tree oyster (***P. ostreatus***), the gray oyster mushroom (***P. sajor-caju***), the abalone mushroom (***P. cystidiosus***), the white oyster mushroom (***P. florida nomen nudum***), the golden oyster mushroom (**P**. ***citrinopileatus***), the pink oyster mushroom (***P. flabellatus***), and the black oyster mushroom (***P sapidus***.). At present, ***Pleurotus spp***. is the second most important cultivated mushroom in terms of world production. Oyster mushroom has been widely cultivated in many different parts of the world. It has abilities to grow at a wide range of temperatures utilizing various lignocelluloses (Sánchez, 2010). Oyster mushroom cultivation was introduced in Nepal in 1981. Research on the proper substrate and climatic condition for oyster mushroom growing was carried out by the division of plant pathology. Growing ***Pleurotus* sajor-*caju*** on stump and chopped paddy straw packets was Mushroom successful in Kathmandu in 1982. The technology, which was distributed to farmers in 1984, was so simple, easy to adopt and suitable to the climatic of Kathmandu valley that farmers could adopt it quickly. The cultivation practices, which produced quick returns, spread like wildfire. Poor farmers were willing to try mushroom growing on a small scale in order to augment their incomes .The growing of the species ***P. osteratus*** was introduced later in 1988. Oyster mushroom are often grown without any environmental control. ***P. sajor-caju*** is cultivated for the summer crop at Kathmandu valley (25-30 ºC and 80% RH) and in hills of Nepal while it is cultivated in terai regions during winter season (22-26ºC and 70% RH).of, course the oyster mushroom cannot be grown in terai during the summer (30-40ºCand 70% RH). The midhills of Nepal are the most appropriate areas for oyster

mushroom production and therefore the mushroom technology has been expanded widely in those villages. In context of Nepal along with ***Pleurotus sajor*-caju** other species of **Pleurotus** cultivated are ***Pleurotus nepalensis, Pleurotus ostratus*** and ***Pleurotus circinatus***.

1.3. Biological description: Oyster mushrooms are cosmopolitan, and belong to the genus Pleurotus (Fungi: Basidiomycetes). Their cap is normally shell-like (about 5-20 cm in diameter; 1.9-7.8 inches), fleshy, with eccentric or lateral stipe; and their color can be white, cream, yellow, pink, brownish, or dark gray. As primary decomposers having the ability to degrade lignocellulose, oyster mushrooms (***Pleurotus spp***.) are found growing in the wild on dead organic matter from tropical and temperate regions. Several species are also capable of acting as parasites of living trees, and attacking nematodes or bacterial colonies. ***Pleurotus sajor-caju*** (grey oyster mushroom) is comparable to the high temperature species in the group of ***Pleurotus*** (oyster) mushrooms, with high temperatures required for fructification. This mushroom has a promising prospect in the tropical/subtropical areas. Its cultivation is easy with relatively less complicated procedures. The temperature for growth of mycelium is 10- 35oC. The optimum growing temperature of the mycelium is 23-28°C. The optimum developmental temperature of the fruiting body is 18-24oC. The optimum pH of the substrate used in making the mushroom bag/bed is 6.8-8.0. The C: N ratio in the substrate is in the range of 30-60: 1. A large circulation of air and reasonable light are required for the development of the fruiting body. .

1.4. Life cycle: ***Pleurotus*** mushrooms show the typical life cycle of Basidiomycetes, a major fungal group. It begins with the germination of a basidiospore in a suitable substrate, which gives rise to a monokaryotic mycelium containing genetically identical nuclei (n) and capable of indefinite independent growth. When two compatible monokaryotic mycelia are in close contact, they are able to establish a fertile dikaryon by hyphal fusion or plasmogamy. This dikaryon (n+n), having clamp connexions and binucleate in each hyphal compartment, contains two genetically different nuclei (one from each monokaryon) throughout the mycelium. When environmental conditions are appropriate (temperature, light, relative humidity), the dikaryotic mycelium will differentiate into fruit bodies having specialized structures called basidia. In these club-shaped, binucleate cells, which are formed in the lamellae (hymenium) of each fruit body, karyogamy (fusion of the paired nuclei; 2n) and meiosis (recombination and segregation) take place. The four

resulting haploid nuclei move to the sterigmata on the basidium, to form four new basidiospores. When the fruit bodies are mature, basidiospores are discharged, starting the sexual life cycle again.

1.5. Production: Oyster mushrooms are the third largest cultivated mushroom. China, the world leader in Oyster production, contributes nearly 85% of the total world production of about a million tonnes. The other countries producing oyster mushrooms include Korea, Japan, Italy, Taiwan, Thailand and Phillipines. The present production of this crop in Nepal is low due to low domestic demand.

1.6. Economic Importance The economic importance of the mushroom lies primarily in its use as food for human consumption. It is rich in Vitamin C and B complex and the protein content varies between 1.6 to 2.5 percent. It has most of the mineral salts required by the human body. The niacin content is about ten times higher than any other vegetables. The folic acid present in oyster mushrooms helps to cure anemia. It is suitable for people with hyper-tension, obesity and diabetes due to its low sodium: potassium ratio, starch, fat and calorific value. Alkaline ash and high fibre content makes them suitable for consumption for those having hyperacidity and constipation. A polycyclic aromatic compound pleurotin has been isolated from ***P. griseus*** which possess antibiotic properties. The spent straw can be re-cycled for growing oyster mushroom after supplementing with wheat or rice bran @ 10-15 % and also for preparing compost of white button mushroom after suitable supplementation with nitrogen rich horse or chicken manure (sun-dried before use). The spent straw can be used as cattle feed and also for bio-gas production, the slurry can be used as manure.

1.7. Nutritional and medicinal attributes: The protein content of oyster mushrooms can be considered as their main nutritional attribute. Average values ranging from 10.5-30.4%, on a dry weight basis, have been reported. The concentration of essential amino acids varies from 33.4-46.0 grams/100 grams of corrected crude protein, showing significant amounts of lysine, leucine, and methionine. The fat content reported is 1.1-2.2% on a dry weight basis, having a high proportion of unsaturated fatty acids (79.3%). The carbohydrate content varies from 46.6-81.8% on a dry weight basis. Main vitamins present in 100 g dry weight of oyster mushrooms are thiamine (1.16-4.80 mg), niacin (46.0-108.7 mg), and ascorbic acid (7.4 mg). Fiber (7.4-27.6% on a dry weight basis), and minerals (potassium, phosphorus, iron, copper, zinc) are also present in good

proportion. Several compounds from oyster mushrooms, potentially beneficial for human health, have been isolated and studied:

1) Polysaccharides showing strong antitumor activity,

2) A lectin called pleurotolysin with hemolytic properties, and

3) Extracts with hypotensive action on renal functions.

Mushrooms have been part of fungal diversity for around 300 million years ago. The word

Mushroom been derived from the French "mousseron", "mousse" or moss known by several names viz. puffballs, morels and truftles (Ramsbottom, 1953). In India, mushrooms vernacularly known as 'Khumbhi', 'Chhatra', Kukurmutta', 'Dhingri', Dharti Ka Phool etc. Mushrooms are the member of higher fungi, which lack of chlorophyll i.e., they can't utilize solar energy to manufacture their own food as green plants. However, mushroom can produce a wide range of enzymes that degrades complex substrate on which they grow, following which they absorb the soluble substrate for their own nutrition. The term mushroom is broadly defined as a macro fungus with a distinctive fruiting body which can be either epigeous or hypogenous and large enough to be seen with the naked eye and to be picked by hand (Chang and Miles, 1993). Taxonomically mushrooms belong to phylum Basidiomycotina and Ascomycotina (Alexopolous et.al., 1996). They occur naturally and seasonally in various habitats and nicks all over the world. The Mushrooms comprise a large heterogeneous group having various shapes, sizes, colour, all quite different in character, appearance and edibility. Out of this large group, with more than 2000 edible species, about 300 species belonging to 70 genera as reported from India. However, only a few have been brought under cultivation on commercial scale.

Out of 200 species of prime edible mushrooms, about 80 have been grown , 20 cultivated commercially and six namely ***Agricus bisporus***, ***Lentinula edodes***, ***Pleurotus***, ***Auricularia***, and ***Volvariella*** produced on industrial scales (Chang and Miles, 1991) and thus called as big six mushrooms. Of these, the ***Pluerotus*** mushroom is generally referred to as '**Oyster mushroom'** all over the world. In India it is commonly known as Dhingri mushroom. It has gained importance only in the last decade and is now cultivated in many countries in the subtropical and temperate zones. 3 ***Pleurotus*** has gained its name from the Greek world "***Pleuro***" which means formed laterally or in a side way position, referring to the lateral position of the stipe in relation to pileus

(C.L. Jandaik 1997). The world '**Oyster'** refers to the oyster like appearance of the fruiting bodies. According to the systemic position, ***Pleurotus*** belongs to the Phylum **Basidiomycota**, Class **Basidiomycetes**, Order **Agraricales** and Family **Pleurotaceae** (Tricolomataceae), (Kirk et. al., 2001). In the nature species of ***Pleurotus*** are generally found as saprophytes, growing on dead and decaying part of wood. However, the first attempt to grow this fungus for human consumption was made by Falck (1971) in Germany.

The process of cultivation on readily available substrates was taken up earlier in India on paddy straw (Bano and Srivastava, 1962) and in Japan on saw dust (Schanel et.al., 1966). This attracted attention of a number of researchers all over the world and today various species of ***Pleurotus*** are appreciated for their culinary attributes and broad adoptability under varied agro climatic conditions. China has become an enormous producer and consumer of cultivated edible mushrooms and also a major producer of medicinal 4 mushrooms. Total production of China in 1997 was 3.910 million tones which amount to 63.6% of the total world output. However, in India, mushroom production started in 1960's. In the year 1985 total mushroom production were only 4000 tones, which reached to 30,000 tons in 1995. Further it was increased to 70,000 tons in 2004. The states involved in mushrooms production in India are Tamilnadu, Maharashtra, Punjab, Haryana, Uttaranchal, U.P. and Andhra Pradesh. Presently China is largest producer of mushroom worldwide and Italy is after China according to latest survey of 2018.

Mushrooms have been consumed as a part of normal diet from thousands of years due to their nutraceutical and pharmaceutical nature. Mushroom relatively higher in good quality protein, low in total fat, higher in poly unsaturated fatty acid, enriched with large amount of carbohydrates, valuable amount of fibers, significant amount of water, soluble vitamins such as thiamine B1, riboflavin B2, niacin, biotin, ascorbic acid, vitamin C and mineral such as potassium, phosphorus, sodium, calcium and magnesium (Manning, 1985 and Rai, 1997).

Unlike other cultivated species of mushroom, genus ***Pleurotus*** exhibit much diversity in their adaptability to varying agro climates and this flexible nature provide much more cultivated species in this genus than any other cultivated mushroom genus. In recent years, industrial use of oyster mushroom for conversion of agriculture and industrial wastes into feed and food has gaining popularity. It has high gastronomic value. The oyster mushrooms ***Pleurotus florida*** is a well-known edible fungus. It is being taken up for commercial cultivations different parts of the world.

There is a great potential for increasing mushroom production in the country because of favorable climatic condition, unemployment of abundant supply of cheap labor and availability a wide range of substrates, considerably reduces production cast. The great advantage is that they are easy to cultivate & have cast rate of growth also got the capacity to cover nutritional value substrate substances into height protein food.

The simple technique of growing ***Pleurotus florida*** with vital substances like proteins, mineral matter & important vitamins, on this context, the present investigation were undertaken with the following objective:

1. Production of spawn culture on wheat grains

2. Cultivation & harvesting of the ***Pleurotus florida*** on wheat straw, rice straw and dry leaf

Observation: Various medicinal value and nutritional value Of ***Pleurotus florida.***

Chapter-2

Review of Literature

Consumption of mushrooms by man probably predates recorded history; however, the historical records of the cultivation of several important mushrooms are well documented and reviewed by Chang and Miles (1987). In nature they can be found growing during rainy seasons in fields, pasture land, on wooden logs and other decaying plant remains including cow dung. ***Auricularia auricula***, as per existing records, is the first mushroom to be cultivated in China around 600 A.D., while, ***Flammulina velutipes*** was reported to be grown since 800-900 A.D., ***Lentinula edodes*** around 1000-1100 A.D., ***Volvariella volvacea*** around 1700 and ***Tremella fuciformis*** around 1800. Commercially important mushrooms like ***Agaricus bisporus*** (button) was first cultivated in France in caves during the period 1550-1650 (Atkins, 1981) and ***Pleurotus ostreatus*** (oyster) on wooden stumps around 1900 (Zadrazil, 1978).

Mushroom can be defined as a macro fungus with a distinctive fruiting body, which can either be epigeous or hypogenous. And, the macro fungi have fruiting body large enough to be seen with naked eye (Chang, 1991). Misconceptions about mushrooms are exceedingly very common and they have been regarded as nature's curiosity. Although mushroom cultivation was thought to be very simple till the mid of 20th century, since then it has grown into a lucrative business involving hi-tech environment controlled agro industrial units especially for uninterrupted round the year production of button mushrooms, the most important commercially grown variety that constituted 34.8% of global mushroom produced in 1997 (Chang, 1999). And in 2002 the total global production of mushroom was 12.25 million tons (Chang, 2006) where buttons still holds the dominant position followed by oyster mushroom and shiitake; the position of oyster mushroom was 6^{th} in 1975 (Sharma, 1997). A modern cultivation involves a number of different aspects including development of fruiting culture and mushroom seeds the spawn, preparation of substrate the compost, as well as the crop management, harvesting and marketing. However, cultivation of the shiitake (***L.edodes***), straw mushroom (***V.volvacea***) and oyster mushroom (***Pleurotus spp***) mostly as a cottage industry can be treated as a primitive type of farming in the South East Asian countries , that still continues as a rural technology thereby generating self-employment in the rural sector.

2.1 *Pleurotus*, *Basidiomycetes*:

The basidiomycete's fungi are highly evolved group of fungi with septate hyphae and lacks defined sexual stages. They are divided in two groups, the heterobasidiomycetes and the homobasidiomycetes. Most of the homobasidiomycetous fungi have two distinct phases in their life cycle. These fungi, during their vegetative growth phase (spawn run) and fructification phase (formation of basidiocarps) have been demonstrated to display a wide range of biosynthetic and bio degradative activities, a composite of complex anabolic and catabolic reactions (Zadrazil, 1978). They have a unique capacity to grow on a wide spectrum of lingo cellulosic wastes, some are typically called as brown-rot species and others are white rot types, however all being cellulolytic in nature. The later to which ***Pleurotus*** belongs are also called as ***lignicolous*** species that have the ability similar to ***Phanerochaete chrysosporium*** to preferentially degrade lignin thereby exposing cellulose that can be utilized as nutrients (Agosin et al., 1985 & Sharma et al., 1999). Fungi belonging to genus ***Pleurotus*** produce fruiting bodies, the basidiocarps that are popularly called **oyster mushroom** because of characteristic shape of their fruiting bodies with an eccentric stalk attached to the pileus that opens up like an oyster shell during fruiting body formation. They are white to variously coloured and enjoy worldwide distribution in nature from temperate to tropical regions, in the temperature range of 10°C to 32°C (Zadrazil, 1978).

The genus ***Pleurotus*** comprises of over two dozen species most of which are wood-rotting saprophytic fungus, a few may be parasitic e.g. ***P. eryngii*** can live as a parasite on the roots of plants of family **Ammeaceae** (Zervakis et al., 2001). The edible fungus ***P. ostreatus*** has been the representative oyster mushroom, the most important commercially produced species (Eger, 1976 & Marino et al., 2003). P. sajor-caju, ***P. eous*** and ***P. pulmonarius*** are the most adaptive species with a very wide growing temperature 15-30°C whereas most of the strain of ***P. ostreatus*** require colder temperature (12-20°C), while species like ***P. florida***, ***P. columbinus, P. sapidus, P. djamor***, ***P. flabellatus, P. citrinopileatus*** etc exhibits an intermediate range and is popular in our country, reviewed by Rajarathnam et al. (1992). P. sajor-caju, isolated by Jandaik in 1974 as a saprophyte on the stumps of ***Euphorbia royleana*** growing in the foothills of the Himalayas (India) is another species that has become very popular (Rajarathanam et al., 1987). Similarly, ***P. flabellatus***, a white, attractive oyster mushroom was reported earlier by Bano et al. (1978). ***P. abalone*** is another saprophytic fungus, cultivated in the Republic of China (Zadrazil,

1978), and since than many more species have been described that are popular in different parts of the globe. Oyster mushroom has been considered as specialty mushroom in many parts of the world including US and Canada. China is the largest producer of oyster mushroom contributing 70.6% to the world produce (Chang, 2006) while India produces about 100,000 tons of mushrooms out of hardly 10% is contributed by the oyster (Rai, 2007).

Basidiomycetous mushroom fungi including ***Pleurotus*** species are heterothallic self-sterile with a bifactorial tetra polar inheritance system governed by two unlinked multi-allelic loci coding for transcription factors and pheromone-receptors due to which thousands of genotypes can be contemplated to exist in nature (Salmones et al., 1997 & Larraya et al., 2001). The generation of enormous diversity results in their high chances of adaptability, selectivity, and survivability. They have two broad mycelial phases in their life-history: the monokaryotic and dikaryotic conditions of mycelia, the later can be distinguished by the presence of clamp connections that are characteristics of dikaryons. Clamp connections are hook-shaped structures involved in equal sorting of nuclei to the daughter cells produced by mitosis during the growth of dikaryotic mycelia at hyphal tips. ***Coprinus cinereus*** and ***Schizophyllum commune***, representing homobasidiomycetes have been used as model organisms to study mating systems in mushroom fungi having bifactorial mating system (Larraya et al., 1999).

2.2 Habitat and biodiversity:

Pleurotus species comprises of white rot fungi that are known to colonize different types of agricultural and industrial wastes (Ragunathana et al., 2003) are widespread globally in various eco-geographic zones. The concept of the morphological species is dominant in the field of fungal taxonomy; most fungi are classified using morphological characteristics. However, morphological characteristics of higher fungi are inconsistent and unstable criteria because they are far more strongly influenced by the climate, cultivation substrate, and environmental conditions (Bresinsky et al., 1976). As a result, different taxonomists have drawn different conclusions regarding the taxonomic status of the same taxon based on morphological characters.

2.3 Life-cycle:

Basidiomycetes represent the highly evolved group of the fungi that have two distinct phases, in their life-cycle the vegetative phase, represented by the mycelium, and the reproductive phase, represented by the fruiting bodies (basidiocarps). A typical basidiocarp has a cap called pileus and a stalk called stipe, resulting from a thick intertwining of dikaryotic mycelium. The stipe may have a ring at its distal end called the annulus as present in ***Agaricus*** or a basal cup termed the volva, as in the case of ***Volvariella*** or both of these structures may be absent, as in ***Pleurotus***. Both the annulus and the volva are characteristically found in species of Amanita the well-known poisonous mushroom; Smith (1978) has described the morphological features and structural details of these fruiting fungi. The stage proceeding from spore to spore i.e. the life-cycle are elaborate in most of the species, involving diverse nuclear segregation and aggregation, with the objective of favouring out breeding, resulting in the generation of innumerable variants and offering greater chance for natural selection and successful survival.

As per Raper (1978) and Kües et al., (1992) nine steps constituting a typical life-cycle is reproduced below:

i. Germination of basidiospore initiates.

ii. A haploid homokaryotic mycelium capable of indefinite, independent propagation develops. This primary mycelium may or may not go through an asexual cycle via the production of oidia or chlamydospores. Mating between two compatible homokaryotic mycelia through hyphal fusion may occur.

iii. Plasmogamy takes place that establishes the fertile mycelium, the dikaryon. Even the broad acceptance of this idea, mating compatibility tests have been used to evaluate the taxonomic identity of fungal species classified by morphological characters. However, different workers have not only identified varying number of intersterility groups in ***Pleurotus*** ranging from 3 to 12 depending upon the geographical region, as reviewed by Bao et al. (2004), but in some cases the same „species" has been placed in different intersterlity groups e.g. ***P.florida*** has been placed separately (Zervakis and Balis, 1996 & Bao et al., 2004).

Therefore, many questions about the taxonomy of ***Pleurotus spp*** still remain unresolved (Boidin, 1986; Zervakis and Balis, 1996 & Bao et al., 2004).

iv Dikaryon represents the heterokaryotic phase with conjugate division. The dikaryotic mycelium is capable of independent and indefinite propagation and may or may not go through a sexual cycle via the production of oidia or chlamydospores. If sexual spores are produced they are uninucleate resulting in generation of homokaryotic mycelia of the parental types. Under suitable environmental conditions, the dikaryons produce the basidiocarps.

v The fruiting body finally develops as an outgrowth of specialized tissue.

vi The spore-bearing tissue of the fruit body develops as a columnar layer of club-shaped, binucleated cells termed the basidia

vii. Fusion of the paired nuclei of the two parental mating types i.e. karyogamy establishes the diploid nucleus in a single cell stage.

viii. Meiosis, which follows immediately, involves recombination and segregation of the parental genetic material, ultimately resulting in the production of four haploid nuclei each of which moves to the tip of stalk-like structure, the sterigma, on the basidium, results in the formation of four uninucleate basidiospores exogenously per basidium.

ix. The spores when discharged undergo mitotic division that lead to basidiospore germination, the point at which the life cycle is reinitiated. The characteristic life cycle of the homobasidiomycetes starts with the germination of the basidiospore, a meiospore, to give rise to a primary homokaryotic (monokaryotic) mycelium. By fusion of two cells of two different but compatible primary hyphae a secondary mycelium called the dikaryon is formed. During the subsequent growth of dikaryons, division of two nuclei takes place in a highly synchronized fashion so that two genetically distinct, haploid nuclei are maintained per new hyphal compartment. One daughter nucleus of the pair of dividing nuclei migrates in to a clamp cell formed laterally on the hyphal tip cell. A septum is then formed in the spindle plan between the hypha and clamp cell, and another septum emerges between the other pair of dividing nuclei, more distantly of located from the hyphal tip. As

a result of this, two genetically distinct nuclei are situated in the apical hyphal cell; the two remaining nuclei being trapped in the clamp and sub-apical cell. By fusion of the clamp to the sub-apical cell, the dikaryotic nuclear distribution is restored. Dikaryotic mycelium is capable of undergoing sexual development. Karyogamy, the subsequent meiosis, and basidiospore formation occur within specialized cells, called basidia, which are borne by fruit bodies in case of homobasidiomycetes.

2.4. Sexuality in Basidiomycetes:

Sexual reproduction enables organisms to shuffle two parental genomes to produce recombinant progeny and to purge the genome of deleterious mutations. Sex is conserved in virtually all organisms, from bacteria and fungi to plants and animals, and yet the mechanisms by which sexual identity are established share both conserved general features and are remarkably diverse. In fungi, a specialized region of the genome, known as the mating type locus, governs the establishment of cell type identity and differs in DNA sequence between cells of different species.

2.5. Nutritional values:

Mushrooms are considered a staple food in the diet of some cultures, they are usually considered for their flavour, nutritional, medicinal and condiment value. Varying opinions have been expressed regarding the true nutritive value of edible mushrooms. Research conducted suggests mushrooms to be a nutritionally sound food that are of greater value to vegetarians. For thousands of years the fructification of higher fungi has been known as a source of food (Mattila et al., 2001). The first species obtained in this way was ***A.* bisporus** (Lange) sing (Grzbowski, 1978), although Chinese have reported to started cultivating paddy straw mushroom around mid of 17th century.

The chemical composition of edible mushroom determines their nutritional value and sensory properties. That differs according to species but also varies as per the substratum, atmospheric conditions, age and part of the fructification (Shah et al., 1997 & Manzi et al., 2001). Owing to their taste, flavour, nutritional value and unique texture (Shah et al., 1997 &

Mattila et al., 2001), edible mushrooms are commonly used in home cooking and in catering (Kubiak, 2001). They can be successfully used as appetizers in marinated form and also as an ingredient in soups, sauces, salads, stuffing's and meat dishes (Achremowicz et al., 1983). Mushrooms also contain many mineral salts and vitamins, particularly of the B and some D groups (Mattila et al., 2001). 100 g of fresh mushrooms contains 5.3-14.8 g of dry matter, 1.5-6.7 g of carbohydrates, 1.5-3.0 g of protein and 0.3-0.4 g of fat. Mushrooms are also rich in mineral constituents, particularly potassium, phosphorus and magnesium with low amount of sodium. Recently, Dundar et al. (2009) have made a comprehensive study of effect of various substrate on the chemical composition and nutritional values of ***P.ostreatus***.

2.5.1 Carbohydrates:

Mushrooms are non-photosynthetic organisms therefore, sugars, carbohydrates are present in lower proportions than vegetables such as carrots and sprouts, and so provide only a fraction of the energy requirement. Of the dry matter constituents of mushrooms, carbohydrates were found in the greatest amounts, constituting 16-85 g/100 g dry matter (Blumenthal, 1976). Whereas, in 100 g of fresh edible parts of ***P. ostreatus*** (Jacq.: Fr) Kumm. Manzi et al. (2001) reported 3.8-6.7 g and Ortíz et al. (1992) found 53.0 g of carbohydrates in 100 g dry matter. Polymeric carbohydrates that occur include glycogen and chitin or "fungus cellulose", a polymer of N-acetyl glucosamine, the structural component of the fungal cell wall. Chitin is not easily digestible and is considered to be the major constituent of the fiber content. Fungal cell wall contains many other large carbohydrate polymers such as glucans, chitosans and manosans, these polymers are linked together with covalent bonds that cannot be attacked by our digestive enzymes. Therefore, it is suspected that humans cannot utilize a large percentage of the mushroom carbohydrate in mushrooms as nutrients and so it functions only as roughage. Due to high content of water and low calorific value, edible mushrooms are regarded as dietetic food. According to Manzi et al. (2001), the content of dietary fibre is 4.1 in 100 g fresh weight of ***P. ostreatus*** (Jacq.: Fr) Kumm. Glucans (Homo- and hetero-glucans) with glycoside bonds β (1→3), β (1→4) and β (1→6) occurring in mushrooms are regarded as healthful constituents.

2.5.2 Proteins:

Mushrooms have fairly high protein content, typically 20-30% crude protein as a percentage of dry matter. High protein content makes them an ideal food because they contain all the amino acids essential to human nutrition. There are about eight essential amino acids (EAA), that is, those which cannot be produced by the human body, and so must be consumed in the diet daily. Mushroom protein appears to be intermediate in nutritional qualities between meat and vegetable proteins. Some species like ***P. eous*** provide nutritive value comparable to that of meats and milk, but ***P. ostreatus***, due to low protein content, and deficiency in some essential amino acids has a low nutritive value (Bano and Rajarathnam, 1982). Proteins are important component of dry cholesterol (Hu et al., 2006). In 100 g fresh matter of ***P. ostreatus*** (J Kumm). The content of fatty compounds was reported to be 0.4 g (Manzi et al., 2001) and 1.8 g in 100 g dry matter (Shah et al., 1997).

2.5.3 Mineral constituents:

The fructifications of mushrooms are characterized by high levels of well assailable mineral constituent (Mattila et al., 2001) whose level depends on the species and age of the mushrooms, the diameter of the pilei and on the substratum (Demirbas, 2001). The content of ash in edible fungi varies from 5 to 13 g per 100 g dry matter (Watanabe et al., 1994). The content of ash is 0.9 g. Whereas Shah et al. (1997) found the highest content of ash in a bisporus (Lange) Sing., 9.2 and the lowest in ***V. volvacea*** (Bull. Fr.) Sing., 5.1g/100 g dry matter.

2.5.4. Vitamins:

There are many essential vitamins required daily in our diet. Mushrooms are important sources of vitamins especially of group B particularly thiamine, riboflavin, pyridoxine, pantothenic acid, nicotinic acid, nicotinamide, folic acid and cobalamin, other vitamins, such as ergosterol, biotin and tocopherols are also present (Mattila et al., 2001). Vegetarians are aware of that mushrooms are one of the best plant-based sources of niacin around the world and 100 g of fresh mushrooms provide more than a quarter of the adult daily requirement of this vitamin. Mushrooms are unique in that they contain vitamin B12, something that is not present in vegetables. Since B12 is mainly of animal origin, deficiency is commonly associated with vegetarian diets. Mushrooms were found to contain 0.32-0.65 mg of B12 per g, allowing just 3 g of fresh mushrooms to provide the RDA of this vitamin. Vegetarians may find this a useful way of getting this important nutrient. Vitamin

A is uncommon although several mushrooms contain detectable amounts of pro-vitamin-A measured as the β-carotene equivalent. Most cultivated mushrooms are believed to contain low amounts of the fat soluble vitamins, K and E, and only a small of vitamin C as detailed below (Bernas et al., 2006) different mating types (Fraser and Heitman, 2004).

2.6. Medicinal Properties:

A number of mushroom species are known to possess medicinal properties where Ganoderma, king of medicinal mushrooms, and Lentinula, are the most important genera (Chang, 1996). ***Pleurotus*** species have shown a number of therapeutic activities, such as antitumor, immunomodulatory, antigenotoxic, antioxidant, anti-inflammatory, hypocholesterolemia, antihypertensive, antiplatelet-aggregating, antihyperglycemic, antimicrobial and antiviral activities are detailed below.

2.6.1 Antitumour activity:

Recently expects of ***Pleurotus spp*** have been shown to contain polysaccharides, proteins and other substances that possess anti neoplastic activities in invitro and in invivo studies (Gu et al., 2005). Methanol extracts of ***P. floridae*** and ***P. pulmonarius*** fruiting bodies significantly reduced solid tumours in mice (Jose and Janardhanan, 2000 & Jose et al., 2002). Among the components of such extracts, polysaccharides are well-documented as potent antitumor and immuno modulating substances (Zhang et al., 2007). Many polysaccharides from ***Pleurotus spp*** have been isolated and identified (Carbonero et al., 2006) to have antitumor activities, have been shown. ***P. tuber*** regium polysaccharides, extracted from mycelium and fruiting bodies, effectively inhibited solid tumor proliferation in mice, and polysaccharides exerted from ***P. tuber*** regium also show antitumour activity, through cytotoxicity and antiproliferative activity, against human leukemia cells through in vitro studies.

2.6.2 Immunomodulatory and anti mitogenic activities:

The antitumor effects of mushrooms are mostly attributed to stimulation of the immune response. Recently, several compounds from ***Pleurotus*** species with immunostimulatory activities on humoral and cell-mediated immunity have been isolated. Water soluble polysaccharides extracted from ***P. citrinopileatus*** fermentation broth administered to mice resulted in a significant increase in the number of macrophages, T, CD4+ and CD8+ cells (Wang et al., 2005). Glucans isolated from P ***.floridae*** fruiting bodies activated the phagocytic response of mouse macrophages in vitro (Rout et al., 2005) and significantly induced the proliferative response as well as phagocytic activity of fish leukocytes in vitro (Kamilya et al., 2006). Antimitogenic effects of Pleurotus spp derived compounds on immune cells have also been reported. A ribonuclease isolated from P.sajor-caju fruiting bodies exerted antiproliferative effect on murine splenocytes (Ngai & Ng, 2004), while eryngeolysin from ***P. eryngii*** inhibited the stimulated mitogenic response of murine splenocytes (Ngai & Ng, 2006).

2.6.3 Antioxidant and gene protective activities:

Antioxidant compounds prevent oxidative damage related to aging and diseases, such as atherosclerosis, diabetes, cancer and cirrhosis. Mushrooms that contain antioxidants or increase antioxidant enzyme activity may be used to reduce oxidative damage in humans (Yang et al., 2002). Of 89 mushroom species tested, an extract from ***P. cornucopiae*** possessed the most effective antigenotoxic and bio-antimutagenic activities when tested on ***Salmonella typhimurium*** and Escherichia coli (Filipic et al., 2002). Furthermore, ***P. cornucopiae*** extracts significantly reduced H2O2-induced DNA damage in Chinese hamster lung cells (Bohi et al., 2005) and *P. ostreatus* extract mitigated genotoxicity, as shown by the fact that it suppressed DNA damage induced by various mutagens in the Drosophila DNA repair test (Taira et al., 2005). On the other hand, a water extract of ***P. sajor-caju*** fruiting bodies had no Genoprotective effects since it did not prevent H2O2induced oxidative damage to cellular DNA (Shi et al., 2002)

2.6.4 Anti-inflammatory activity:

Pleurotus spp has been shown to possess anti-inflammatory activity by exerting antioxidant and immunomodulatory effects on rats with induced colitis (Bobek and Galbavy, 2001). Hypersensitive immune responses, such as inflammation in delayed allergy, were suppressed by an ethanol extract of ***P. eryngii***. It exhibited anti allergic activity after oral or percutaneous

administration to mice with oxazolone induced type IV allergy (Sano et al., 2002). 2.7.5 Cardiovascular disease protection and antihyperglycemic activities: Oyster mushrooms possess bioactive compounds with hypocholesterolemic activities, such as polysaccharides, mevinolin and other statins (Gunde-Cimerman and Plemenitas, 2001). It has recently been reported that P.citrinopileatus fruiting body extracts exerted antihyperlipidemic effects. Serum triglyceride and total cholesterol levels were lowered in hyperlipidemic rats supplemented with the extracts, while high-density lipoprotein levels were significantly increased (Hu et al., 2006). Similar effects were noted by them with powdered ***P. ostreatus*** fruiting bodies or a water-soluble polysaccharide extracted from ***P. citrinopileatus*** fermentation broth.

2.6.5 Antimicrobial activity:

Antibacterial and antifungal activities have been observed in ***Pleurotus spp*** extracts and isolated compounds, presumably produced as a defense mechanism against other organisms (Ngai & Ng, 2006).

2.6.6 Antiviral activity:

Mushrooms contain substances that exert direct or indirect antiviral effects as a result of immunostimulatory activity (Brandt and Piraino, 2000), Inhibitory activity against human immunodeficiency virus (HIV)-1 reverse transcriptase has recently been demonstrated for ***P. sajor-caju*** and ***P. pulmonarius*** hot water extracts (Wang et al., 2007). Anti-HIV activity was also demonstrated for an ubiquitin like protein isolated from ***P .ostreatus*** fruiting bodies (Wang et al., 2000). Moreover, (Grigori., 2007) demonstrated that, in contrast to water-insoluble β-glucans isolated from ***P. tuber-regium sclerotia***, their corresponding water-soluble sulphated derivatives exert antiviral activities against herpes simplex virus type 1 and type 2. The effect is presumably elicited by the binding of sulphated β glucans to viral particles, thus preventing them from infecting the host cells.

2.7. Other Bio potentialities:

Besides producing oyster mushrooms ***Pleurotus spp*** have gained additional global importance due to their other biopotentialities explored during the last three decades. The increased agro-industrial activities have led to the accumulation of a large quantity of lignocellulosic residues and many agrochemicals all over the world. Many of ***Pleurotus*** species are primary decomposers of hardwood trees and are found worldwide. Due to presence of nonspecific oxygenases they are being used in the in situ degradation of many xenobiotics, phenolics, colouring pigments in effluents etc.

2.7.1 .Bioconversion of agricultural wastes:

Right from harvesting, processing and consumption of agricultural products a huge quantity of agrowastes are generated which often create disposal problem. Besides cereal and other crop wastes agro industrial units also produce huge quantities of wastes e.g. the citrus processing plants produce 50,000 tons per year of citrus bagasse which represents 40-50% in weight of the fresh fruit (Alborés et al., 2008). The composition of citric bagasse is relatively adequate for the feeding of ruminants, however, it has palatability problems in additional to being contaminated with normal flora of the rinds, some of which are mycotoxin producers (Alborés et al., 2008). Rice straw it is obtained at the rate of 2000 kg per harvested hectare (310,000 ton of straw per year); and although it is used in the feeding of ruminants, it has a very low protein content and low digestibility. It is now well accepted that some fungi, particularly some species of ***Pleurotus*** has the ability to upgrade cattle feed by colonizing different types of crop/vegetable wastes thereby increasing their digestibility through delignification (Rajarathnam et al., 1992, Adamovic et al., 1998 & Salmones et al., 2005). Efforts to detect lignin peroxidase activity or lignin peroxidase genes in ***P. ostreatus*** have been unsuccessful and instead ***P .ostreatus*** has been shown produce laccase, a copper-containing phenol oxidase that degrades lignin (Platt et al., 1984).

Later, Sannia et al. (1991) suggested that a lignin metabolism significantly different from that reported for other white rot fungi may exist in at least some species of fungi. Laccase (EC 1.14.18.1) is an extracellular phenol oxidase produced by many basidiomycetes and has an important role in lignin biodegradation (Higuchi, 1990 & Sanjdr and Baldrian, 2007). 2.8.2 Degradation of organopollutants: The ability of ***Pleurotus spp*** for the bioconversion of agro-wastes is due to the presence of non-specific oxygenases, are also being explored in bioremediation

efforts. This includes degradation of chlorinated mono-aromatics and BTEX compounds (Buswell, 2001), as well as in the biodegradation of other xenobiotic compounds (Morgan et al., 1991), in the purification of air, water and soil, in the cleanup of contaminated soils and in the treatment of industrial effluents (Reid et al., 2002).

2.7.2 Production of enzymes for industrial importance:

Enzyme production is a growing field of biotechnology. Annual world sales figures are close to billion dollars (Layman, 1990) with increasing number of patents and research articles related to this field. Most enzyme manufacturers produce enzymes using submerged fermentation techniques with enzyme titers in the range of grams per litre (Periasamy and Natarajan, 2004). Filamentous fungi have a number of properties, which make them important both scientifically and industrially. Fungi play a key role in Solid State Fermentation (SSF) for their hyphal development and allow them to selectively colonize and penetrate the solid substrate (Reid, 1989 & Villas-Boas et al., 2002). ***Pleurotus spp*** grows on lignocellulosic substrates that are rich in cellulose, hemicellulose and lignin contents. To utilize these substrates ***Pleurotus*** mycelium has the ability to secrete various extracellular lignolytic enzymes, viz. laccase, lignin peroxidase, manganese peroxidase and aryl alcohol oxidase (Upadhyay and Fritsche, 1997).

Laccase is an extracellular enzyme produced by the white-rot fungi which is capable of reducing the toxicity of phenolic compounds through a polymerization process (Field et al., 1993). It is a polyphenol oxidase from fungi, which can use oxygen to oxidize different types of aromatic molecules and to form lignin type of aromatic polymers from phenolic compounds. ***Pleurotus***, grow very well both in the submerged and solid state fermentations. They produce both laccase and cellulase in submerged and solid state fermentation. Higher levels of laccase and cellulase activity were seen in solid state fermentation than in submerged fermentation. The results clearly explain that ***Pleurotus spp*** are potential candidates for the production of industrially important enzymes using cheap raw materials like agro-wastes.

2.7.3. Nematicidal activities:

The involvement of toxins by ***Pleurotus*** to kill nematodes through their inactivation and their eventual colonization in their nematode host has been shown by Barron & Thorn, (1987).The hyphae of this organism has been shown to enter the body orifices of the victim nematode finally penetrating through the orinces and colonize there to digest the victim. ***Pleurotus*** methods of capturing and consuming nematodes are more common than currently known. Such nematophagus behavior is interpreted as a strategy of these fungi to supplement the low levels of nitrogen available in wood and other substrates by capturing nematodes (Stadler et al., 1994). Earlier three antimicrobials metabolites oligosporon, oligosporol a, oligosporol B were isolated by Stadler et al. (1993) from the culture filtrates of ***Arthrobotrys oligospora***. Similarly, trans-2-decenedioic acid was isolated as a weakly nematicidal compound from cultures of ***P.ostreatus***, which in high concentration immobilized ***Panagrellus redivivus*** within an hr (Kwok et al., 1992). The nematicidal compounds formed by ***P.pulmonarius*** are also fatty acids namely linoleic acid and scoriolic acid (Stadler et al., 1994). Sharma et al. (2002) has studied the dynamics of nematophagus activities of 8 species of ***Pleurotus***, it took 30-60 min to immobilize the nematodes namely ***Aphelenchoides composticola*** and ***Ditylenchus myceliophagus***. However, the culture filtrate of different species of ***Pleurotus*** killed there organisms in 8 to 72 hrs depending upon the fungal species. However, they made no attempt to study the role of toxins or other metabolites to find the mechanism of killing. Recently, a comprehensive study of nematicidal activities of five species of ***Pleurotus*** on the root-knot nematode, Meloidogyne javanica, has been made by Heydari et al. (2006).

2.8. Strain improvement:

Verma (1997) & Periasamy and Natarajan (2003) have reviewed breeding strategies for genetic improvement of mushroom encompassing both conventional and modern molecular approaches. Stoop and Mooribroek, (1999) have indicated the possibility of producing transgenic mushroom that can result in better understanding of molecular, physiological and biochemical process essential for improving production shelf life, quality and disease resistance. However, the modern genetic manipulation through genetic engineering for strain improvement is still proving very difficult because mushroom is complex organism with different characteristics or traits under mutagenic control (Whiteford and Thunston, 2000). Mushroom of commerce is valued by its cap with thick flesh and delicious looking whitish under surface, good qualitative characteristics and

appearance, good keeping quality and storage life and delicious tasting. The low yields obtained with commercial strains, and a short post-harvest life of oyster mushroom compared to cultivated mushrooms such as button mushroom has limited its cultivation (Wang et al., 2002).

In this sense, a significant improvement in biological efficiency (BE), defined as the yield relative to the dry substrate weight, becomes essential to make ***Pleurotus*** species economically attractive.

One of the problems with commercial strains with respect to mushroom production is the decline after several consecutive subcultures in their production profile and other desirable attributes such as colour, texture, bruisability, postharvest preservation, crop duration, pest resistance etc. This is a serious limitation of commercial strains during long period of storage in culture medium, leading to a reduction in the yield and other desirable attributes. BE can also be raised through optimization of cultural conditions, such as combining different substrates and/or by adding nutrient supplementation. Nevertheless these practices are not always successful in recovering the yield performance of commercial strains. The need of the hour is not only to explore other new and wild species of ***Pleurotus*** but also to improve the existing and newer species through various breeding techniques for high yield, better quality, texture, colour and taste, and some of these are quantitative traits and under polygenic control.

The strategy for breeding potentials of edible mushrooms with special reference to hyphal anastomosis in ***P. sajor-caju*** has been reviewed (Jandaik, 1997 & Pahil, 1997). Selective dikaryotization has also been used to evolve new strains of ***P. sajor-caju*** resulting in fast colonizing ability leading to crop earliness, size, shape, bud mortality, colour of the pileus and also the protein content of fruit bodies (Ghosh and Chakravarty, 1991). The design of breeding programmes in ***Pleurotus*** species depend on the establishment of compatible crosses between different strains and on the selection of desirable characteristics.

2.8.1 Protoplast fusion: Somatic hybridization through fusion of protoplast is a powerful and very useful parasexual technique for transformation/ engineering of higher plants and microbial strains, specially the fungi, and actinomycetes. During the enzyme treatment for digesting the cell wall, protoplast from adjoining cells fuses through their plasmodesmata to form multinucleate protoplasts. And, hybrid protoplasts so developed contain heteroplasmic cytoplasm and two fused parent nuclei (Murlidhar and Panda, 2000). Protoplast fusion continues to be an emerging area of

research in modern biotechnology for strain improvement by developing hybrids through breaking down the genetic exchange barrier imposed by cell wall in conventional breeding systems. Protoplast fusion requires removal of cell wall through the judicious use of cell wall degrading enzymes. Commercial enzyme preparation is commonly used contains mixture of a lytic enzymes to digest fungal cell wall. Those are generally rich in chitin, β-glucans, α-glucan, glycoproteins and chitosan (Farkas, 1985 & Peberdy, 1990). Novozyme 234 (Novo), Cellulase CP (Stugre), Cellulase onozuka R-10 (Yakult), Chitinase (Sigma), β-Glucanase (BDH) and snail enzyme have been used for the release of protoplast from edible fungi (Peberdy, 1985). Recently, Bhattacharya and Sikder (2007) have optimized the conditions to produce good source of purified protoplast. Protoplast fusion has been widely used for the improvement of cellulase, ß- glucocidase, pectinase, amylase and lipase, penicillin, citric acid producing fungi and fungi of agricultural interests (Varavallo et al., 2004). In higher plants transfer of many useful genes for disease resistance, nitrogen fixation, rapid growth rate, more product formation rate, protein quality, frost hardiness, herbicide resistance, drought resistance, heat and cold resistance has been accomplished from one species to another (Murlidhar and Panda, 2000). However, for the same reasons as that implied to the conventional method, the greater the distance in genetic relationship between the two mating isolates, the less successful protoplast fusion will be (Anne and Peberdy, 1976). Breeding of edible mushrooms through mycelia anastomosis is only applicable to intra specific hybridization using monokaryotic strains. Thus, an alternative approach for breeding of basidiomycetes to obtain inter specific and inter generic protoplast fusion is now being widely adopted (Kim et al., 1997) to produce hybrids which produce fruit bodies of desirable qualities. Induced protoplast fusion can be achieved through electrofusion (Jogdand, 2001) and chemofusion; the later is the most popular technique followed by electrofusion (Jogdand, 2001). Chemofusion utilizes several chemicals to induce protoplast fusion such as sodium nitrate, polyethylene glycol, Calcium ions, etc. that causes the isolated protoplast to adhere to each other and leads to tight agglutination followed by their fusion (Pasha et al., 2007 & Jogdand, 2001). Unlike conventional hybridization, protoplast fusion in mushrooms including ***Pleurotus spp*** is gaining lot of popularity. Fusion of protoplasts have also been made to combine incompatible strains of the some mushroom species to develop interspecific hybrids (Yoo, 1992 & Dhitaphichit, and Pornsuriya, 2005) intergeneric hybrids (Yoo, 1994 & Kim et al., 1997), interorder hybrids (Yoo, et al., 2002 & Bhattacharyya and Sikdar, 2007) and even

interheterogenerically (Eguchi and Higaki, 1995) many of them involving ***P. ostreatus*** monokaryon as one the parent.

Confirmation and evaluation of strains/hybrids: Molecular techniques such as protein profiling, isozymes electrophoresis, RFLPs, and RAPD-PCR are not only used to study genetic or epigenetic changes at the genome level (Zarvakis et al., 2001 & Bao et al., 2005) but they are equally useful for authentication of species/hybrids (Julian and Lucas, 1990 & Yadav, 2002.). Isozymes studies have proven useful for the identification of fungal cultures at species (Bonde et al., 1991 & Petrunak and Christ, 1992) or subspecies level (Julian and Lucas, 1990). Electrophoretic analysis of whole cell proteins by one-dimensional protein patterns provides a rough measure of the number and physicochemical properties of gene products. One dimensional polyacrylamide gel electrophoresis of proteins has been used extensively for identification and classification at the strain and species level (Snider, 1973). Isozymes and RFLPs were first molecular markers used for genetic analysis in the button mushrooms. A low level of genetic diversity among commercial white strains of ***A.bisporus*** was detected using isozymes (Royse and May, 1982) and RFLPs (Castle et al., 1987). Whereas DNA polymorphism in seven strains of ***L.edodes*** using RFLP markers was reported by Kulkarni (1991). Multilocus enzyme electrophoresis (MLEE) has been called as allozymes by May & Royse (1981). They are the allelic variant of same enzymes resolved on the basis of electrophoretic mobility that have been studied involving a large number of micro-organisms (Selander and Levin, 1980 & Soltis et al., 1983). Enzyme polymorphism is due to simultaneous occurrence within or between populations of multiple phenotypic forms of a trait attributable to the alleles of a single gene or the homologue of a single chromosome (Acquaah, 1992). In natural populations recurrent mutations of genes produce variability that may show polymorphic loci and different loci may have different degree of polymorphism (Zervakis et al., 1994). Molecular techniques, such as Randomly Amplified Polymorphic DNA Polymerase Chain Reaction (RAPD-PCR), use a small sample of the subjects DNA which is then selectively amplified a million fold thus producing a large amount of concentrated DNA (PCR products). Randomly amplified polymorphic DNA sequences or RAPD markers are based on the amplification of unknown DNA sequences using single, short, and random oligonucleotide primers to generate "fingerprint" that may be used to distinguish different genetic types (Ruiz et al., 2000). RAPD, the oldest PCR based technique relies on use of short 10 per random PCR primers to amplify random portions of the genome; it provides researcher to scan the entire genome with a quick screening for DNA sequence-based polymorphism at a very large number of

loci (Williams et al., 1990). RAPD has many advantages over RFLP technique such as non-radioactive detection; no prior sequence information for a genome is required, universal primers work in genome, very small amount of genomic DNA is needed. More over RAPDs techniques are experimentally simple and there is no need for expensive equipment's beyond a thermocycler and a transilluminator (Rafalski, 1997). RAPDs have also been utilized for DNA fingerprinting for assessing genetic diversity (Tatineni et al., 1996) and to establish relationship between genotypes of same and different species (Munaut et al., 2002). RAPD markers were used for the first time by Khush et al. (1992) for fingerprinting the strains of A.bisporus for the analysis of genetic variability amongst wild and commercial strains, and also for identification of homokaryon and confirmation of hybrids generated by crossing two compatible homokaryons of A.bisporus.

2.9 Substrate: ***Pleurotus*** mushroom can degrade any kind of agricultural or forest wastes, which contain lignin, cellulose and hemicellulose. In future species of ***Pleurotus*** are generally found as saprophytes, growing on dead or decaying part of wood. Parasitism by a few 5species have been reported e.g. ***P. eryngii*** (Singer, 1961). Cultivation df Pleurotus species (***P. ostreatus***) is known for a long time in European countries. Growing it on tree stumps and logs was first described in the beginning of 20" century, (Falck, 1917, 1919; Passecker, 1959; Singer, 1961; Luthard, 1969; Vessey and Olah et. al, 1979). Later cultivation of ***Pleurotus*** species has also been reported on other substrates. Etter (1929) produced fruiting bodies of ***P. ostreatus*** in culture. On saw dust medium, production of sexual spores of P. cotficatus was reported by Kaufert (1936). Block et al. (1958) cultivated ***P. ostreatus*** for the first time under laboratory conditions on. sawdust medium. They used a mixture of Oatmeal / and sawdust. In India successful cultivation of ***P. flabellatus*** on paddy straw as reported by Bano and Srivastava (1962). Later, Jandaik and Kapoor (1974) reported cultivation of ***P. Sajor-caju*** on Banana pseudo stem and chopped paddy straw. Ragaswamy et.al (1975) reported successful cultivation of ***P. sajor-caju*** using different waste material like paddy straw, sawdust and wood shaving. Different plant waste materials such as wheat straw and ragi straw were used by Bano et.al. (1979) for growing ***P. flabellatus***. Das et.al. (1987) successfully used different agricultural wastes for cultivation of two ***Pleurotus spp.*** The best results (1650 for ***P. flabellatus*** and 1970 kg for ***P. Floridae*** from 3 kg dry substrate) were obtained from wheat straw using spawn Zhang et al, (2002) cultivated ***P. floridae*** on rice and wheat straw without nutrient supplementation. The highest yield of ***P. floridae*** was obtained on cotton straw (993g/kg of dry straw) followed by soybean, paddy, wheat and jowar straw with yield of 935.25g/Kg, 816g/kg, 708g/kg and 445.50g/kg of dry straw

respectively (Chavan et al, 2003). Biological 20 efficiency of P. djamor was found to be 52 per cent on paddy straw (Sharma, 2003). Rathore and Thakore (2004) reported the maximum number of sporophores and yield (106 and 468g/kg of dried substrate, respectively) on wheat straw among the substrate tested. Tupatkar and Jadhao (2006) cultivated P. Floridae on different agro-substrates (wheat straw, rice straw, bajra straw and leaves, cotton stalks and leaves, soybean straw, groundnut creepers + wheat straw, soybean straw wheat straw and groundnut creepers) to correlate yield performance. They reported substrate comprised of cotton stalks and leaves gave the highest number of sporophore (178.33), average weight of sporophore (5.12g) and yield (914.032) on wheat straw.

2.10. Spawn Production: Little information is available on researches done on spawn production. Generally methods for spawn production of all cultivated mushrooms are almost similar these days. Spawn making was once a highly selective procedure. In seventeenth centime, the mushroom growers used to plant the horse droppings containing living mycelium which they called spawn. In 1891, the French for the first time succeeded in germinating spores of ***Agaricus*** for the purpose of obtaining sterile spawn, which found great commercial acceptability in the market (Atkinson, 1961) Bahukhandi and Munjal, (1989) suggested use of sterilized presoaked wheat grains for Oyster mushroom spawn while, Lee, S.S. (1991) concluded that rice bran in sawdust spawn medium provides three kinds of nutrients (starch, nitrogen and minerals) supporting fast growth, prevent contamination by other microorganisms. Rathaiah. et al., (1999) reported parboiled paddy gave 7.5 per cent greater yield over conventionally cooked paddy spawn. The moisture content in parboiled paddy was less than that of cooked wheat. Shah et al, (1999) recorded maximum yield of ***P. sajor-caju*** on ***Trifolium*** straw when used as a substrate for spawn production, Other four substrate i.e. wheat grain, ragi grain, wheat straw and a combination of wheat straw and ***Trifolium*** (1:1) gave downward mycelial growth and the time taken for spawn substrate colonization was recorded. The time required for complete 24 spawn run was 11 days for ***Trifolium*** followed by wheat grain (11 days) with the longest spawn run for wheat straw (22 days). Jhune-chang-sung (2000) observed that 10 to 20 per cent supplementation with rice bran resulted in a good mycelial growth and density. Field test "showed that 15 to 20 per cent addition of the supplement resulted in the highest yield, the shortest time period from spawning to pinhead appearance and the lowest infection rate. Sharma, B.B. (2003) tried different grains viz. jowar (Sorghum bicolor], kutki (***Panicum*** mitia,re), kodo (***Paspalum scrobiculatum***), maize (***Zea mays***) mid wheat (***Triticum aestivum***). The shortest period for spawn development (8 days) -was observed with kutki grains indicating its suitability for efficient

spawn production. However, Kumar et al, (2004) recorded highest biological efficiency (81.00) and yield (810g) of ***Pleurotus sajor-caju*** with wheat grain spawn.

2.11. Physical Factors: Temperature, humidity and light have a significant effect on growth and formation of fruiting bodies of ***Pleurotus spp***. (Chang and Ran, 25 1977). The growth of mycelium and formation of fruit bodies of ***Pleurotus spp***. depends on a number of physical, chemical and biochemical parameters (Zadiazil, 1978).

2.11.1. Temperature: The temperature requirement for mycelial growth and fruit body formation diffuse with different species. Kurtzman and Zadrazil (1982) mentioned different temperature ranges worked out by different workers in different ***Pleurotus*** species. The temperature mentioned, which was optimum for mycelial run and maximum fruit body production as 27°C and 20°C, respectively in ***P. corticatus*** (Kaufert, 1936). Block et cul, (1958) reported that in ***P. ostreatus*** (***floridae***) 32°C optimum temperature for mycelial run and 21-26°C for fruit body formation. ***P. cystidiosus*** needed 28°C for mycelia growth and 25°C for fruit body formation (Miller, 1969).While for ***P. eryngii***, 25°C has been found optimum for mycelial run and below 20°C for fruiting (Zadrazil, 1975). Jandaik and Kapoor (1976) recorded 25-30°C for mycelial run and 20-25°C for fruiting of ***P. sajor-caju***. Temperature for ***P. tuber-regiurm*** requires being 40-45°C for 26 mycelial run and 35°C for fruiting body formation (Osq, 1977). Development intensity of mycelium decreased at 10°C and tolerance reached maximum at 30-35°C. The spread of mycelial growth is related to the temperature of the substrate. The temperature is highly important since it affects the growth and adaptability as well as quantity and quality of fruiting bodies (Zadrazil, 1978). P. Aba Zonesand ***P. ostreatus***, ***P. florida*** need 30°C for mycelial growth and 25°C for fruiting (Huang, 1979; Zadrazil and Kuitzman, 1982). ***P. sajor-caju***, ***P. ostreatus***, ***P. sapidus***, ***P. flabellatus***, ***P. florida***, ***P. membranaceus*** and ***P. eryngii*** showed maximum mycelium growth between temperature range of 25-30°C (Zadrazil, 1976; Balazs and 1979; Sohi and Upadhyay, 1989).With regard to sporophore production, most ***Pleurotus*** species cultivated in the tropics required a slightly lower temperature ranges from 21-25°C (Jandaik and Kapoor, 1976; Bano et al, 1979). Kalita et al, (2000) observed different species of ***Pleurotus*** can be deployed successfully to obtain better yield during the different growing season. ***P. citrinopileatus*** was suitable for cultivation during March-April which had slightly higher environmental temperature while ***P. sajor-caju*** performed better in the month of October and January. 27 Kushwaha et at, (2000) observed that spawn run and fruiting body of all the tested species of ***Pleurotus*** were

greatly influenced by temperature' of different months. The low temperature of December and January resulted in maximum period for spawn run and fruiting of various species ofPleurotus. Five species of ***Pleurotus*** namely ***P. flabellatus***, ***P. sajor-caju***, ***P. florida***, ***P. ostreatus*** and ***P. cystidiosus*** were evaluated using paddy straw. He tried to work out possibilities of their cultivation in different months and reported that mycelial growth was good and the time required for initiation of pinhead and production of first flush was less when grown from March to November (except during May). The highest biological efficiency was recorded in October cultivated ***P. flabellatus*** followed by ***P. Florida*** Dubey (2003). Several workers reported that optimum temperature for the hyphal growth of ***Pleurotus*** spp. was 25°C (El Fallal et al, 2003); Moorthy and Chandramohanan, 2003 and Han et al., 2004). However, Yao-Fangjiee Ual., (2004) reported that the optimal temperatures for hyphal growth of hybrid strains were lowerthan those oftheir parents.

2.11.2. Humidity: Humidity is the second cardinal factor which has very important role in development and growth of Suit bodies of mushroom (Zadrazil and Kurtzman, 1982). A moisture content of about 50-75 per cent was found to be optimum for the growth of mushroom mycelium and the maintenance of a high relative humidity of the air in the mushroom houses. It also reduces ft. evaporation from the substrate surface (Flegg, 1962; Zadrazil and Brunnert, 1980), Block et al, (1958), Han et al, (1974); Cailleus and Diop (1976) and Bano et at, (1979) worked out relative humidity by 90-95, 85-95, 70-80 and above 85 per cent for production of P. abalones, ***P. flabellatus*** and ***P. sajor-caju,*** respectively. Jang et ah, (2003) and Han et ah, (2004) reported that the most suitable relative humidity for ***Pleurotus*** spp. ranged from 60-80 per cent with an optimum relative humidity of 80 per cent.

2.11.3. Light: The effect of light promote fruiting of ***Pleurotus*** was apparently first noticed by Kaufert (1936). However, Gyuiko (1972) observed that light is obligatory' for sporophore development in ***Pleurotus***. Stipe remains thin and crop rudimentary in complete darkness. It is inhibitory for mycelial growth in ***P. ostreatus*** (Eger et.al., 1974) but according to Chang and Han (1977) light has no significant role in cultivation of Pleurotus. Branched growth and continuous segmentation of abnormal fruit bodies have been observed due to lack of light in ***Pleurotus ostreatus*** (Tschierpe, 1972; Zadrazil, 1975) while, P. sajor-caju, ***P. eryngii***, ***P. Florida***, and ***P. ostreatus*** grew best in total darkness (Rawal and Singh, 1980). Datta and Chakraborty (2002) observed that darkness favoured the spawn run in both ***P. sajor-caju*** and ***V. volvacea***. But for primordial formation and their

further development low intensity of light was essential. Sharma (2004) reported that the highest growth (83.12mm) of P. djamor was observed in completed darkness. The lowest radial growth was recorded when light and darkness duration was same (12h; 50 mm). Jhang et.al. (2005) recorded that the mycelia of ***Pleurotus eryngii*** grew better under darkness than under light (i.e. light inhibited growth of the mycelia).

2.12. Evaluation of locally available substrates: Block et. al. (1958) successfully cultivated ***Pleurotus*** on sawdust. In India Bano and Srivastava (1962) used paddy straw first time as substrate for ***Pleurotus*** cultivation. Synthetic white mushroom compost with a relatively high nitrogen content proved un-suitable for ***P. ostreatus*** and ***P. florida*** (Hunke, 1972). Jandaik and Kapoor (1974) observed that banana pseudo stem followed by paddy straw was most suitable substrate for production of ***P. sajor-caju***. It was also cultivated on bits of ladies finger, brinjal and papaya mixed in equal proportion with paddy straw. ***Pleurotus*** flabellatus was cultivated on wheat, ragi and rice straw. The highest yield was obtained on rice straw (Bano et al 1979). A number of leguminous agricultural wastes were tried for the cultivation of ***P. sajor-caju*** (Pal and Paul, 1985). They observed that legume yielded significantly higher compared to paddy straw. Sivaprakasham et al. (1986) used the paddy straw to raise the P. citrinopileatus. It grew well and yielded 414.0 g/2.5kg on pre-soaked straw. 47 Several locally available substrates were evaluated for cultivation of ***P. florida.*** They found the paddy straw and banana leaves as best substrates. Different quantities of compost were compressed in bags of same size i.e. 80, 90, 100, 110 and 120 kg/m2. There was progressive mushroom yield increased with quantities up to 120 kg/m at 65 to 70 per cent compost moisture level (Gupta and Dhar, 1993). 2.9 Effect of different supplementation to the substrate on the yield - Schisler and Sinden (1963) studied the effect of addition of various organic supplements on the yield and observed that ii increased the yield. He tried various pulses (powdered) and cereal grains to paddy straw for growing ***P. flabellatus*** and concluded that oat meal and bengal gram powder gave the highest yield. Jandaik (1974) reported that addition of oat meal or Arhar dal powder resulted in better yield. Various workers have reported enhanced yields in oyster mushroom by incorporating various nitrogen sources as supplements in the substrate (Bano and Rajarathanam, 1983; Gunasegaran and Graham, 1987; Royce and Schisler, 1987; Zadrazil and Kurtzman, 1982). Addition 48 of nitrogenous organic substances to the substrate increased the mushroom yield (Upadhyay et al., 1988). Studies on oyster mushroom substrate supplemented with chicken manure along with wheat bran, cotton seed meal, rice bran and mustard cake as nitrogen supplements in wheat straw

for ***P. flabellatus***. The result obtained that there was no difference in spawn run duration and time required for pin head formation among the treatments, However, highest yield was noticed with cotton seed meal supplements followed by rice bran, wheat bran (Vijay and Upadhyay, 1989), Jandaik (1989) tested ***P. sajor-caju*** for size and yield response to spawning (wet wt basis), respectively. However, there was no effect ofrate of spawning from 1 to 4 per cent on yield (Sohi, 1986). Bhattacharjee et al (1989) studied the effect of different amount and methods of application of spawn on the yield of ***P. sajor-caju*** and found best result when spawn was spread only on the middle layers of straw. They recorded highest yield of sporophore with 250 g spawn per tray of 60 cm in diameter and 9 cm deep. 49 Tiwari (1991) evaluated spawn doses viz. 0.5, 1, 2, 3, 4, and 5 per cent of wet substrate. Maximum biological efficiency was recorded from 4 per cent spawn during summer and 5 per cent spawn during rainy winter season. However, during summer season there was significant difference in yield from lower to higher doses whereas, during rainy winter season such pattern was not observed. An experiment was conducted to study the effect of different quantities viz. 75 g, 150 g, 225 g and 250 g of oyster mushroom (***P.sajor-caju***) spawn by Wahab et al. (1993). This study revealed that a minimum quantity (75 g) of spawn inoculated in 1800 g of wet paddy straw, mushroom bed contained in polythene bags of 60 x 30 cm dimension was found to be highly superior when compared to the other quantities i.e. 150, 225 and 250 g of spawn per bed, respectively. It was interesting to note that with increment in the spawn used there was corresponding gradual decrease in the yield. Very little work has been done on the effect of quantity of the substrate on the yield of oyster and other mushrooms. Earlier, bags holding 30- 40 kg of compost were used for the cultivation of button mushroom, but these are now replaced with 15-20 kg of compost supplementation with brewer's 50 grain, apple, wheat bran and oat meal at 5 and 10 per cent dry weight. They found highest yield with wheat bran and brewer's grain, respectively. Upadhyay and Vijay (1990) studied the effect of addition of various nitrogen supplements namely wheat bran, rice bran and cotton seed meal @ 5 and 10 per cent (D.W. of straw) and brewer's grain @10 and 20 per cent to the wheat straw substrate, before spawning. The influence of physical factors like temperature, light and humidity on the growth of P. eryngii, ***P.florida***, ***P. ostreatus***, ***P. sajor-caju*** and ***P. sapidus*** was studied by Rawal and Singh (1980). The optimum temperature for the growth of ***P. eryngii***, ***P. ostreatus*** and ***P. sajor-caju*** was (bund to be 25°C whereas, for others 30°C. All the species attained maximum growth at 100 per cent relative humidity. Puri et al (1981) attempted to cultivate ***P. fossulatus*** and found 20 ± 1 °C temperature optimum. Studies at Mysore have indicated

that maximum yield of ***Pleurotus spp.*** was obtained during rainy season when the temperature was 20-26°C and R.H. 70-90 per cent. Production of fruit body of ***P. ostreatus*** was recorded at a temperature range of 9- 18°C and relative humidity of 85 per cent (Purkayastha and Chaudra, 1985). Agarwala and Jandaik (1986) stated 52 that P. floridae required a temperature of 25°C for vegetative growth and 20- 22°C for generative growth of fruit body. Temperature condition followed by ***P. ostreatus*** and ***P. fossulatus*** (35 & 32% B.E.). However, ***P. eryngii*** failed to produce any Suiting bodies. The yield performance of ***P. sajor-caju*** during different months of the year at Solan was studied. Effective spawn run could be obtained only during the period of May to October, when temperature in Solan hills was congenial for this species. Highest yield (53.5 B.E.) was obtained when the spawning was done in the month of August (Anonymous, 1993).

2.13. Evaluation of different sterilization technique of substrate for cultivation: Vijay and Sohi (1986) suggested that the substrate is either boiled in water (80°C for 2 hrs) or chemically sterilized by steeping in a solution of Formalin (500 ppm) plus Bavistin (75 ppm) for 18 hours for Mushroom cultivation. Sohi (1988) found that chemical sterilization (steeping of straw in Formaldehyde and Bavistin solution (500+75 ppm) for 18 hrs) gave consistently and higher biological efficiency. Tiwari and Pandey (1988) recorded highest yield (280.60 g) of ***P. sajor-caju*** from 15 lbs p.s.i. sterilization for 30 minutes followed by 60 minutes (271.0 g) and 90 minutes (253.75 g). Modified hot water-substrate treatment yielded significantly higher quantity of mushroom than chemical method (Kumar et al, 1990). Lelley and Niehrenheim (1991 found that fungicide treatments, especially at 100-250 ppm, favorably influenced the mycelial growth and increased yield. Singh et al (1991) studied the effect of sterilization of substrate on the production of P. ***sajor-caju***. Various treatments viz. steam sterilization at 15 lbs p.s.i. for 30 minutes, chemical sterilization with Bavistin at 100 ppm, Formalin at 500 ppm and Dithane Z78~at 200 ppm concentration was evaluated. Maximum yield of mushroom was obtained on substrate treated with bavistin followed by formalin. However, there was no significant difference in yield on substrate treated with chemicals and steam sterilization. Jadhav and Jagtap (1991) observed that all chemicals used for pasteurization gave significantly higher mushroom yield as compared to no pasteurization. Singh et. al. (1992) found that chemically treated wheat straw combination sugarcane trashes (3:1) performed best for ***P. citrinopileatus*** and gave 295.0g/bag yield.

Chapter-3

Materials and Methods

To, fulfill the all following objectives on an 'Edible mushroom ***Pleurotus florida*** were conducted at Department of Biotechnology, ***Pt. CLS GOVT. COLLEGE, KARNAL***. The experiments were laid out in completely Randomized design. The objective are as follows: 1. Production of spawn culture on wheat grains 2. Cultivation & harvesting of the ***Pleurotus florida*** seed on wheat straw **3.1. Collection of culture:** The pure culture of ***Pleurotus florida*** was obtained from mushroom research lab in Department of Plant Pathology, CCSHAU Hisar (Haryana) which was multiplied and maintained on freshly prepared PDA medium in the laboratory of the department of Biotechnology, ***Pt CLS Govt. P.G. College***, ***KARNAL*** for further studies.

3.2. Spawn Preparation: In order to carry out various experiments, wheat grain spawn was prepared by employing following methods: The clean and healthy wheat grains were selected for spawn preparation. The grain were washed 3 times under running water and then boiled (1 kg grain./1.5 litre water) for 20 minutes. After boiling grains were put over a wire mesh to drain off excess water. It was then mixed with calcium carbonate (3.5 g/kg) and calcium sulphate (13.5 g/kg) on dried grain weight basis. The mixture, thus obtained was filled upto two third volume in 500 ml bottles. Bottles were plugged with non absorbent cotton and then sterilized in an autoclave at 15 lbs pressure per square inch for two hours. The sterilized bottles were cooled down to room temperature and shaken vigorously to avoid clumping of grain. These sterilized bottles were surface sterilized by dipping in two percent formalin solution without wetting the cotton plugs. Bottles were inoculated with approximately equal mycelial bits, obtain from pure culture, under laminar flow in totally aseptic condition. The inoculated bottles were inoculated at 25°C + 1°C temperature in BOD incubator. After 7 days inoculated bottles were shaken vigorously for through mixing of mycelial threads with grains. Then after these bottles were again kept in BOD incubator at 25°C + 1°C temperature to obtain full growth of fungal mycelium just to cover the entire bottle.

3.3. Cultivation Technique: **3.3.1. Preparation of Substrate**: **Preparation of leaves**: The leaves was fragmented into small pieces (less than three centimeter particle size) after sun dried with a sickle. The substrate consisted of banana leaves was not supplemented. **Preparation of rice straw**: After sun drying, rice straw was fragmented into small pieces (less than three centimeter particle size) with a sickle. The substrate consisted of rice straw was not supplemented. **Preparation of wheat straw**: After sun drying, wheat straw was fragment into small pieces (less than three centimeter particle size) with a sickle. The substrate consisted of wheat straw was not supplemented. Following method was used to prepare substrate for mushroom cultivation. One hundred liters of tap water was filled in a plastic drum of 200 liter capacity. A stock solution with 125 ml formaldehyde and 10g bavistin in 100 liter water was prepared. This solution was stirred properly with a slick for its mixing. Now 10 kg dry straw substrate was steeped completely in this chemical solution. The mouth of the container was closed with the lid and kept as such for 18 hours. After 18 hours the straw was taken, out from the chemical solution and put on a wire sieve for removal of extra solution. It was then spread in thin layers over a clean cemented floor for further removal of excess moisture.

3.3.2. **Spawning**: The mushrooms were grown on Paddy straw in surface sterilized polythene bags measuring 60 x 45 cms. in size. These surface sterilized polyethylene bags were taken and two small

vents were made on both corers of the bottom side for leaching the excess water of the chemically treated substrate. The two layer spawning was done by using the 120 g of spawn/2 kg dry substrate in a bag. One third quantity (approximate 1.3 kg wet straw) of 1 kg dry substrate of above prepared substrate was filled in these bags and gently pushed down. The fully grown spawn was broad casted over the upper surface of the substrate. The rest of the substrate (approximate 1.4 kg wet straw) was filled in the remaining spaces of the bags and the mouth of the bags were tied with threads.

3.3.3. Care after spawning: The spawned bags were transferred to spawn running room and kept on a flat surface under prevailing room temperature. These bags were watched daily for spawn run. When full growth of mycelium of fungus was seen in the substrate the polythene coverings were removed. The blocks of compact substrate were transferred in the cropping room, which was earlier surface sterilized, under prevailing room temperature. Humidity of cropping room was maintained by sprinkling of top water on the walls, roof, floor and beds with the help of sprayer and atomizer frequently.

3.4. Determination of moisture content of the substrate at the time of spawning: For recording the moisture content of the straw substrate, an empty box of aluminum was washed with HC1 followed by tap water to remove even last traces of adhered acid. Then it dried in hot air over at 70°C for two hours cooled and weighted. The process of washing, drying, cooling and weighting was repeated thrice for obtaining constant weight. Now 100 g of moist straw was transferred to an empty box as prepared above and weighed. The box, containing moist straw, was kept into hot air oven at 70°C for eight hours. Then it was cooled down and weighed. The process was repeated thrice to obtain constant weight. Moisture loss was calculated by subtracting weight of box along with wet straw before hot air drying and weight of box along with dried straw after hot air drying.

3.5. Isolation, purification and growth of *P. florida* on PDA solid media: The pure culture of ***P. florida*** obtained from mushroom research lab department of Plant Pathology, CCSHAU Hisar. Isolation & purification was done by standard method. Growth of ***P. florida*** tested on synthetic solid media. To find out the best suited medium for growth of the ***P. florida*** under present study,

Dry leaf.

Wheat straw.

Rice straw

Adding fangiside (Bavistin)

Put the substrate into the basket

Growing mycelia

Hyphae

Mature mashroom

agar medium was used with following composition- Potato starch- 20.00g, 63 agar 20.00g, dextrose 20.00g distilled water 1000 ml. The media were sterilized in the autoclave at 121^0C for 20 minutes. The glassware's were cleaned with chromic acid and distilled water was used during the entire study relating to media study. Two hour in hot air oven.

3.5.1 Pour in Glassware sterilized at 160°C fog of media in Petri plates: Previously sterilized petri dishes used for pouring the medium. A set of petri dishes was maintained for each treatment and 15 ml sterilized, melted but cooled medium (about 45°C) was aseptically poured in each 10 petri dishes. The petri dishes were handled aseptically in a inoculation chamber using a sprit lamp flame. The medium in the plates was allowed to solidify before inoculation with ***P. florida***. The inoculum of ***P. florida*** was grown PDA for 5 days at 25°C. Linear growth was observed when the mycelium reached the edges of the petri dishes.

3.5.2. Evaluation of wheat straw for production of *P. florida*. In order to evaluate the suitability of locally available base material s as substrate for growing ***P. florida***, an experiment was laid out with treatment viz. wheat straw. The straw substrate was prepared by using the one kg dry substrate of wheat straw and mixed with spawn of 120gm. All necessary requirements were provided for obtaining good mushroom yield. Data on all observation were recorded.

3.5.4. To develop simple & effective technique of substrate sterilization: In order to study the effect of different sterilization techniques of substrate on yield of ***P. florida***, an experiment was laid out by treating paddy straw substrate with hot water & bavistin treatment. All requirements for cropping of mushroom were accomplished as usual.

3.5.4. Effect of varying amount of spawn on production of *P. florida* In order to observe the effect of different quantity of spawn on the yield of ***P. florida***, an experiment was conducted with three replication viz. 80g, l00g and 120g spawn per bag. In every treatment one bag contain 1 kg paddy straw substrate on dry weight basis. Two layered spawning was done with above mentioned quantity of spawn per bag. All recommended practices were followed to grow good crop of the mushroom and data on all the observation were recorded timely.

3.6. Analysis of data: The data was analyzed morphologically and by weight of mushroom to draw the conclusion.

Chapter-4

Results

The experiments were conducted on the study of edible mushroom ***Pleurotus florida***. The wheat straw, rice straw and dry leaf was used as substrates.

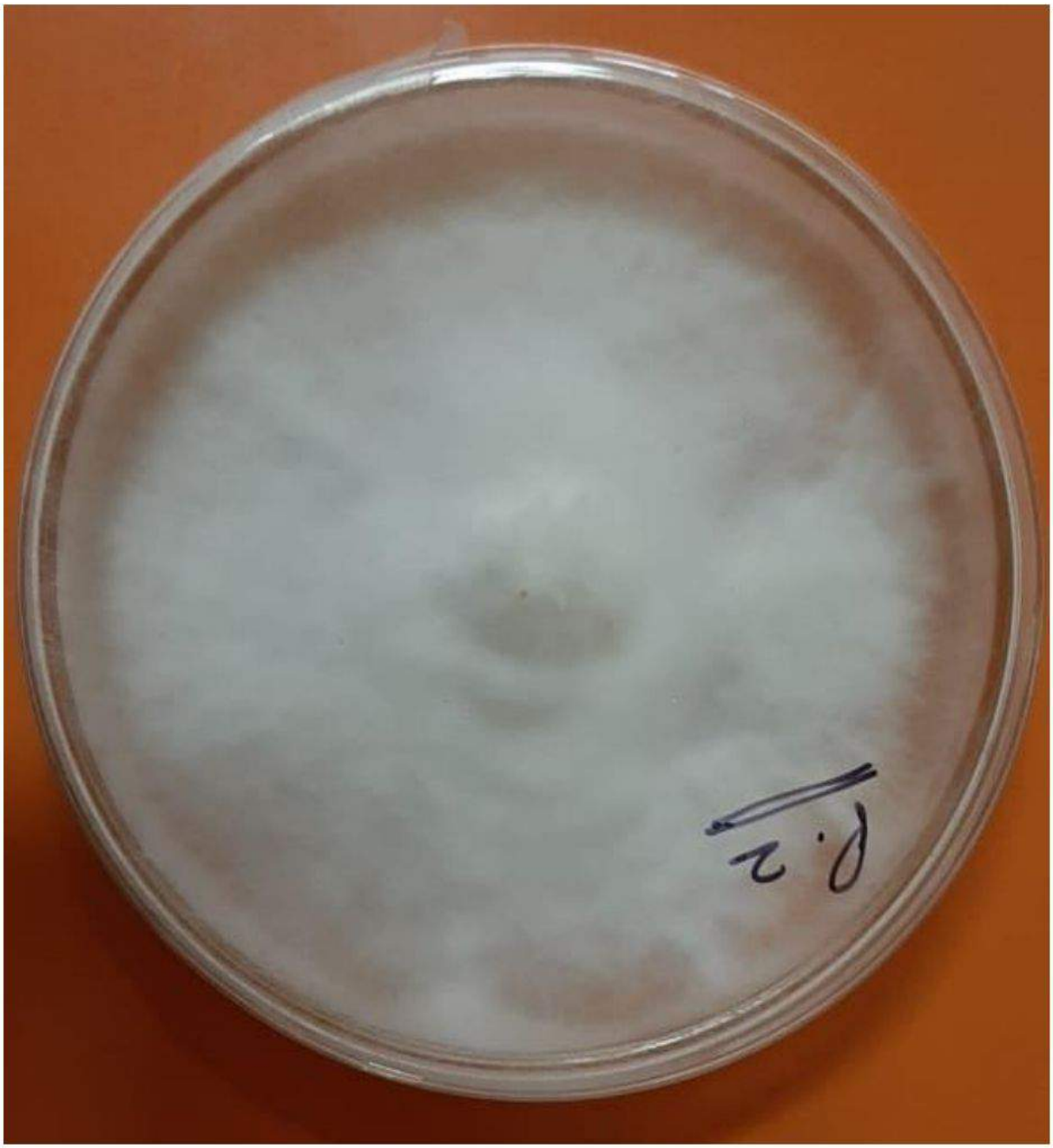
4.1. Isolation, purification & maintenance of pure culture of the fungus: The pure culture of ***P. florida*** was obtained from mushroom research lab, Department of Plant Pathology, CCSHAU Hisar. Isolation & purification was done by standard method. Potato Dextrose Agar medium was significantly superior to other tested medium with direct potato starch.

4.2. **Water provided to the yield of *P. florida*** Tap water was used every day to provide moisture in straw by using spray bottle and direct. Every bag contains different substrates as two bags of wheat straw, two bags of rice straw and two bags of dry leaf.

4.3. Evaluation of using wheat straw, rice straw and dry leaf for production of *P. florida* Wheat straw provides large production of mushroom as compare to dry leaf and the rice straw. **4.4. To develop simple & effective technique of substrate sterilization:** The data taken in the experiment to see the effect of different sterilization techniques of substrate on the production of ***P. florida*** was recorded. It was observed that chemical sterilization of substrate enhanced the spawn run which was completed in 10 days as compared to steam sterilization and without sterilization.

DAYS OF PROJECT WORK	OBSERVATIONS
First day	Isolation, Purification, and Preparation of substrate. Addition / Mixing of **spawn** in substrate and put them into the baskets.
Third day	Shift the yield from baskets to the polythene bags and pore the polythene bags for aeration.

Seventh day	Small white colored mycelia are visible on substrates.
Eleventh day	Large number of mycelia are visible on the wheat straw as compare to the rice straw and dried leaves.
17th day	**Hyphae** are well grown on wheat straw.
18th day	Bulb like structure called **Cap,** appeared on the hyphae.
19th day	Mushroom was matured. The bulb like structure called cap was opened and the gills were visible.



Chapter-5

Discussion

With the increasing pressure of world population and the widening gap of nutritional deficiency particularly in developing countries, demand utilization of unconventional sources of food which can be obtained by making use of raw materials which are otherwise wasted. The farm wastes like straws, dried leaves can easily be transformed to biomass by treating them with fungi there by producing a valuable food like mushrooms. The substrates used for mushroom cultivation forms the most important part of commercial mushroom cultivation. Paddy straw has generally been found be suitable for the cultivation of ***Pleurotus spp.*** Some worker tried other substrates but with much less success. In the present investigation wheat straw gave the yield of 2kg from first slot and 500g from second slot, which was significant superior to all over substrates like leaves & stalk of maize, leaves & stalk of sorghum, sugarcane leaves and sugarcane bagasse's according to literature.

5.1. Effect of Supplementation - In the present study wheat straw was used as nitrogenous supplements followed by IAA and different aromatic amino acid resulted significant increase for spawn run. Various workers have also reported that addition of nitrogenous organic substance to substrate increased, the mushroom yield. (Schisler and Sinden, 1963; Upadhyay, 1988, Upadhyay and Vijay, 1990; Tiwari, 1991).

5.2. Effect of Sterilization Techniques: In the present investigation chemical sterilization techniques of substrate was found superior than other treatments i.e. hot water treatment and steam sterilization. The chemical sterilization method enhance the spawn run by 1 to 2 days The yield of mushroom i.e. 320.0 g and 200.0 g were also significantly higher in chemical treatment followed by steam sterilization (220g and 160.0g) and hot water treatment (200.0g and 190.0g). Control treatment was significantly inferior to all other treatments. The present observations clearly showed that wheat straw treated with bavistin 10g + formaldehyde 125ml was superior. It favoured early spawn, first harvest and increase yield. This contention has also been supported by several workers. Vijay and Sohi (1986) and Sohi (1988) also reported that chemical sterilized straw gave consistent and higher biological efficiency and favourable influenced the mycelial growth. Nollathambi and Marimuthu (1994) compared the hot water, steam and chemical method of substrate sterilization for cultivation of ***P. citrinopleatus***. They found chemically treated wheat straw showed earlier spawn run by 1-2 days, increased the yield and hastened the days taken for first harvest by 1.5-4 days than other treatments.

5.3. Varying amount of Spawn: The effect of different quantity of spawn viz. 80g, l00g and 120g on yield of mushroom was observed during the experimentation. Maximum yield of 420.0 g mushroom were harvested with 120g spawn respectively. It was followed by 120g, l00g and 80g spawn which gave 390.0g and 370.0g. The minimum yield of 370.0g was recorded from 80g spawn. Significant difference in yield from lower to higher doses of spawn has also been reported by Sohi (1986) and Tewari (1991).

5.4. Varying amount of substrate With a view of determine the effect of varying amount of substrate on production of ***P. florida***, the different quantity i.e. 0.750kg, 1.0 kg, 1.25 kg, 1.50 kg and 2.0 kg dry substrate were tried with a fixed amount (120g) of spawn. Out of these different quantities of substrate used, the 2.0 kg dry substrate gave the maximum yield. This was followed by the yield obtained from 1.50kg, 1.0 kg and 0.750 kg dry substrate. Progressive increase in mushroom yield with treatment of substrate has also been reported Gupta and Dhar (1993).

Chapter-6

Summary and Conclusion

Studies on an edible mushroom ***Pleurotus florida*** have been carried out in the Department of Biotechnology in **Pt. CLS GOVT. COLLEGE**, during session 2019-2020. The findings of different experiments are being summarized. The pure culture of ***P. florida*** obtained from mushroom research lab Karnal. Pure culture of P. Florida tested on potato dextrose agar media, was the best tested media of fungal growth. The maximum production of ***P. florida*** produced on wheat straw proved to be the best substrate with maximum yield of 2kg from 10kg straw respectively. To see the effect of supplements on the yield of ***P. florida***, wheat straw gave superior result. Three sterilization techniques of wheat straw substrates were tried to know their effect on the yield of the ***P. florida*** under the present study. The chemical sterilization method (Bavistin 10g + Formalin 125ml) gave significantly higher yields of 320.0g than other treatments viz. hot water and steam sterilization methods during study. It was followed by steam sterilization (220.0g) and hot water treatments (200.0g). The fungus, ***P. florida*** when grown on a fixed amount (1.0 kg dry matter) of wheat straw and spawned with varying amount of spawn *i.e.* 80g, l00g and 120g, the maximum yield of mushroom was obtained with 120g of spawn followed by 100g, 80g. Substrate, spawned with 80g spawn gave minimum and significantly less yield than all other treatments. To find out the suitable amount of substrate to maximum production of ***P. florida*** varying amount of substrate viz. 1.0 kg, 1.25 kg, 1.50 kg and 2.0 kg were taken on dry weight basis. The maximum yield of mushroom was obtained in 2.0 kg substrate, followed by 1.5 kg, 1.25 kg, 1.0 kg. Study of edible mushroom ***Pleurotus florida*** (Oyster) on wheat straw

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Pt. C.L.S Govt. COLLEGE, KARNAL

DEPARTMENT OF TOURISM MANAGEMENT

Bachelor of Tourism Management (BTM) is an undergraduate course of 3 years (divided into 6 (Six) Semesters) in Travel and Tourism field. Training in Bachelor degree in tourism management is a prerequisite for acquiring in-depth practical and theoretical knowledge in the field of business management in tourism.

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The indicative list of students who have undergone On the Job Training in Session 2020-21 are as follows.

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1.	Neha	2157620004
2.	Ankita	2157620007
3.	ISHU KAMBOJ	2157610017
4.	NANCY KAKKAR	2157620009

Principal
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Sr. No	Name	Roll No
5.	RADHIKA	2157620002
6.	SARANSH	2157610051
7.	BADAL SHARMA	2157610019
8.	LALIT BALDA	2157610013
9.	PRATEEK	2157610015
10.	KAJAL	2157620008

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TO WHOM IT MAY CONCERN

This is certified that **Mrs. Neha W/o Ravi Kumar** has worked with our company from 01-10-2020 to 15-11-2020 as a **Sr. Sales Executive.**

During this tenure with us we found her to be quite hardworking, sincere and result oriented person. As a **Sr.Sales Execuvite** few of her responsible are:-

- To develop the business for the company.
- To add new franchise and white labels to the company client list.
- To promote the new and existing schemes of the company in market.
- To help the clients to make complete starting setup of the business.
- To ensurethe satisfaction of the clients.

She has excellent communication skills and is extremely organized reliable and has excellent computer skills. He is flexible and willing to work on any project that is assigned to her.

She was quick to volunteer to assist in other areas of company sales, as well.

Since the inspection of her appointment she has been taking the responsibilities as a challange with dedication that has absolutely no vanilty inspite of her high accomplishments and profound knowledge in her field.

She has done a fabulous job in her training period and we wish him best of luck for her future. Due to this skills, commitment and continued hard working, we wish him success in her ambition.

For KAUSHIK TRAVELS

PROP.

Principal
Pt. C.L.S Govt. College
KARNAL

FIELD SURVEY REPORT

SOCIO – ECONOMIC SURVEY BETI BACHAO

(A CASE STUDY OF INDRI TEHSHIL)

SESSION

2019-20

Report Submitted By

Name _Abhishek Dhiman

Roll- 1336010039

Class- B.A.6th Semester

University Roll- 170073001

(Dr Jamil Selmani)

DEPARTMENT OF GEOGRAPHY, PT. C.L.S.GOVT. COLLEGE, KARNAL

CHAPTER - 1

INTRODUCTION

National level programme BETI BACHAO AND BETI PADAO (The save the girl child and educate her) started from Panipat, Haryana with the aim to improve gender of our country. Under this programme 100 districts of country are identified which have low genders ration. Out which are highest in number compare to any other state. A closed second on the list is neighbouring punjab with 11 gender critical districts, followed by uttar pradesh, Maharastra and Rajas -than with 10 districts each. Gender ration is defined by the districts census of India as the number of female per 1000 males in population. According to the last census 2011 the Sex ratio in Haryana was 879 females per thousand male This was lowest among the states. Moreover Condition was worrisome in the child gender ratio where it was 834 females over 1000 male

Therefore there is immediate need to understand spatial and temporal pattern of gender ratio in Haryana. The present study is on gender ratio of Indri tehsil which lies in karnal district. The karnal district is one of the district which included in Beti Bachao program.

In this stu we try to understand the spatial pattern

of gender ratio of Indri tehsil.

OBJECTIVES :—

1. To understand spatial pattern of gender ratio in Indri Tehsil.
2. To find out causes of low gender ratio in Indri Tehsil.
3. To give suggestion for improving low gender ratio.

STUDY AREA

The present study area is Indri Tehsil. Indri is one of the tehsil of karnal. Other tehsil of karnal districtets are Nilokheri, Asandh, Gharaunda and karnal. Indri has total population of 162593. out of 162593 only 17487 live in urban area.

There are 80 village panchayat in Indri Tehsil. The total area of Indri tehsil is 1967 km2.

SOURCE OF DATA

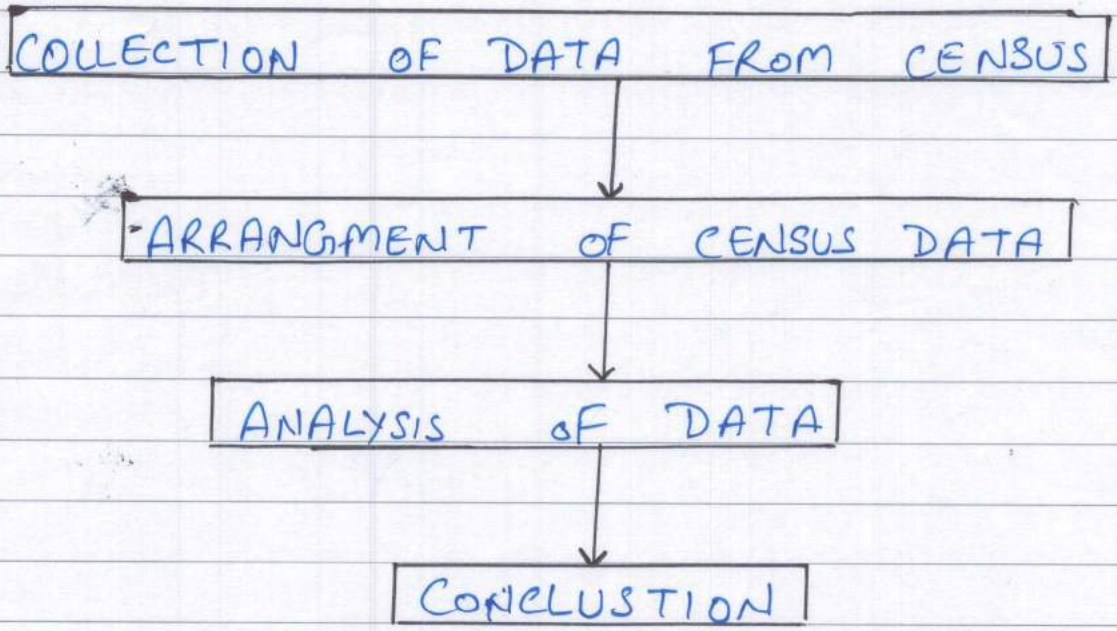
The main source of data is census data. This data we receive from website of school education department Haryana. However some data we gathered through personal contact with local people. The articles in local and national news paper also provide additional information about

Causes and pattern of gender ratio.

METHODOLOGY ADOPTED :-

This is small and simpl study therefore simple methodology adopted. The fallow chart of methodology adopted is given belaw.

METHODOLOGY ADOPTED



CHAPTER - 2.

GENDER RATIO

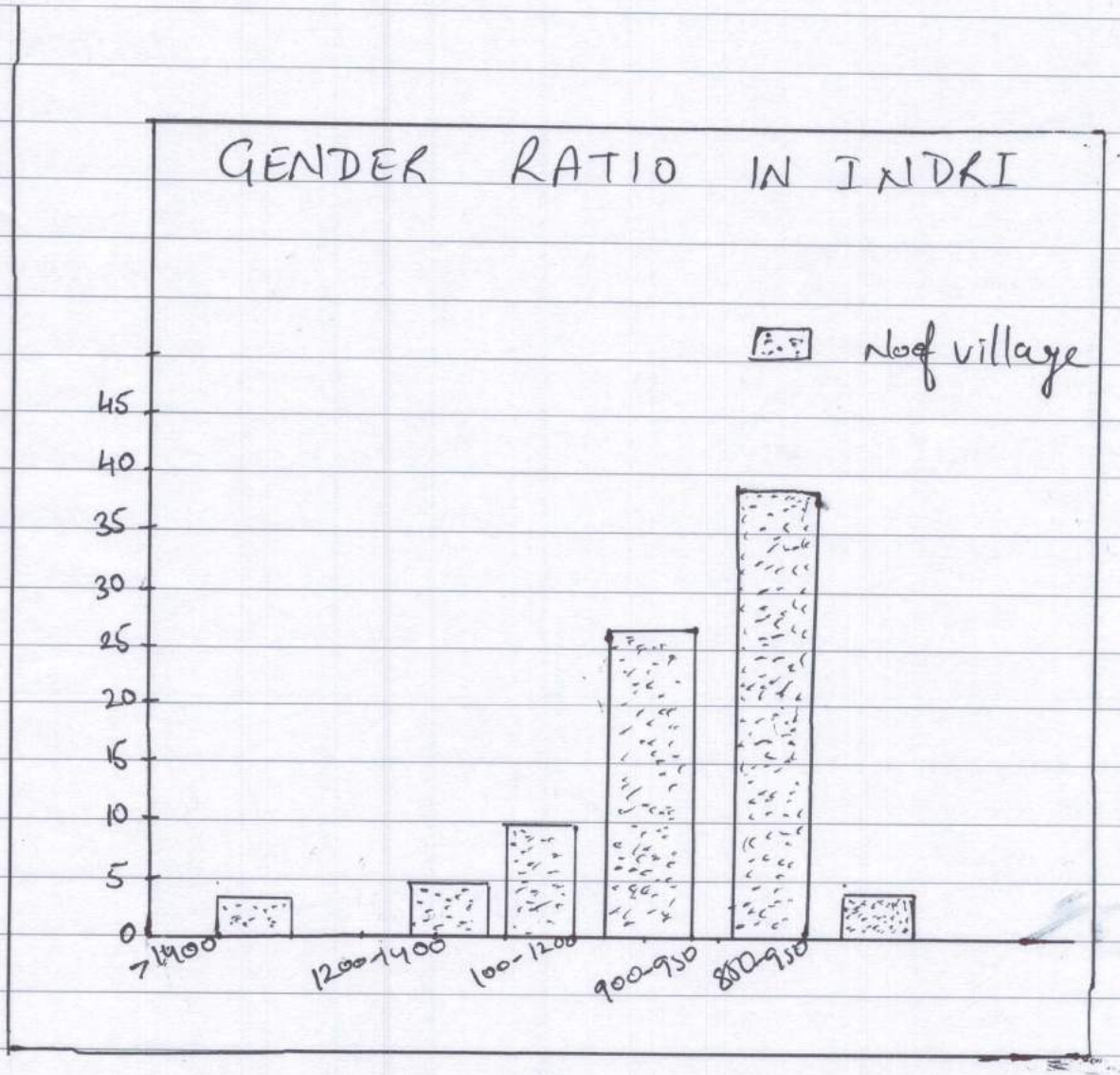
Gender ration is ration between number of males and females. In Indian context gender ration is number of females over per 1000 males. The gender ratio of Indri is low which 893 over 1000 male. However child gender ration (0-6) of Indri is very critical which 815.

The gender ratio of Indri is not uniform throughout Indri. Because some village has gender ration more than 1000 at the same time some village has gender ratio very critical which is less than 800. The following table shows number of village and their gender ratio.

Females over 1000 males	No. of village
> 1400	2
1200 - 1400	0
1000 - 1200	3
950 - 1000	6
900 - 950	26
850 - 900	39
< 800	2

The most of the village les in the

Category 850 - 950. There is only two village which has more than 1400 females over males. Moreover there are 11 village which has more females than males on the other side there are two villages which has gender critical ratio



The detail of gender ratio of different villages given below:

VILLAGE	GENDER RATION
INDRI	901
KHERI JATAN (19)	887
Udana (18)	872
Haibatpura (17)	922
Rai Tikhana (13)	941
Bir Rai Tikhan (12)	867
Dhunsa (16)	1400
Dhumsi (14)	935
Khanpur (7)	891
Chhapur (6)	834.
Hanauri (18)	916
Sheikhupura (12)	932
Dhanora jagir (1)	897
Kalri jagir (5)	841
Dhano kheri (4)	885
Kalra (3)	859.
Khokhni (6)	878.
Chogawan (7)	880
Hanso Majra (8)	875
Makhala (9)	892.
Nathauri (14)	817
Shergarh (15)	892
Bhoji (17)	846
Bhudhapur (19)	903
Chhapparian (20)	876
Tapparian (21	838
Zainpur Sadhan (5)	936
Kehrba (4)	1012.

VILLAGE	GENDER RATIO
Santhri (3)	.794
Bana (48)	.864
Randauli (49)	.853
Nagal (106)	.922
Kamalpur Gadria (108)	.920
Dabkauli Kalan (51)	.885
Chanal Samand (50)	.894
Nagal Roran (62)	.903
Kamalpur Roran (66)	.887
Bibipur Jattan (65)	.883
Shahpur (63)	.905
Manoharpur (64)	.842
Fazilpur (47)	.821
Jahar Majra Kalan (41)	.959.
Jahar majra khurd (46)	.969.
Ghisarpari (51)	.909
Nawrta (52)	.867
Janesron (53)	.923.
Gorgarh (64)	.937
Garhi Gujran (54)	.862
Samora (55)	.906
Kheriman Singh (63)	.909
Indri (MC)	.901
Indri (MC) Ward No. 0001	.913
Indri (MC) Ward No. 0002	.921
Indri (MC) Ward No. 0003	.971
Indri (MC) Ward No. 0004	.913
Indri (MC) Ward No. 0005	.936
Indri (MC) Ward No. 0006	.931
Indri (MC) Ward No. 0007	895.

VILLAGE	GENDER RATIO
Indri (MC) Ward No. 0008	852
Indri (MC) Ward No. 0009	914
Indri (MC) Ward No. 0010	848
Indri (MC) Ward No 0011	906
Indri (MC) Ward No. 0012	874
Indri (MC) Ward No. 0013	860
Andhgarh (8)	970
Garchi Jattan (9)	960
Badheri (2)	909
Garchi Sadhan (10)	901
Anjo khera (23)	829
Rampura (11)	808
Sorwan Majra (20)	862
Bhadson (21)	823
Bir Bhadson (22)	877
Sherpur Virgn (25)	741
Butan kher (24)	831
Ramalpur Gradian (42)	1025
Budhanpur Sikri (43)	856
Ramgarh (44)	667
Gadirbad (45)	817
Phusgarh (1)	874
khera (23)	897
Patehera (22)	928
Rojapur (28)	888
Fatehgarh (29)	667
Umarpura (31)	882
Nandi khalsa (16)	915
Malik - Apo-Ap (33)	1500

VILLAGE	GENDER RATIO
Gahri Birbal (32)	896
kharak (12)	893
Chandrach (10)	907
Garh pur Tapoo (11)	952
Lahkari (34)	918
kartarpur (35)	885
Musapur (36)	900
Shamashpur (37)	898
Tansang (30)	941
Islam Nagar (42)	921
kalri khalsa (27)	946
Nanhera (26)	916
Matak Majri (part) (24)	899
Jndri (Rural) (part) (46)	864
Dhamra (47)	893
Gumton (48)	898
Manak Majra Gadian (41)	945
Sheikhpura (40)	838
Bahlopur viran (65)	867
Dhamman Heri (49)	889.
Gudah (part) (50)	588
Rasulpur (24/1)	893
Jndergarh (25)	853
Muradgarh (44)	873
Garhpur khalso (43)	926
Badarpur (41)	947
kalsaura (38)	881
Nabiabad (101)	703
Zabti Chhapra (102)	921

VILLAGE	GENDER RATIO
Syed chapura (103	958
Halwana (105)	1052
Bibi pur Brahmana (39)	941
Sikanderpur (49)	947

CHAPTER-3.

CHILD GENDER RATION {(0-6) AGE-GROUP}

The Condition was warrisome in the child gender ratio where it was 834 females over 1000 males. Therefore there is immediate need to understand spatial and temporal pattern of child gender ration in Haryana.

VILLAGE	No of female child	VILLAGE	No of female child
Gndri	815	Nathauri (14)	446
Gndri	812	Shergarh (15)	859
Gndri	834	Bhaeji (17)	716
Kheri Jatan (19)	788	Bhudhanpur (19)	732
Udma (18)	828	Chhapriyan (20)	963
Haibatpura (17)	825	Zainpur sadhan (18)	920
Rai Tikhana (13)	917	Japrian (21)	745
Bir Rai Tikhana (12)	821	Keherba (4)	947
Dhumsa (16)	1000	Santheri (3)	679
Dhumsa (14)	868	Andhgarh (8)	714.
Khanpur (7)	770	Garhi Jattan (9)	856
Chapar (6)	896	Badhori (2)	1279.
Hanairi (18)	864	Garhi Sadhan (10)	917
Shakhupura (2)	1125	Punja khera (23)	727
Dhanora jagir (1)	1007	Rampura (11)	587
Kalra (3)	1037	Sariyan Majra (20)	921
Khokhri (6)	641	Bhadson (21)	782
Chogawan (7)	730	Bir Bhadson (22)	489
Harnso Majra (8)	678	Sherpur viran (25)	1000
Makhala (13)	696	Butan kheri (24)	798
Makhali (9)	716	Kamalpur (42)	1400

VILLAGE	ON of female child	VILLAGE	ON of FEMALE CHILD
Budhanpur Sikriya	725	Gudah (part) (50)	333
kalri jagir (5)	890	Dasulpur (24k)	1000
Dhano Khera (4)	735	Jindergarh (25)	714
Ramgarh (44)	273	Muradgarh (44)	549
Qudratabad (45)	467	Garhpurkhalso (43)	800
Phusgarh (1)	523	Badarpur (41)	916
khera (23)	614	kalasura (38)	781
patehera (22)	813	Nabiabad (101)	385
Rajapur (28)	0	Zabit chapra (102)	967
Umarpur (31)	756	Syed chapra (102)	1000
Nandi khalsa (16)	729	Halwana (105)	1800
Malik-Ap-AP (33)	1000	Bibipur Brahmana (35)	947
Garhi Birbal (32)	896	Sikanderpur (40)	643.
Garhpur taboo (11)	915	Biana (48)	796.
Lakkari (34)	804	Randauli (49)	770
kartarpur (35)	435	Nagal (106)	870
Musa pur (36)	1086	kamalpur (108)	762)
Shamashpur (37)	537	Dabkuli kalan (51)	815
Tasang (3)	1000	Chand Samand (62)	796
Islam Nagar (92)	860	kamalpur Rajan (66)	817
kalri chalso (27)	913	Shahpur (63)	935
Nanhera (26)	682	Manoharpur (64)	653.
Modah Majri (24)	1022	Fazilpur (47)	872
Indri (Rural) part (42)	1069	Johar majra kalan (45)	800
Dhumra (47)	810	Johar majra khurd (46)	823
Gumton (48)	734	Ghisarpari (51)	720
mahal majra Gadiyan (41)	741	Nauta (52)	816
Sheikhpura (40)	592	Jamesron (53)	928
Bahlalpur (42)	#DIV/0!	Jorgarh (64)	891
Dhamman Heri (49)	605	Garhi Gujran (54)	750

VILLAGE	No of FEMALE CHILD
Bibipur Jattan (65)	740
Somora 55	682
kheri man Singh (63)	797
Indri (MC)	834
Indri (MC) Ward No. 0001	605
Indri (MC) Ward No. 0002	542.
Indri (MC) Ward No. 0003	1121
Indri (MC) Ward No. 0004	894
Indri (MC) Ward No. 0005	1081
Indri (MC) Ward No. 0006	1000
Indri (MC) Ward No. 0007	758
Indri (MC) Ward No. 0008	769
Indri (MC) Ward No. 0009	674
Indri (MC) Ward No. 0010	703
Indri (MC) Ward No. 011	994
Indri (MC) Ward No. 0012	784
Indri (MC) Ward No. 0013.	813

SIZE OF VILLAGES (POPULATION)

The settlement of an area is demarcated by the either size of population or size of area. In the present chapter we are discussing the population size of different villages. The pattern of Indri are discussed. pattern of size of village. The most of villages have small in term of population size. The following table show the numbers of villages and their population size.

POPULATION SIZE OF VILLAGES 2011

NO OF VILLAGES	POPULATION SIZE
5	> 3000 Persons.
12	2000 - 3000
50	1000 - 2000
43	< 1000

The above table reveal that only five village have population more than 3000 persons and rest villages lies in range of 1000-3000 persons. moreover 80% village has population less than 2000 persons. The detail table of villages population size is given below.

VILLAGES	SIZE OF POPULATION	VILLAGE	SIZE OF POP
Indri Tehsil	162593	Santheri (3	845
Indri	17487	Andhgarh (8)	132
kheri Jatan (19)	849	Garhi Jattan(9)	1991
Udana (18)	1981	Badheri (2)	989
Haibatpura (17)	1741	Garhi Sadhan(10)	1544
Raj Tikhana (13)	1687	Ranja khera(23)	1241
Bir Rai Tikhana (12)	745	Rampura (11)	839
Dhumsa (16)	24	Sarwan majra (20)	1346
Dhumsi (14)	1320	Bhadson (21)	3200
khanpur (7)	2175	Bir Bhadson (22)	565
Chhapur (6)	1621	Sherpur Virgan(25)	47
Hanauri (18)	1606	Butan kher (24)	1734
Sheikhupura (2)	541	kamalpur Cadian(42)	164
Dhanora jagir (1)	2155	Budhanpur sikri(43)	644.
Ralri Jagir (4)	2310	Ramgarh (44)	95
khokhni (6)	565	Phusgarh (1)	1083
chogawan (7)	2344	Khera (23)	2698
Hanso majra (8)	2788	Patehera (22)	1822
Makhala (13)	808	Rajapur (28)	2032
Makhali (9)	995	Patehgarh (29)	20
Nathauri (14)	(25	Umarpur (31)	2340
Shergrh (15)	1417	Nandi khalso (16)	1360
Bhaoji (17)	1104	Malik - Apo-Ap (33)	15
Bhudhanpur (19)	1003	Garhi Birbal (32)	4129.
Chhapriqn (20)	788	kharak (12)	551
Tapriqn (21)	842	Chandrgon (10)	2269
Zainpur Sadhan (5)	2039	Garhpur tapoo(11)	886
Reherba (4)	648	Labkari (34)	

VILLAGES	SIZE OF POPULATION	VILLAGES	SIZE OF POPULA
karterpur (35)	296	Randauli (49)	2438
Musapur (36)	1248	Nagal (106)	1007
Shamashpur (37)	579	Kamalpur Qadria (08	695
Tasang (30)	990	Dabkauli kalan (57)	2729
Gslam Nagar (42)	1214	Chand Samand (50)	2248
Kalri Khalso (27)	1374	Nagla Karan (62)	2327
Nanhera (26)	941	Kamalpur Karan (66)	1912
Matak Majri (Part) 24	773	Bibipur Jattan (65)	3554
Indri (Rural) Part (46)	997	Shahpur (63)	1444
Dhamra (47)	636	Manoharpur (64)	574.
Gumton (48)	983	Fazilpur (47)	765
Mahak majra Gadhan	671	Johar Majra kalan 45	1297
Sheikhpura (40)	603	Johar Majra Khurd (46)	1142.
Bhalalpur Viran (65)	5	Chhisarpari (51)	420
Dhamman Heri (49)	529	Nausta (52)	1561
Gudah (Part) (50)	27	Janesoon (53)	3031
Rasulpur (24/1)	810	Gorgarh (64)	1792
Indergrah (25)	958	Garhi Gujran (54)	1724
Muradgarh (44)	1708	Smora (55)	1969.
Garhpur khalsa (43)	994	Kherimansingh (63)	3050
Baderpur (41)	2177	Indri (MC)	17487
Kalsaura (38)	5123	Indri (MC) ward no 001	1538
Nabiabad 101	126	Indri (MC) ward no. 002	1106
Zabti chhapra (102)	1470	Indri (MC) ward no. 0003	1033
Syed Chhapra (018)	1265	Indri (MC) ward no. 0004	2375
Halwana (105)	238	Indri (MC) ward no. 0005	948
Bibipur Brahmana	3175	Indri (MC) ward no. 0006	
Sikanderpur (40)	183	Indri (MC) ward no. 0007	1421
Biana (48)	6073	Indri (MC) ward no. 0008	1313

VILLAGES Name	SIZE OF POPULATION
Indri (MC) Ward No. 0009	1095
Indri (MC) Ward No. 0010	1674
Indri (MC) Ward No. 0011	1479
Indri (MC) Ward No. 0012	1306
Indri (MC) Ward No. 0013	1267

CAUSES OF LOW GENDER RATIO AND SUGGESTION :-

1. **DOWRY SYSTEM :-**

As Haryana is economically stronger than other states, per capita income of the people is more so there is more demands of dowry.

2. **Crimes against females :-**

In Haryana Crimes causes ageist females are more and administration is not able to put control on such incidences in last few years.

3. **Small family norms :-**

For the sake of small families also parents do not want more daughters, abortin of female foetus preferred.

4. **Problem of security of Girls :-**

As girls are more prone to crimes, problem security of girls is also a main problem of parents.

SUGGESTION :—

1. The pre-natal diagnestic technique Act (PNDT) should be implemented strictly and local government should also play a supervisery role in it

2. Awareness about declining sex ration and towards the problems of less numbes of girls should created by the local goverment with help of an ganwedies workers, self help groups, mahila mandals and NGOs.

3. Media can also play important role in creating awareness about PNDT Act and female foeticide.

4. Refresher Course for the doctors to follow PNDT Act and ethical standards in their practices.

Pt. Chiranji Lal Sharma Govt. College, Karnal

PG diploma in Guidance Counselling and Psychotherapy

Point 1.3.2

List of Student who underwent Internship during session 2019-20

Sr. No.	Name	Class Roll NO.
1	Salinder Kumar	4721010001
2	Guljar	4721010002
3	Vedvart Kajal	4721010003
4	Afsar Singh	4721010004
5	Sikha Tyagi	4721020002
6	Jyoti	4721020004
7	Ritu Rani	4721020005
8	Sonia Devi	4721020007
9	Neetu Rani	4721020009
10	Manju	4721020013

Teacher in-Charge

Principal
Pt. C.L.S Govt. College
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Principal

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Memo No.:- KCGMC/Estt./GA-1/2020/

Dated:

INTERNSHIP TRAINING CERTIFICATE

It is certified that Mr. Salinder Kumar has completed his Internship Training in this Institute as per schedule given below. During this period of internship his work and conduct remained satisfactory: -

Sr. No.	Name	Address	Period of training	Department
1	Mr. Salinder Kumar S/o Sh. Hardev	VPO- Picholia, Karnal.	02.12.2019 to 01.01.2020	Psychiatry

Dated: 14.01.2020

Sd/-
Director,
Kalpana Chawla Govt. Medical College,
Karnal

Endst No.: KCGMC/Estt/GA-1/2020/ 777-778 Dated: 20/01/2020

A copy of the above is forwarded to the followings for information and necessary action: -

1. HOD/Incharge (Psychiatry), KCGMC, Karnal.
2. Mr. Salinder Kumar S/o Sh. Hardev, VPO- Picholia, Karnal.

Superintendent
For Director, Kalpana Chawla Govt. Medical College,
Karnal

Principal
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Dated:

INTERNSHIP TRAINING CERTIFICATE

It is certified that Mr. Guljar has completed his Internship Training in this Institute as per schedule given below. During this period of internship his work and conduct remained satisfactory: -

Sr. No.	Name	Address	Period of training	Department
1	Mr. Guljar S/o Sh. Skur Mohamad	Village- Nandi Khalsa, Indri, Karnal	02.12.2019 to 01.01.2020	Psychiatry

Dated: 14.01.2020

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Endst No.: KCGMC/Estt/GA-1/2020/ 779-780 Dated: 21/01/2020

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1. HOD/Incharge (Psychiatry), KCGMC, Karnal.
2. Mr. Guljar S/o Sh. Skur Mohamad, Village- Nandi Khalsa, Indri, Karnal.

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INTERNSHIP TRAINING CERTIFICATE

It is certified that Mr. Vedvrat Kajal has completed his Internship Training in this Institute as per schedule given below. During this period of internship his work and conduct remained satisfactory: -

Sr. No.	Name	Address	Period of training	Department
1	Mr. Vedvrat Kajal S/o Sh. Narinder Singh	H. No. 12, Jeevan Vihar, Kunjpura Road, Karnal	02.12.2019 to 01.01.2020	Psychiatry

Dated: 14.01.2020

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Endst No.: KCGMC/Estt/GA-1/2020/ 785 786 Dated: 20/1/2020

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1. HOD/Incharge (Psychiatry), KCGMC, Karnal.
2. Mr. Vedvrat Kajal S/o Sh. Narinder Singh, H. No. 12, Jeevan Vihar, Kunjpura Road, Karnal.

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Dated

INTERNSHIP TRAINING CERTIFICATE

It is certified that Mr. Afsar Singh has completed his Internship Training in this Institute as per schedule given below. During this period of internship his work and conduct remained satisfactory: -

Sr. No.	Name	Address	Period of training	Department
1	Mr. Afsar Singh S/o Sh. Surjan Singh	Village- Dussain, Kaithal	02.12.2019 to 01.01.2020	Psychiatry

Dated: 14.01.2020

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Endst No.: KCGMC/Estt/GA-1/2020/ 791-792 Dated: 20/1/2020

A copy of the above is forwarded to the followings for information and necessary action: -

1. HOD/Incharge (Psychiatry), KCGMC, Karnal.
2. Mr. Afsar Singh S/o Sh. Surjan Singh, Village- Dussain, Kaithal.

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Dated

INTERNSHIP TRAINING CERTIFICATE

It is certified that **Ms. Sikha Tyagi** has completed her Internship Training in this Institute as per schedule given below. During this period of internship her work and conduct remained satisfactory: -

Sr. No.	Name	Address	Period of training	Department
1	Ms. Sikha Tyagi W/o Sh. Kamal Tyagi	1271, Sector-7, Urban Estate, Karnal	02.12.2019 to 01.01.2020	Psychiatry

Dated: 14.01.2020

Sd/-
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Karnal

Endst No.: KCGMC/Estt/GA-1/2020/ 787-788 Dated: 20/1/2020

A copy of the above is forwarded to the followings for information and necessary action: -

1. HOD/Incharge (Psychiatry), KCGMC, Karnal.
2. Ms. Sikha Tyagi W/o Sh. Kamal Tyagi, 1271, Sector-7, Urban Estate, Karnal.

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Dated:

INTERNSHIP TRAINING CERTIFICATE

It is certified that Ms. Jyoti has completed her Internship Training in this Institute as per schedule given below. During this period of internship her work and conduct remained satisfactory: -

Sr. No.	Name	Address	Period of training	Department
1	Ms. Jyoti D/o Sh. Dharamveer	H. No. 358, Kalandri Gate, Jattan Gali, Karnal	02.12.2019 to 01.01.2020	Psychiatry

Dated: 14.01.2020

Sd/-
Director,
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Karnal

Endst No.: KCGMC/Estt/GA-1/2020/ 783-784 Dated: 20/01/2020

A copy of the above is forwarded to the followings for information and necessary action: -

1. HOD/Incharge (Psychiatry), KCGMC, Karnal.
2. Ms. Jyoti D/o Sh. Dharamveer, H. No. 358, Kalandri Gate, Jattan Gali, Karnal.

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Memo No.:- KCGMC/Estt./GA-1/2020/

Dated:

INTERNSHIP TRAINING CERTIFICATE

It is certified that **Ms. Ritu Rani** has completed her Internship Training in this Institute as per schedule given below. During this period of internship her work and conduct remained satisfactory: -

Sr. No.	Name	Address	Period of training	Department
1	Ms. Ritu Rani D/o Sh. Satbir	Village- Sohana, PO- Sheikhpura, District- Karnal	02.12.2019 to 01.01.2020	Psychiatry

Dated: 14.01.2020

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Karnal

Endst No.: KCGMC/Estt/GA-1/2020/ 781-782 Dated: 20/1/2020

A copy of the above is forwarded to the followings for information and necessary action: -

1. HOD/Incharge (Psychiatry), KCGMC, Karnal.
2. Ms. Ritu Rani D/o Sh. Satbir, Village- Sohana, PO- Sheikhpura, District- Karnal.

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Memo No.:-KCGMC/Estt./GA-1/2020/ 673 Dated 24/1/2020

Dated: 24-1-20

INTERNSHIP TRAINING CERTIFICATE

It is certified that **Ms. Sonia Devi** has completed her Internship Training in this Institute as per schedule given below. During this period of internship her work and conduct remained satisfactory: -

Sr. No.	Name	Address	Period of training	Department
1	Ms. Sonia Devi D/o Sh. Raghubir Singh	Village- Panjokhera, PO- Bhuttan Kheri	02.12.2019 to 01.01.2020	Psychiatry

Dated: 14.01.2020

Sd/-
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Endst No.: KCGMC/Estt/GA-1/2020/ 673-674 Dated: 24/1/2020

A copy of the above is forwarded to the followings for information and necessary action: -

1. HOD/Incharge (Psychiatry), KCGMC, Karnal.
2. Ms. Sonia Devi D/o Sh. Raghubir Singh, Village- Panjokhera, PO- Bhuttan Kheri.

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Memo No.:- KCGMC/Estt./GA-1/2020/ Dated:

INTERNSHIP TRAINING CERTIFICATE

It is certified that **Ms. Neetu Rani** has completed her Internship Training in this Institute as per schedule given below. During this period of internship her work and conduct remained satisfactory: -

Sr. No.	Name	Address	Period of training	Department
1	Ms. Neetu Rani D/o Anant Ram	VPO- Ghogripur, Karnal	02.12.2019 to 01.01.2020	Psychiatry

Dated:

Sd/-
Director,
Kalpana Chawla Govt. Medical College,
Karnal

Endst No.: KCGMC/Estt/GA-1/2020/ 1336-1337 Dated: 03/02/2020

A copy of the above is forwarded to the followings for information and necessary action: -

1. HOD/Incharge (Psychiatry), KCGMC, Karnal.
2. Ms. Neetu Rani D/o Anant Ram, VPO- Ghogripur, Karnal.

Superintendent
For Director, Kalpana Chawla Govt. Medical College,
Karnal

Principal
Pt. C.L.S Govt. College
KARNAL

OFFICE OF THE DIRECTOR,
Kalpana Chawla Govt. Medical College, Karnal
Telephone No. & Fax No. 0184-2266152, Website www.kcgmc.edu.in Email: kcgmckarnal18@gmail.com

Memo No. :- KCGMC/Estt./GA-1/2020/

Dated:

INTERNSHIP TRAINING CERTIFICATE

It is certified that Ms. Manju has completed her Internship Training in this Institute as per schedule given below. During this period of internship her work and conduct remained satisfactory: -

Sr. No.	Name	Address	Period of training	Department
1	Ms. Manju D/o Sh. Subhash Chander	Village- Kailash, PO- Tikari, Karnal	02.12.2019 to 01.01.2020	Psychiatry

Dated: 14.01.2020

Sd/-
Director,
Kalpana Chawla Govt. Medical College,
Karnal

Endst No.: KCGMC/Estt/GA-1/2020/ 5041-50 Dated: 20/1/2020

A copy of the above is forwarded to the followings for information and necessary action: -

1. HOD/Incharge (Psychiatry) KCGMC, Karnal
2. Ms. Manju D/o Sh. Subhash Chander, Vill. Village- Kailash, PO- Tikari, Karnal.

Superintendent
For Director, Kalpana Chawla Govt. Medical College,
Karnal

Principal
Pt. C.L.S Govt. College
KARNAL