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Botanical Herbicides in System Intensification: An approach towards Sustainability in Environment and Agriculture

Dibyendu Mondal*, Anannya Ghosh, Adyant Kumar, Ratikanta Ghosh and Pintoo Bandopadhyay

Department of Agronomy, Bidhan Chandra Krishi Viswavidyalaya, West Bengal
**Corresponding author: dibyendumondal.agri@yahoo.com*

Abstract

For global food security, system intensification is the best low cost eco safe approach that deals with the best management practices from within the available resources and perception of the by farmer. Biological management for the improvement of soil & plant health is the underlying concept. The weed pest alone causes 11.5 & 12.5 % production losses in global & national agriculture. Among the various alternatives of traditional hand weeding management practices through physical, ecological, biological in integration with chemical herbicides are gaining ground. Chemical herbicides no doubt have been a boon to the farmers but in the long run continuous inorganic use in agriculture has posed a significant threat to the natural environment. With the rising consumerism of organic food and policy support towards sustainable agriculture correcting vices of Green Revolution, incorporation of more eco-friendly and sustainable weed management practices, among which botanical plant extracts offer a new dimension through production of excellent source of biologically active natural products. In India Tectona grandis (Teak), Calotropis gigantea (Akand), Hibiscus sabdariffa (Roselle-Tak Bhindi), Jasminum officinale (Jui phul), Bambusa vulgaris (Bamboo), Parthenium hysterophorus (Gajar ghash), Echinochloa colonum (Jangli Dhan) Physalis minima (Ban makao), Melilotus alba (Senji methi), Xanthium strumarium (Cocklebur),etc. extracts were used in paddy, soyabean and many other crops. Besides lesser detrimental effects on the soil microflora, 30-40 % more economic advantages over the chemical herbicides were also observed. This is possible owing to botanicals having phenol and formation of stable phenoxide ion which triggers its acidic nature and causes ACEase enzyme inhibition. Plant extracts potentially possess multiple phytotoxic components and hence multiple modes of herbicidal actions, making it more difficult for weeds to develop herbicide resistance and most products show wide windows of crop safety. Hence botanicals can be ushering in a new regime to promote sustainability in agriculture and fostering safe agriculture. To promote it needs more awareness programmes.

BACKGROUND

The demand for food and processed commodities is increasing due to growing population and rising per capita income. Global food demand is expected to be doubled by 2050 while production, environment and natural resources are continuously shrinking and deteriorating. Food crisis has aggravated further because of climate change and diversion of arable lands to urbanization, industrialization and also for producing bio-fuel. There are projections that demand for food grains in India would increase to 345 mt by 2030. Hence in the next 15 years, the production of food grains

needs to be increased at a rate of around 5 mt annually, which is a challenge to agriculturists. In such a situation the 'System of Intensification', is a low cost ecosafe methodology that deals with the best management practices with what farmers have by their improved thinking and using integrated seed, nutrient, water, pest & quality management. Biological management for improved soil & plant health is the basic concept of this methodology (Uphoff, 1999; Ghosh *et al*. 2014). The production losses due to pests are 33 % and the major pest i.e., weed plants alone causes 11.5 & 12.5 % global & national production losses (DWR, 2015).

INTRODUCTION

The Plant world comprises a rich storehouse of bio-chemicals which could be more tapped as pesticides. The total number may exceed 4 million. Of these, only 10,000 are secondary metabolites. Allelopathy, the term coined by Prof. Hans Molisch, a German Plant Physiologist in 1937, is a new field of science. Plants have acquired a complex eco-physiological strategy that allows them to directly or indirectly modify the growth and development of other plants by releasing chemicals into the environment, this phenomenon is known as allelopathy. Allelochemicals inhibit the growth and development of the plants primarily in two ways- Autotoxy (allelochemicals of the same plant inhibit the growth and development of the seedlings of same plant e.g., *Parthenium hysterophorus*) and Teletoxy (allelochemicals of some plants inhibit the seedling germination and development of other plants e.g *Lantana camera*). Plants typically biosynthesize these compounds as secondary metabolites, which, in addition to act as ecological factors that regulate the composition and dynamics of plant communities, can also be used directly to control the growth of weeds or in other words can serve as a source of natural herbicides (Koul and Walia, 2009). Weeds constitute a major obstacle to the productivity of numerous crops. Because of easy availability & less costlier than traditional hand weeding, the chemical weed management, since last few years, have been more accepting by the farmers. In spite of knowing that synthetic pesticides cause ecological and health hazards as hardly 0.1% enter the target pests and rest 99.9 % are released to the environment. Contamination of synthetic chemical pesticides with soil and water bodies causes detrimental effect on macro and micro flora & fauna. However, the large-scale use of synthetic herbicides has led to the development of a number of environmental problems, including risks to human health and the induction of weed resistance (Jabran *et al.* 2010). Nowadays in respect to the ill effects of synthetic pesticides to the human health & environment, some safer pesticides (blue & green labelled) are available in the market. But the urgent need is, to aware the farmers about the use of these pesticides. Natural phytotoxins derived from plants may represent an alternative to the use of synthetic herbicides. These compounds are advantageous because they are biodegradable, have great structural diversity and complexity, demonstrate diversity in their sites of action and are safer for non-target organisms (Koul and Walia, 2009). Furthermore, these phytotoxins have different levels of action, and the combination of different modes and multiple levels of action make these substances effective for the control of weeds. Recent research through the

programme taken under Rastriya Krishi Vikash Yajona (RKVY) Project, Government of West Bengal (Jana *et al.* 2011) indicated that biological management is more eco safe and lesser costly than chemical herbicides and would be more acceptable in system intensification (Ghosh *et al.* 2014). But the availability of botanical herbicides at the rural market with proper formulation along with improved thinking of stake holders and farmers through awareness and training programmes is urgently needed to exploit the potentiality of ecosafe botanical herbicides.

NATURAL PRODUCTS FOR WEED MANAGEMENT

The management of weeds has been a major problem since the inception of agriculture. In fact, unmanaged weeds cause greater reduction in crop yields than the presence of any other agricultural pest. Manual labour came down as a skill from ancestral farming and is still practiced. Not surprisingly, modern agriculture relies heavily on the use of synthetic herbicides for managing weeds. This has been possible because synthetic herbicides are highly effective (active ingredient application rates can be as low as a gram per hectare). Many of these compounds have very good selectivity toward crops and are relatively inexpensive to manufacture. While their use has become increasingly controversial, most currently used herbicides have low impact on the environment and wildlife. Today, herbicides account for more than half of the volume of all agricultural pesticides applied in the developed world and the public has expressed concern about the potential health and environmental impact of these compounds. Partly due to this, organic agriculture has received a recent surge in popularity.

Plant bioagents with herbicidal activity

Several plants or their parts are directly used to control many pests particularly weed pests through natural allelochemicals e.g. *Cassia tora /uniflora /occidentalis; Amaranthus spinosus; Sida spinosa; Tephrosia purpurea; Croton sparsiflorus; Tagetes erecta /patula; Kochia scoparia. Cymbopogon flexsuosus* etc. areused to manage invasive weed *Parthenium hysterophorus*. Similarly, many plants like *Lantana camera, Bambusa vulgaris* etc. with their natural allelochemicals (secondary plant metabolites like Phenolic acid, Prussic acid, Benzoic acid, Cinnamic acid, Lactones, Alkaloides, Oxalates, Glucosides, Tannins etc.) inhibit the germination and restrict the invasion of many weed pests in surrounding areas without any detrimental effect on the desired cultivated crops (Dayan *et al*. 2009). Some examples are - plant extracts containing acetic acid use as non-selective herbicide; fatty acids like pelargonic acids (succinic, lactic or glycolic acid) use to control annual weeds; essential oils use as non-selective contact herbicide to control many weed pests.

Probable mechanism of action of botanicals

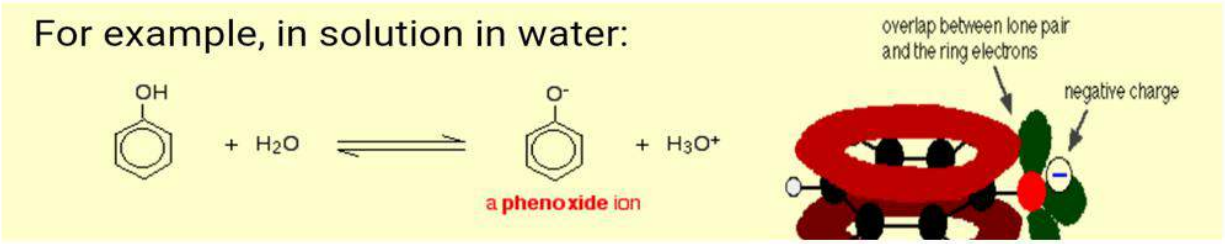
- **Protein Synthesis / Microtubule assembly inhibitors:** It inhibits the assemblification of microtubules, polymerization of tubulin (the major protein content) which is very much essential for formation of cell wall. As a result arrestation of cell division, formation of polynucleate cells and eventually inhibition of root and plant growth.

Table 1 Allelochemical activities of some natural plants (Botanicals)

Name of plant	Allelochemical	Action
Ageratum conyzoides/ haustonianum (Gandhali)	Chromoneme derivative precocens	Anti allelotropic i.e. prevent JH synthesis
Andropogon aciculatus (Chorkanta)	Essential oil - repellent	The oil effective against mosquito
Argemone mexicana (Sialkanta)	Sanguinarine and 11-Oxotriacontanoic acid	Poison - Blindness
Artemisia absinthium (Common rag weed)	Absinthium, a dimeric sesquiterpene ethanol extracts	Antifeedent activity against insects leaf roller
Artemisia capillaries (Rag weed)	Capillin	Fungal infections
Bambusa vulgaris (Bamboo)	Rutin, Tricin, Luteoalin	Controlled small grassy weeds; Pesticide effects
Blumea lacera (Bon mula)	Fenchane, δ- Fenchone, Monoterpene Citral a	Pesticide effects
Calotropis gigantean /procera (Akanda)	Calotropin and Mudarine	Controlled most small grassy weeds; Pesticide effects
Carica papaya (Papaya)	Benzyl isothiocyanate	Herbicide effects
Chrysanthemum richilaria (Chandramallika) + *Blumea lacera* (Bon mula)	Pyrithrum (I & II) and Cinerin (I & II) [same action as Pipernyl Butoxide]	Pest control & against *Meloidogyne spp* after decomposition
Cyperus rotundus (Mutha)	Valencene, Noolkatone	Oil for incense; Pesticide effects
Datura stramonium/ Datura fastuosa (Thronapple)	Xanthoxyletin - Leaves, Root Antifeedent activity	Against insects *Meloidogyne spp* after six week of decomposition
Echinochloa colona (Jangli dhan)	Cumaric acid, Apegenin Benzoxazinoids	Potential used for monocot grassy weed control
Lantana camera (Lantana)	Lantradene -A	Jaundice to animal; Weed control, Pesticides effect
Melilotus alba / indicus(Senji)	Dicumarin	Antiblood coagulent
Ocimum basilicum/ suave (Bon tulsi)	Essential Oil / Leaves	Pesticides effect
Oryza sativa (Paddy wild cultivars)	Momilactone B	Control grassy weeds like *Echinochloa spp.*
Parthenium hysterophorus (Bon gajar, Sada tupi)	Sesquiterpene lactones & Phenols	Control small grassy weeds; Skin disease
Physalis minima (Bon makao)	Imperatorin withanoilides	Antifeedent activity
Pinus sylvestris (Pine)	Terpene hydrocarbons, Ethers and esters; Cyclic terpene alcohols.Alpha-Terpineol	Non-selective herbicide, not so much effective as glyphosate
Sorghum halepense (Johnson grass)	High prussic acid**;** Sorgoleone	Suppress the weed growth,Poison to animal
Syzygium aromaticum (Clove)	Bud, leaf and stem oil Eugenol, caryophyllene and acetyl eugenol	Controlled most small grassy weeds; Pesticide effects
Tagetes patula / erecta	Root exudates four thiophenes	Pesticides effect

(Marigold)	and two benzofurans	
Tectona grandis (Teak)	Phenols, Salicyclic Acid	Controlled small grassy weeds; Pesticides effect
Tephrosia purpurea (Ban neel)	Hildecarpan, a Pterocarpan and Rotenoides & Rotenone	Antifeedent against legume pod borer / Lepidopteran
Withania somnifera (Aswaganda)	Withanolides –antifeedents	Pesticide effects
Xanthium strumarium (Cocklebur)	Carboxyatractyloside	Plant inhibiting effects

- **Fatty acid (Lipid) Biosynthesis**
  ACEase (Acetyl Elongase) inhibition (Very long fatty acid chain inhibition). The chemicals inhibit the cell division and elongation in seedling shoots before they emerge above ground.
- **Uncouplers (Membrane Disruption): Inhibition of Oxidative Phosphorylation**
  Botanicals are having very weak phenolic acids but these will be recognisably acidic properties particularly in moist soil. A Hydrogen ion can break away from the – OH group and transfer to a base. The position of equilibrium lies well to the left.



Phenolic acids may lose a hydrogen ion because the phenoxide ion (and Hydroxonium ion) formed is stabilized to some extent. The negative charge on the oxygen atom is delocalised around the ring through resonance action. The more stable the ion is, more likely it is to form.One of the lone pairs on the oxygen atom overlaps with the delocalised electrons on the benzene ring. Formation of stable phenoxide ion triggers its acidic nature which attacks the long chain and causes ACEase inhibition (Ghosh *et al*. 2016).

Plant extracts (raw, aqueous, methanolic etc.)

These are used to control weed pest through the allelochemical activities (Ghosh *et al*. 2015) and are normally called as *'Botanicals'*e.g. raw extracts of *Parthenium hysterophorus***;** aqueous extracts of *Bambusa vulgaris*; methanol extracts of *Tectona grandis* etc (Chen, 2009). To enhance the bioefficacy, these botanicals can also be used in mixture e.g. mixture of aqueous extracts of *Bambusa vulgaris* + *Parthenium hysterophorus.*

Procedure of preparation raw extract from the following natural plants

Parthenium hysterophorus (Stem & Leaf)	*Calotropis procera / gigantea* (Stem & Leaf)	*Ageratum conyzoides/ haustonianum* (Stem & Leaf)
Melilotus alba / indica (Stem & Leaf)	*Echinochloa colona* (Stem & Leaf)	*Cyperus difformis* (Young plant)
Physalis minima (Stem & Leaf)	*Blumeala cera* (Stem & Leaf)	*Tephrosia purpurea* (Leaf)
Jasminum officinale (Leaf)	*Carica papaya (*PapayaLeaf)	*Hibiscus sabdariffa* (Leaf)
Ocimum basilicum (Young twigs)	*Tagetes patula* (Young plant)	*Cannabis sativa* (Young plant)

(i) Collect the green natural plants and from it separate the required specific green part.
(ii) Measured the required part (X kg) and from it take 900 g sample.
(iii) Bruise the sample in "Hamaldista" adding 100 ml fresh water.
(iv) With the help of fine mesh collect the juice or raw extract.
(v) Measure the amount and calculate conversion factor.
[Initial raw material (900 g + 100 ml) x ---------- (conversion factor) = Actual extracts]
(vi) Keep the actual raw extracts in a safe container

Procedure for Preparation of Aqueous extract from the following natural plants

Parthenium hysterophorus (Whole plant)	*Calotropis procera / gigantea* (Stem & Leaf)	*Xanthium strumarium* (Fruit & leaf)
Sorghum halepense (Stem & Leaf)	*Melilotus alba / indica* (Stem & Leaf)	*Blumea lacera* (Stem & Leaf)
Ageratum conyzoides/ haustonianum (Stem & Leaf)	*Echinochloa colona* (Stem & Leaf)	*Physalis minima* (Stem & Leaf)
Tephrosia purpurea (Leaf)	*Cyperus rotundus* (Whole plant)	*Cyperus difformis* (Whole plant)
Jasminum officinale (Leaf)	Papaya (Leaf)	*Hibiscus subdarifa* (Leaf)
Tectona grandis (Leaf)	*Bambusa vulgaris*(Root & Leaf)	*Datura stramonium* (Stem & Leaf

Figure 1 Preparation of raw extract

a) Collect the required natural plants and separate the necessitated plant parts
b) Dry these plant materials and dried up plant parts grind in grinder machine
c) 100 g powder placed into the glass container and adds 900 ml water in the glass container
d) Overnight soak this container and then boil this for two hours at 60^0 C
e) After proper boiling, the plant parts are separated by filter paper and keep the aqueous extract in a safe container
f) Measure this amount and find out the conversion factor

[Initial raw material (100 g + 900 ml) x ---------- (conversion factor) = Actual extracts]

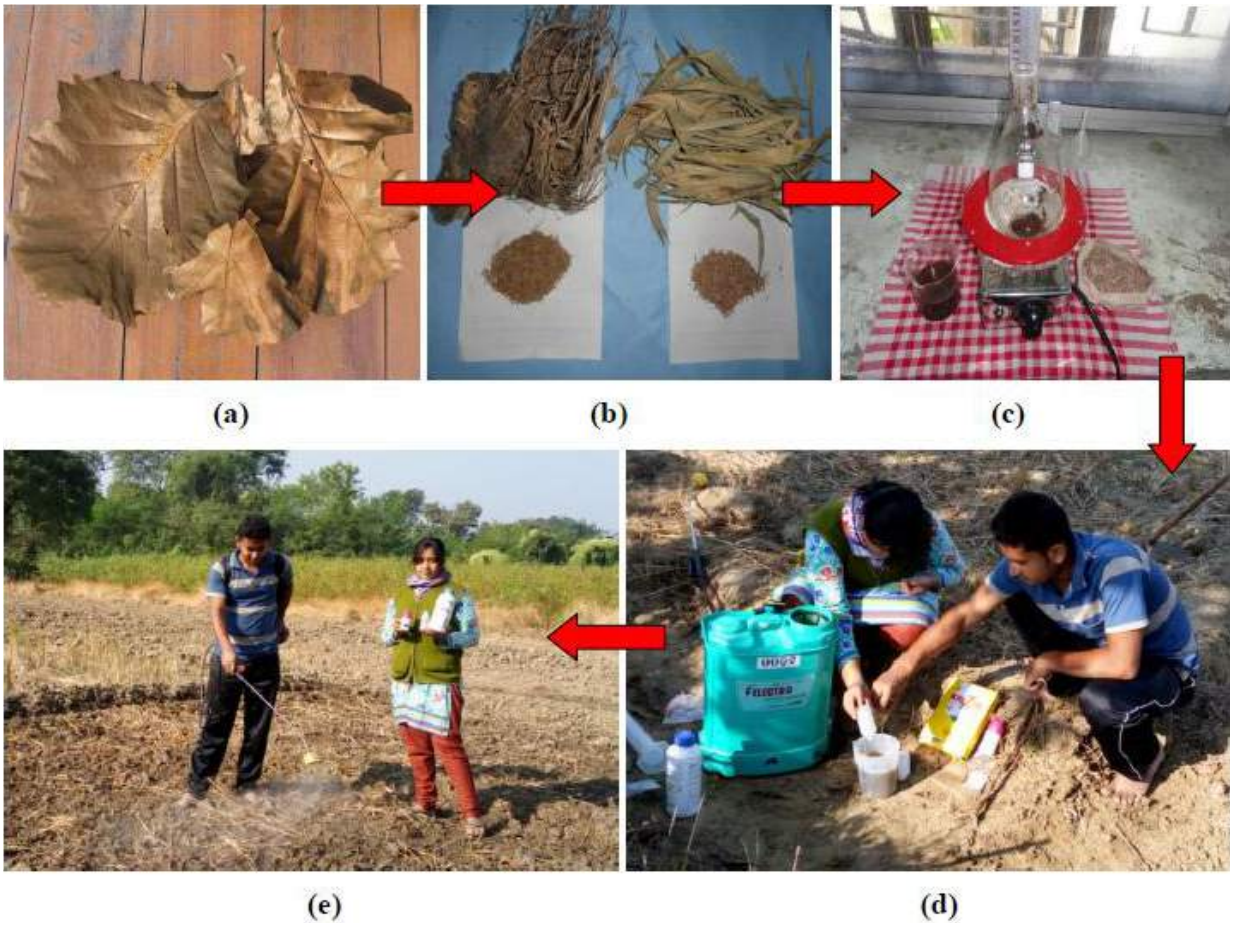


Figure 2 Preparation of Aqueous extract

Preparation of spray solution and spraying it in suitable field as pre emergence

- Select a fresh field with sufficient moist condition and measure area to be sprayed
- Fixed spraying sites of minimum 100 m^{-2} in this field. Then sites are demarcated with pegs
- Identify weed flora of the demarcated area and make density list of weed flora species wise
- Measure the raw or aequeous extracts for spraying @ 100 ml litre of water $^{-1}$ for the area to be sprayed and water must be @ one litre of water for 20 m^{-2}
- Before spraying add 0. 25% non ionic surfactant (e.g. Tween- 80, Tween- 20, S -145 etc.) with the ready spray sample
- Spray in moist soil as PE (within 1 DAS/DAP/DAT) and Spay at earliest after preparation (within an hour after preparation)
- After two weeks take observation about bioefficacy on weed plants

CONCLUSION

For maintaining global food security, system intensification is the best low cost eco safe methodology that deals with the best management practices of the available resources by farmers' improved thinking. Biological management for the enhancement of soil and plant health is the basic concept for maintaining sustainability in environment and agriculture. Keeping in view the detrimental effects of chemical herbicides towards

mankind and environment, the natural phytotoxins derived from plants may represent an alternative to the use of synthetic herbicides. The botanicals are advantageous because they are biodegradable, have great structural diversity and complexity, demonstrate diversity in their sites of action and are safer for non-target organisms. Plant extracts potentially possess multiple phytotoxic components; hence multiple modes of herbicidal actions make it more difficult for weeds to develop herbicidal resistance and thus most of the products show wide windows of crop safety. Hence botanicals can be ushering in a new regime to promote sustainability in agriculture and fostering safe environment. But availability of botanical herbicides at the rural market with proper formulation along with the improved thinking through awareness and training programme of stake holders and farmers is urgently needed to exploit the potentiality of ecosafe botanical herbicides.

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Organic farming: a curative approach against pesticidal residue

Mala Singh*, Ram Kumar Singh, Ravi Prakash Pal and Rachana Sharma

[1]PhD scholars, ICAR-NDRI, Karnal Haryana
Corresponding author: raviprakashpal61@gmail.com

Organic agriculture was practiced for thousands of years without the use of hazardous chemicals. Artificial fertilizers were first created during the mid-19th century. These early fertilizers were cheap, powerful and easy to transport in bulk. Similar advances occurred in chemical pesticides in the 1940s, leading to the decade being referred to as the 'pesticide era'. These new agricultural techniques, while beneficial in the short term, had serious longer term side effects such as soil compaction, erosion, and declines in overall soil fertility, along with health concerns about toxic chemicals entering the food supply. In the late 1800s and early 1900s, soil biology scientists began to seek ways to remedy these side effects while still maintaining higher production.

Pesticides

Substances intended for preventing, destroying, attracting, repelling or controlling any pest including unwanted species of plants or animals during the production, storage, transport, distribution and processing of food, agricultural commodities, or animal feeds or which may be administered to animals for the control of ecto-parasites.

Major chemical groups of pesticides-

- **Organochlorines- S**uch as DDT (Dichloro dipenyle trichloroethane), HCH (Hexachloro cyclohexane), aldrin, dieldrin, endrin, heptachlor, toxaphene, chlorobenzilate.
- **Organophosphorus-** Such as Acephate, chlorpyriphos, dichlorvos, dimethoate, malathion, parathion, monochrotophos, triazophos, quinalphos.
- **Carbamates-** Such as Carbaryl, carbofuran, aldicarb, propoxur.
- **Synthetic pyrethroids-** such as Allethrin, cypermethrin, deltamethrin, fenvalerate, fluvalinate.
- **Neonicotinoids-** such as Imididacloprid, acetamiprid, thiamethoxam.

➢ **Phenyl-pyrazoles-** such as Fipronil.

MAJOR CATEGORIES OF PESTICIDES

- **Insecticides-** It includes pyrethroids, carbamates, organophosphorus, organochlorine and manganese compounds.
- **Rodenticides-** It includes warfarins, indanodiones.
- **Fungicides-** It includes thiocarbamates, dithiocarbamates, cupric salts, tiabendazole, triazoles, dicarboximides, dinitrophenoles and organotin compounds.
- **Herbicides-** It includes bipyridyls, chlorophenoxy, glyphosate, acetanilides, and triazines.
- **Fumigants-** It includes aluminium and zinc phosphides, methyl bromides and ethylene dibromide.

Pesticidal contamination of food commodities-

Scenario	% Contaminated	% Above MRL
World	21	2
India	60	14

(Agnihotri, 1999)

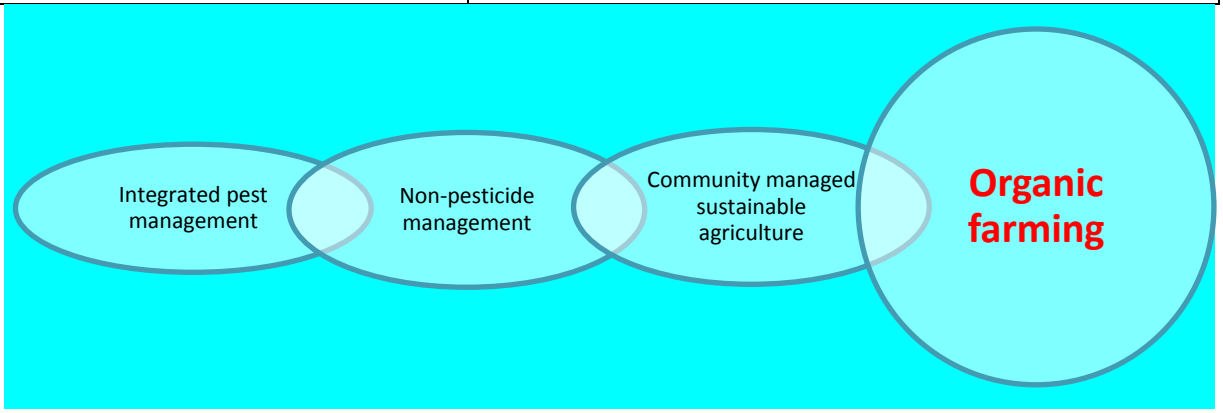
Thus, we can assume the catastrophic effects of pesticide residue in feed and edible items. Infect bio-magnification of pesticide residue is the burning issue of current scenario and we needs urgent action against ill effects of pesticide residue.

Health consequences of pesticide residue

Indiscriminate uses of pesticide causes hazardous ill-effects on health and well-being of society such as,

Trade name	**Possible health consequences**
Camphechlor	Cancer causing, residual effects, toxic to fish culture
Chlordane/Heptachlor	Leukemia causing, toxic to wild life and long term residual effects
Chlordimeform	Cancer causing, bladder toxicity and ill-effects on wild life
DBCP (dibromochloropropane)	Cancer causing, sterility and residual conconcentration in water
DDT	Cancer causing, damage liver, nerves and brain, highly residual effects and toxic to wild life
Aldrin/ Dieldrin/ Endrin	Cancerous, teratological effects and residual effects
EDB (Ethylene Dibromide)	Potent cancerous, teratogenic and ill-effects on liver, lung
BHC/ Lindane	Cancer, miscarriage, leukemia and residual effects
Paraquat	No antidote is available and causing lung scarring
Endosulphan	Damage nervous system

PCP (Pentachlorophenol)	Nervous damage, liver damage and skin diseases
2, 4, 5 T (2,4,5-Trichlorophenoxyacetic acid)	Cancerous, teratogenic and residual effects



INTEGRATED PEST MANAGEMENT (IPM):

It involves the use of cultural practices, crop husbandry, resistant varieties, biological and chemical control strategies; Scientist develops the strategies and farmers follows the prescribed practices. However, introduction of chemicals is frequently allowed as a significant step for the enhancement of production.

Non-pesticide management:

Emphasis on existing uses of hazardous chemicals towards safer biological and physical methods such as, through deep summer ploughing, bonefires and pheromone trapping.

COMMUNITY MANAGED SUSTAINABLE AGRICULTURE:

Focus on maintaining soil fertility and prevent pest incidence with minimum external inputs and judicious crop management. Farmers are connective link between technology development and extension. Farmers carry out diagnosis and replace chemical pesticides with physical and biological methods or bio-pesticides. Soil fertility is maintained by using bio-fertilizers or organic manure

Organic farming

It is a method of crop and livestock production that involves much more than choosing not to use pesticides, fertilizers, genetically modified organisms, antibiotics and growth hormones. Organic production is a holistic system designed to optimize the productivity and fitness of diverse communities within the agro-ecosystem, including soil organisms, plants, livestock and people. The principal goal of organic production is to develop enterprises that are sustainable and harmonious with the environment.

Milestones of organic farming

There are four important pillars of organic farming

- **Principle of well-being -** Organic farming should sustain and enhance the health of soil, plant, human and plants as one and indivisible.
- **Principle of nature -** Organic agriculture should be based on living ecological systems and cycles, work with them, emulsion them and help sustain them.

- **Principle of justifications -** Organic agriculture should build on relationships that ensure fairness with regard to the common environment and life opportunities.
- **Principle of safety -** Organic agriculture should be managed in a precautionary and responsible manner to protect the health and well being of current and future generations and environment.

General health considerations of organic farming-

- Protect the environment, minimize soil degradation and erosion, decrease pollution, optimize biological productivity and promote a sound state of health.
- Maintain long-term soil fertility by optimizing conditions for biological activity within the soil.
- Maintain biological diversity within the system.
- Recycle materials and resources to the greatest extent possible within the enterprise.
- Provide attentive care that promotes the health and meets the behavioural needs of livestock.
- Prepare organic products, emphasizing careful processing and handling methods in order to maintain the organic integrity and vital qualities of the products at all stages of production.
- Rely on renewable resources in locally organized agricultural systems.

SUMMARY

Organic farming can be a viable alternative production method for sustainability, but there are many challenges. One key to success is being open to alternative organic approaches to solving production problems. Determine the cause of the problem, and assess strategies to avoid or reduce the long term problem rather than a short term fix for it.

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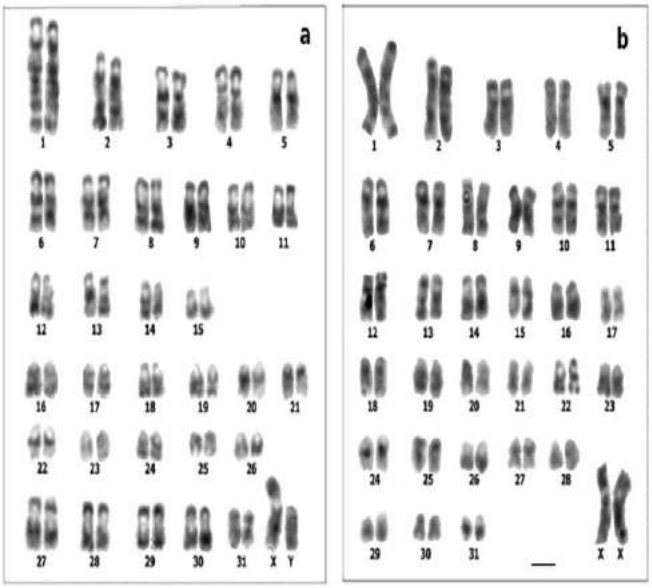
Cytogenetic Technique in Farm Animals

***Manjeet[1], Kapil Dev[1] and Ravinder Dahiya[2]**

[1]Ph.D. Scholar, Department of Animal Genetics and Breeding, Luvas, Hisar
[2]Assistant TAM, Cargill India Pvt. Ltd.
**Corresponding Author: manusheokand25@gmail.com*

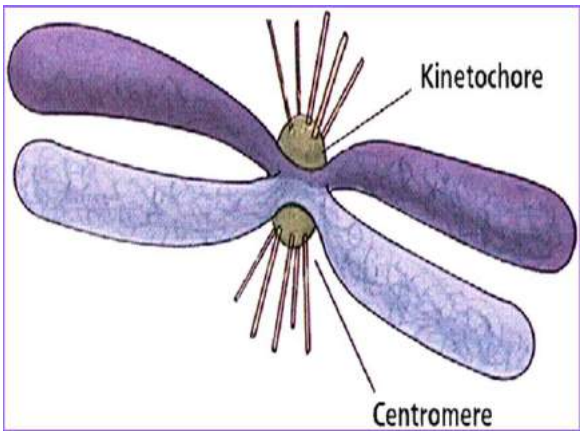
WHAT ARE CYTOGENETIC TECHNIQUE?

Cytogenetics is a branch of genetics that is concerned with the study of the structure and function of the cell, especially the chromosomes. It includes routine analysis of G-banded chromosomes, other cytogenetic banding techniques (R,Q,C etc),as well as molecular cytogenetics such as fluorescent *in situ* hybridization (FISH) and comparative genomic hybridization (CGH) and many more……



IMPORTANCE OF CYTOGENETIC TECHNIQUES

Development of cytological techniques over the last 20 yr enables accurate and detailed observations of the chromosomes of mammals and birds. Much of the pregnancy wastage in farm animals may be caused by abnormal chromosome complements of afflicted zygotes. To reduce embryonic loss, the causal bases of chromosomal abnormalities should be sought. Many therapeutic agents administered to animals, as well as herbicides, pesticides, feed additives, and other products mediate undesirable side effects. Karyological methods are useful to detect chromosomal damage or irregular mitosis or meiosis which are indicators of toxicity and carcinogenic activity. It is probable that polymorphisms of "banding patterns" of chromosomes are sufficiently widespread to enable identification of individual animals and authentication of pedigree. The study of relationships of animals within populations and among populations also will be enhanced by application of chromosome banding techniques to livestock.



In animal breeding, cytogenetic methodology is applied to test assumptions of theory. New sources of genetic variation may be chromosome rearrangements, duplications, aneuploidy, and euploidy. When applied to cells in culture and combined with modern methods of molecular biology, cytogenetic technique can help discover new loci, assign genes to specific chromosomes, and create genetically modified cell lines which can be introduced into the germ line of animal populations.

TYPES OF CYTOGENETIC TECHNIQUES

Chromosome analysis

Chromosome may be analyzed by :

- Chromosome structure
- Chromosome no. or count
- Karyotype

Karyotype

- Karyotype is the number and appearance of chromosomes in the nucleus of a eukaryotic cell.Karyotypes describe, Number of chromosomes, Length of chromosome, Position of the centromeres, Banding pattern.
- Karyogram or Idiogram
- Chromosomes arranged in pairs, ordered by size and position of centromere for chromosomes of the same size.

Karyotypes can be used for many purposes; such as……

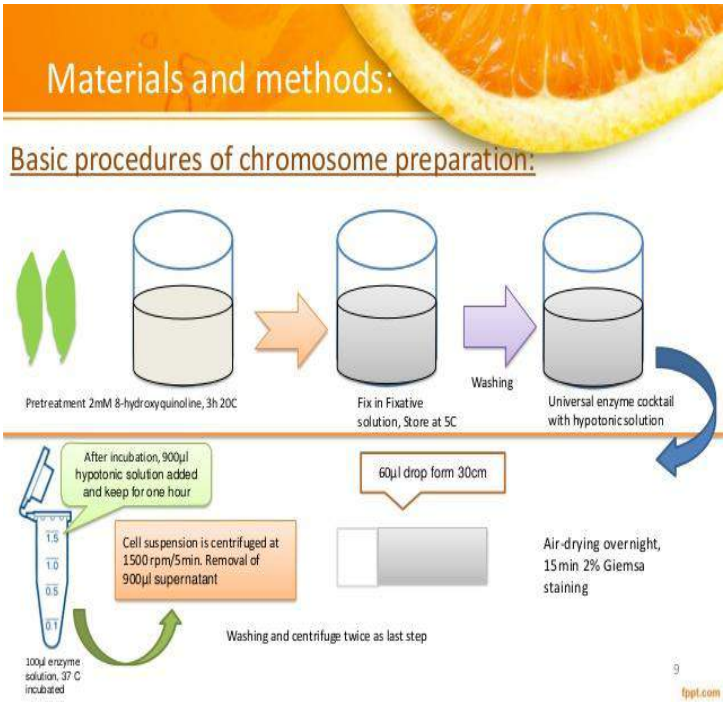
- to study chromosomal aberrations
- taxonomic relationships
- to gather information about past evolutionary events
- species identification
- confirmation or exclusion of a suspected cross contamination
- normal and transformed cells can be distinguished
- to study chromosomal aberrations
- taxonomic relationships
- to gather information about past evolutionary events
- species identification
- confirmation or exclusion of a suspected cross contamination
- normal and transformed cells can be distinguished

CHROMOSOME PREPARATION

Protocol

1. Chromosome Harvesting of Adherent Cells

1. **Standard Protocol**



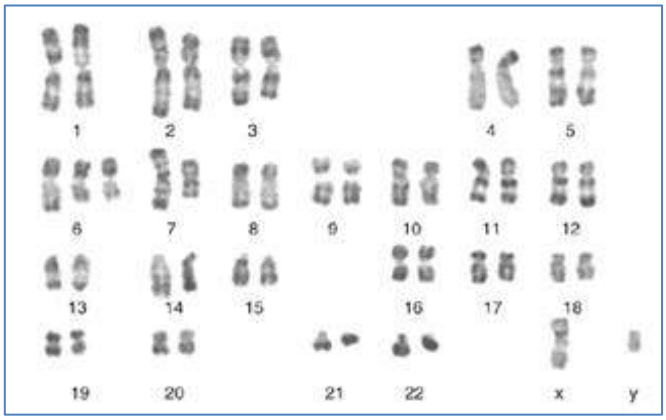
1. Grow cells according to specific cell culturing conditions. When the cells have reached logarithmic phase (80% confluency), add 10 µl/ml of Colcemid to the cell culture flask. A minimum of 2 x 10^6 cells is recommended.
2. Incubate cells at 37 °C in a 5% CO_2 incubator for 45 min. Using a sterile pipette, transfer media from cells into a 15 ml conical tube. Set aside.
3. Gently wash the cells by adding 2 ml of HBSS Buffer into the flask. Swirl buffer and then remove using a pipette. Discard.
4. Add 1 ml of trypsin, ensuring that it covers the entire surface of the flask. Only leave the cells in trypsin for about 2 min. Once the majority of the cells have detached, pipette the media in the conical tube back onto the cells.
5. Transfer the cell suspension in 10 ml aliquots into 15 ml conical tubes. Centrifuge at 200 x g for 10 min. Remove supernatant and resuspend the pellet.
6. Add 10 ml of 0.075 M KCl which has been prewarmed to 37 °C to the remaining pellet in the conical tube. Vortex tube at medium speed to mix KCl and cells.
7. Incubate cells at 37 °C for 10 min. Centrifuge at 200 x g for 5 min at 25 °C. Remove supernatant (until about 0.5 ml remains) and resuspend pellet.
8. Carefully add 5 ml of fresh Carnoy's Fixative (3:1 ratio of methanol:glacial acetic acid) to the cells while vortexing. Then add 5 ml more of fixative without vortexing for a total of 10 ml.
9. Centrifuge at 200 x g for 5 min. Remove supernatant and resuspend cells. Add 5 ml of fixative to each tube.
10. Centrifuge at 200 x g for 5 min. Remove supernatant and resuspend cells. Add 5 ml of fixative to each tube. The cells can now be stored in 4 °C for up to one year.

2. SLIDE PREPARATION AND SOLID STAINING

A rapid evaluation of one representative slide will provide information on the quality of the harvest before continuing to further procedures such as G-banding, FISH, CGH, or SKY. Some laboratories prefer to solid stain the cells for rapid harvesting and chromosome assessment. Alternatively, a phase contrast microscope may be used for this analysis. Slides are best prepared when the humidity is approximately 50% and the temperature ambient (20-25 °C).

1. Centrifuge the cells at 200 x g for 5 min at 25 °C. Remove the supernatant until only 0.3-0.5 ml remains.
2. After gently resuspending the pellet, pipette three drops of the cell suspension from a distance of about 2 in onto a slide which is tilted at an angle of about 45° and allow the suspension to roll across the slide. Add one large drop of fresh Carnoy's Fixative to the slide.
3. Dry the back of the slide on a paper towel and then sit the slide out to dry for at least 10 min. The slide should be completely dry.
4. Prepare fresh Giemsa Staining Solution (3:1 ratio of Gurr Buffer and Giemsa Stain). Place the slides on a staining rack. Cover the entire slide in the Giemsa staining solution. Let the slides remain in the staining solution for 5 min. Rinse slides with distilled water, drain, and allow to air dry.
5. Add 4 drops of Permount and a cover slip to the slide. Make sure there are no bubbles under the coverslip. The excess Permount can be removed with a paper towel.
6. Analyze cells with a light microscope under 10X and 100X magnification. If the metaphase cells are abundant and well spread, the remaining slides can be used for other experimental procedures.

CHROMOSOME BANDING



- ❖ The most common methods of dye based chromosome banding are G,R,C,Q,T
- ❖ The most widely used function-based banding method is replication banding and is based on the fact that different bands replicate their DNA at different times during S phase of the cell cycle.

➢ **G banding** obtained with Giemsa stain.

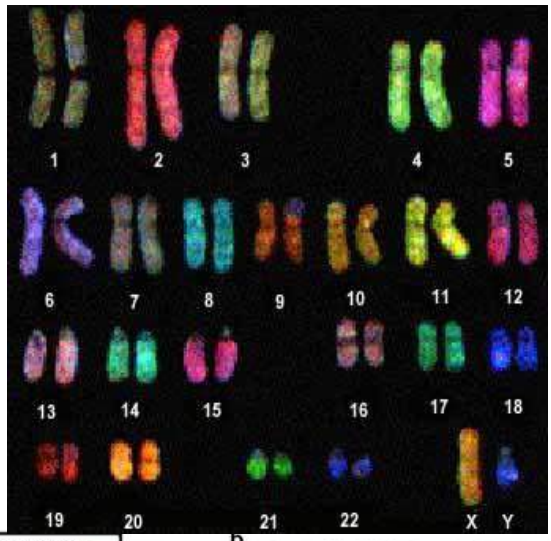
- mixture of methylene blue, eosin, and azure B
- heterochromatic(dark)
- euchromatic (light)

➢ **R-banding is the reverse of G-banding**

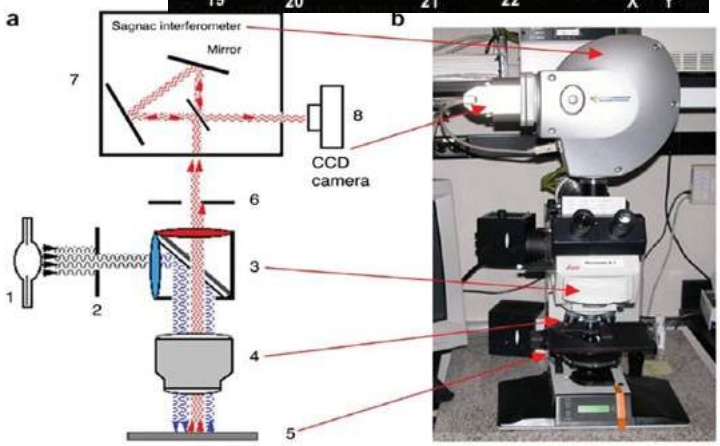
- heterochromatic(light)
- euchromatic(dark)

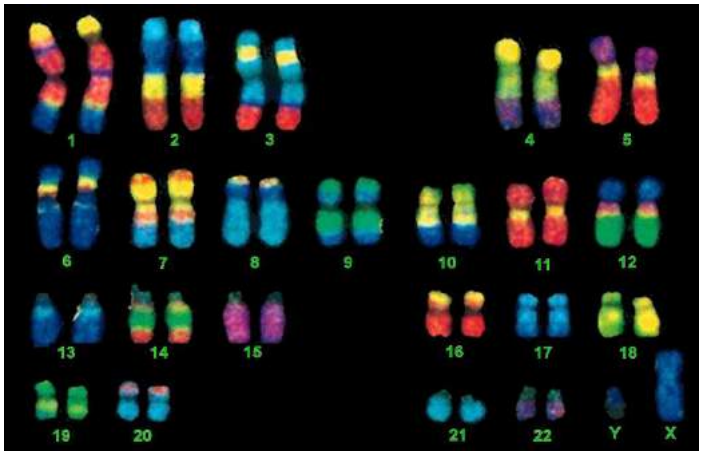
- **C-banding it stains centromeres and region containing constitutive hetetrochromatin**
- **Q-banding is a fluorescent pattern obtained using quinacrine for staining.**
- The first method to be used to identify all 46 human chromosomes.
- The pattern of bands is very similar to that seen in G-banding.
- Bright band (AT) rich.
- **T-banding**: visualize telomeres.
- **NOR-banding** visualize nucleolar organizer region.
- Silver nitrate
- Stains protein adjacent to this region

CHROMOSOME PAINTING



- To locate genes, identify translocations, and determine the species of origin of chromosomes.
- This technique employs in situ hybridization technology. SKY, M-FISH
- Spectral karyotyping (SKY) is a laboratory technique that allows scientists to visualize all of the human chromosomes at one time by "painting" each pair of chromosomes in a different fluorescent color.
- How does SKY work?
- When a chromosome in which the origin cannot be identified or the structural abnormality of a partial copy of a chromosome is observed with G-banding, the SKY technique makes it possible to recognize each chromosome with different color tones. Furthermore, when cells are cultured under conditions in which the image acquisition of cell division is difficult, SKY enables bleaching and staining of the specimen after the images of division have been verified.
- SKY provides the advantage of





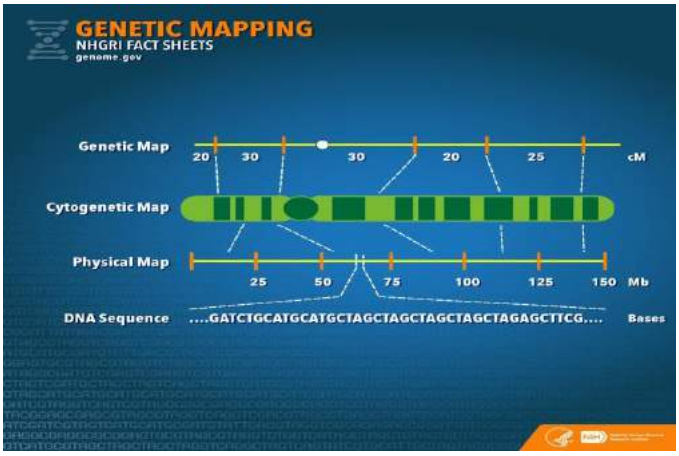
easy visual interpretation when analyzing results, but it is not possible to evaluate structural abnormalities, such as inversion, deletion, insertion, and duplication in the same chromosome, because these are shown with the same color. Therefore, in order to verify the site of chromosomal breakage, it is usually necessary to use SKY beforehand in combination with G-banding or high-resolution chromosome banding, instead of using SKY alone to macroscopically observe the banding patterns. SKY is very useful in the clinical practice of genetic counseling

M-FISH

- M-FISH are molecular cytogenetic techniques that permit the simultaneous visualization of all human (or mouse) chromosomes in different colors.

Steps:

- Preparation of microscopic slide with cells in metaphase of mitosis
- The slide is treated with a weak base to denature the DNA.
- A radioactively labeled probe is poured onto the slide.
- Expose slide to photographic emulsion for a few days or weeks.
- Develop emulsion.
- **Use…..**
- SKY/M-FISH is particularly useful in :
- Mapping of chromosomal breakpoints.
- Detection of subtle translocations.
- Identification of marker chromosomes, homogeneously staining regions, and double minute chromosomes.
- Characterization of complex rearrangements.



GENE MAPPING TECHNIQUE

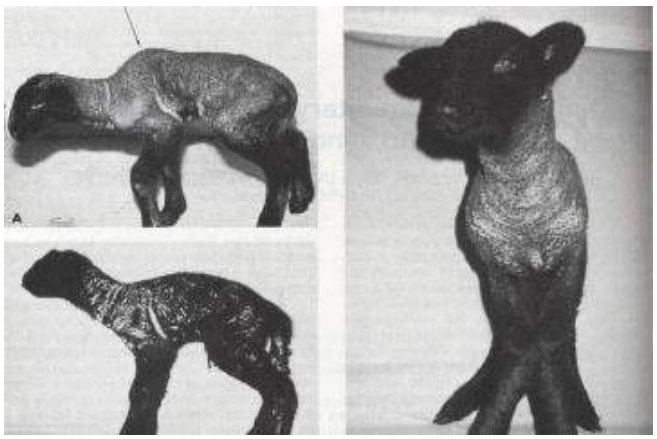
Gene mapping describes the methods used to identify the locus of a gene and the distances between genes. The essence of all genome mapping is to place a collection of molecular markers onto their respective positions on the genome. Identification of genes is usually the first step in understanding a genome of a species; mapping of the gene is usually the first step of identification of the gene. Gene mapping is usually the starting point of many important downstream studies. Different techniques of gene mapping are restriction mapping, radiation hybrid mapping, somatic cell mapping etc.

Disease association

The process to identify a genetic element that is responsible for a disease is also referred to as "mapping". If the locus in which the search is performed is already considerably constrained, the search is called the *fine mapping* of a gene. This

information is derived from the investigation of disease manifestations in large families (genetic linkage) or from populations-based genetic association studies.

CHROMOSOMAL ANOMALIES IN FARM ANIMALS



Chromosome abnormalities in cattle can cause significant adverse effects on fertility through failure of production of viable gametes or early embryonic death that consequently leads to great economic loss. Chromosomal aberrations can occur as numerical errors or structural rearrangements usually without causing phenotypic abnormalities on carrier animals. According to current knowledge on chromosomal abnormalities, Robertsonian translocation (ROB) that involves chromosome 1 and 29 represents the most common form of aberration found in cattle of various breeds. Other less commonly encountered abnormalities in cattle include reciprocal translocation, chimerism (including freemartins), mosaic and rarely sex chromosome aberrations. A similar trend in incidence of abnormalities has been observed in sheep and goats although systematic studies are limited. Centric fusion that involves different chromosomes but not specific to chromosome (1;29), is the most common abnormality, followed by chimerism, sex chromosome abnormalities, and rarely deletions and inversions. In swine, reciprocal translocations are the most common abnormalities with significant economic loss due to reduction in litter size by up to 50%. This is followed by chimerism for sex chromosomes. Unlike cattle, incidence of ROB (1,29) in pigs is very rare. In domestic buffaloes, sex chromosome abnormalities are the most common found associated with infertility due to extensive damage to sex adducts. Freemartinism is the most prevalent form of all sex chromosome abnormalities detected in buffalo. However, translocations are rare incidences in buffalo.

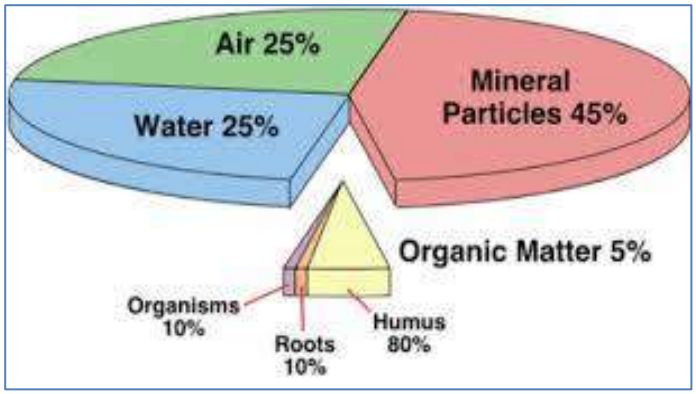
Soil Health and Organic Farming

Satyendra Patley[1], Pragya Keshri[2], Payal Jaiswal[3] and Arun Kumar Singh[4]

[1,2,3] Indira Gandhi Krishi Vishwavidyalaya , Raipur-492012
[4]Kerala Agriculture University, Thrissur
Corresponding author: isatyendra.patley@gmail.com

INTRODUCTION

- Soil health is defined as "the capacity of a soil to function within ecosystem boundaries to sustain biological productivity, maintain environmental health, and promote plant and animal health." Soil properties that determine soil health include soil physical, chemical and biological properties.
- In some cases, the term "soil quality" may be used; the two terms have the same meaning.



Key Soil Physical And Biological Properties :

Soil texture, Soil depth, Soil organic matter content, Cation exchange capacity, Bulk density, Porosity, Plastic/liquid limit, Aggregate stability, Water content, Water-holding capacity, Hydraulic conductivity (permeability), Infiltration, Soil respiration, Earthworms

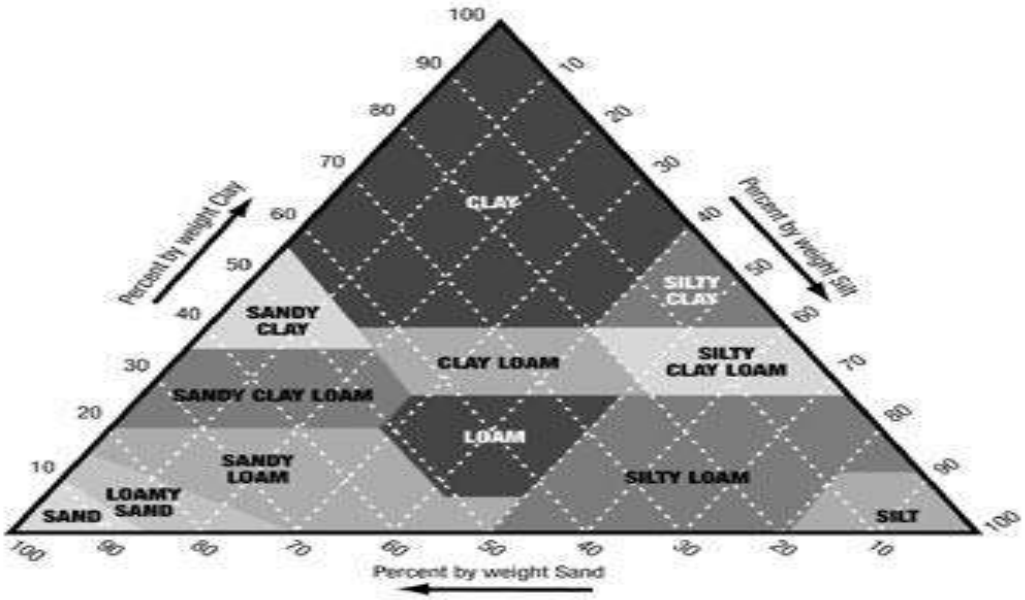
Soil texture

- Soil texture affects almost all other soil health indicators such as porosity, water infiltration and percolation, moisture holding capacity, sensitivity to compaction etc.
- To determine soil texture the soil particles are completely dispersed until all aggregates are destroyed. With experience, it is also possible to determine soil texture by the 'feel method'.

Soil depth

- Soil depth is the depth of soil to bedrock or to an impermeable layer.
- Soil depth determines how deep roots, water, and air can penetrate into a soil.
- This, in turn, influences how much water can infiltrate the soil, how much water can be held by the soil, and how much soil plant roots can occupy.

Figure 1.1-2. The textural triangle quickly helps to determine the textural classification of a soil from the percentages of sand, silt, and clay it contains.



Soil organic matter

- Soil organic matter consists of living, partially to fully decomposed organic materials.
- Soil organic matter is typically 1 to 5 percent of the total dry weight of topsoil, with lower amounts in the subsoil.
- Different types of organic matter play unique roles in soil.
- Highly decomposed organic matter (also called humified organic matter) typically makes up 95% of the total soil organic matter.

Cation exchange capacity

- The CEC (cation exchange capacity) of a soil is determined by the soil's clay and organic matter content.
- These particles carry a negative charge that enables a soil to hold on to positively charged molecules called "cations."
- Potassium, calcium, and magnesium are nutrient cations that dissolve in water and would wash out of the soil if they were not held by the CEC.

Bulk density

- Bulk density is a measure of the mass of particles that are packed into a volume (e.g., a cubic foot) of soil. If bulk density goes up, porosity goes down. It is favorable to have a low bulk density so that water and air can move through the soil. The optimal bulk density depends on soil texture.

The plastic and liquid limits

- The plastic and liquid limits of a soil are two measures used to characterize the ease with which a soil can be worked or compacted.

- The plastic limit is the moisture content at which it is possible to make a wire of approximately one-quarter inch in diameter by rolling the soil between two hands.
- The liquid limit is the moisture content at which soil starts to flow and act as a liquid.

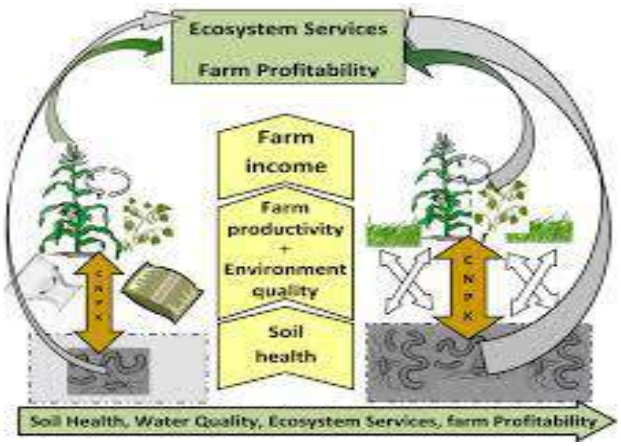
Soil structure and soil tilth

- Soil structure and soil tilth are very important but still elusive concepts.
- Soil tilth refers to the state of aggregation of a soil. Aggregates are conglomerates of clay, silt, and sand particles that are held together by biological, physical and chemical forces.
- Soils with stable aggregation tend to have better soil tilth, greater water infiltration, and better aeration for crop growth.

Hydraulic conductivity (permeability)

- Hydraulic conductivity (permeability) and infiltration rate are two closely related properties.
- Hydraulic conductivity is the rate of water movement in the soil, whereas infiltration is the rate at which water enters into the soil from the surface.
- Hydraulic conductivity and infiltration are determined by soil texture, changes in soil texture between surface and subsurface, impermeable layers, and depth to bedrock, as well as by soil management.

Earthworms



- Earthworms generally increase microbial activity, increase the availability of nutrients, and enhance soil physical properties.
- They also accelerate the decomposition of crop residue by incorporating litter into the soil and activating mineralization and humification processes.
- Earthworms improve aggregation and porosity, suppress certain pests or disease organisms, and enhance beneficial microorganisms.

A MODERN APPROACH TO FARMING

- Organic farming does not mean going 'back' to traditional methods.
- Many of the farming methods used in the past are still useful today.
- Organic farming takes the best of these and combines them with modern scientific knowledge.
- Organic farmers do not leave their farms to be taken over by nature; they use all the knowledge, techniques and materials available to work with nature.

ORGANIC FARMING

- Organic farming is a system which avoids or largely excludes the use of synthetic inputs (such as fertilizers, pesticides, hormones, feed additives etc) and to the maximum extent feasible rely upon crop rotations, crop residues, animal manures, off-farm organic waste, mineral grade rock additives and biological system of nutrient mobilization and plant protection.

- Protecting the long term fertility of soils by maintaining organic matter levels, encouraging soil biological activity and careful mechanical intervention.
- Providing crop nutrients indirectly using relatively insoluble nutrient sources which are made available to the plant by the action of soil micro-organisms.

NEED OF ORGANIC FARMING

- Increase in population make compulsion to stabilize agricultural production, but to, increase it further, in sustainable manner.
- Natural balance needs to be maintained at all cost for existence of life and property.
- Agrochemicals which are produced from fossil fuel and are not renewable and are diminishing in availability.
- It may also cost heavily on our foreign exchange in future.

CONCLUSION

- Good soil health play important role for feeding the increasing population.
- Maintain the soil fertility and productivity.
- Organic farming full-fill needs of the present generation by using natural resources making resources available for the future generation.
- Utilising all the agricultural bi-products.
- Less harm to the environment.
- Improves farmers economic condition.

Real Time Nitrogen Management in Agriculture: Problems and Opportunities

Satyendra Patley[1], Pragya Keshri[2], Payal Jaiswal[3], Arun Kumar Singh[4] and Ramesh Kumar Dhurwe

[1, 2, 3] Indira Gandhi Krishi Vishwavidyalaya , Raipur-492012
[4]Kerala Agriculture University, Thrissur
Corresponding author: isatyendra.patley@gmail.com

INTRODUCTION

Areas of opportunity for improvement in fertilizer N use efficiency

- Continued improvement in cropping system management.
- Use of site- specific precision agricultural technologies.
- Better prediction of soil N mineralization.
- Improved timing of N application.
- Improved manure management.
- Improved fertilizer.

Strategies for N management

- **Prevention strategies**
  Application of N input prior to or early in the N uptake phase of plant growth to avoid nutrient deficiencies.
- **Intervention strategies**
  N input are applied to meet N requirements as determined by the nutrient status of soil or plants during the rapid N uptake phase of growing plants.
- **Hybrid strategies**
  Combination of both strategies.

Variable Rate N Application

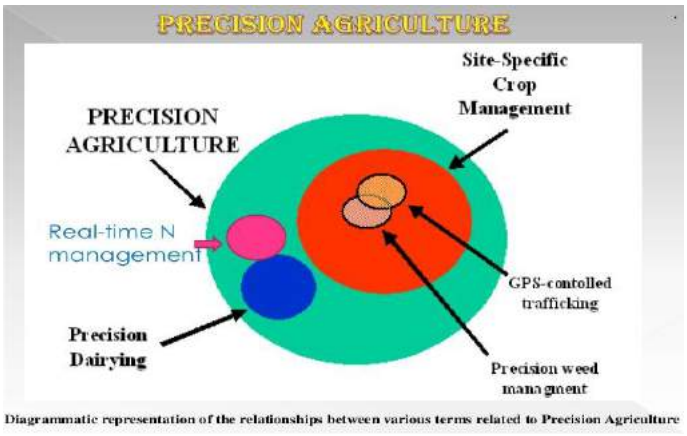
Variable rate N fertilizer demand is a function of year to year climate differences (Rainfall and Temperature).

Point- to – point soil differences

- Nutrient content of manure
- Soil test and crop need
- Water quality concerns

PRECISION AGRICULTURE

"Match the agricultural inputs and practices to localized conditions within field to do the right thing, in the right place, at right time and in right way"



Diagrammatic representation of the relationships between various terms related to Precision Agriculture

WHAT IS REAL- TIME N MANAGEMENT ?

NEED OF REAL TIME N MANAGEMENT

- Nitrogen is the nutrient that most often limits crop production. (Pathak *et al*., 2005)
- Crop use nitrogen inefficiently, generally more than 50% of N applied is not assimilated by plants. (Dobermann and cassman, 2004)
- Leaching, runoff and denitrification are the processes that result in loss of N from soil-plant system creating the potential for N deficiency in crop. (Nowak *et al*., 1998)
- Worldwide nitrogen use efficiency for cereals grains and row crops estimated at only 33%.
- Unaccounted 67% represent a $ 28 billion annual loss of fertilizer N. (FAO., 2006)

AIM…..?

- To apply nutrient at optimal rates.
- To achieve high yield and high efficiency of nutrient use by the rice crop.
- Estimating the total fertilizer N required for rice in a typical season.
- Formulating the dynamics N management to distribute fertilizer N to best match the crop need for nitrogen.

Basic steps in Real-time Nitrogen management

- **Assessing variability**

On cannot manage what one does not know

(1) Spatial variability (high degree is needed)
(2) Temporal variability (difficult to manage)

- **Management of maps**

(3) Condition maps
(4) Prescription maps
(5) Performance maps

MANAGING VARIABILITY

- Soil supply and plant demand vary in space and time.
- Higher the spatial dependence, higher the potential for precision.
- Field variability should be accurately identified and reliably interpreted.

BASIC APPROACHES OF N MANAGEMENT

- To develop Site-specific N Management based on crop N status monitoring

(1) Canopy reflectance of light
(2) Chlorophyll content

Where and when Real-time N management will pay off in terms of either profitability or environmental benefits….?

- Where N input are high.
- Where residual N is temporally stable and /or high residual N is predictable.
- Where crop quality is affected by excess N in soil.
- Where crop yield spatial variability is high and predictable.
- Where net mineralization is high and consistently related to soil and landscape properties.
- Where N application is not restricted in time.
- Where leaching potential is very high during the crop N uptake period of the plant growth.

TOOLS….?

- LCC
- SPAD
- Optical sensor or crop canopy spectral reflectance
- GIS

LEAF COLOUR CHART (LCC)

- IRRI-1996
- The Leaf colour chart (LCC) is an easy-to-use and inexpensive diagnostic tool for monitoring the relative greenness of a rice leaf as an indicator of the plant N status.

HOW TO USE THE LEAF COLOUR CHART (LCC)

- Select at least 10 disease free rice plants.
- Select the topmost fully expanded leaf and compare the leaf colour with the colour panels of the LCC and do not detach or destroy the leaf.
- Measure the leaf colour under the shade of your body.
- Determine the average LCC reading for the selected leaves.

ADVANTAGES OF LEAF COLOUR CHART

- The LCC is a cheap to operate.

- Farmer can easily use the LCC to qualitatively assess foliar N status and adjust N topdressing accordingly.
- It helps to manage N for large area leading to improved fertilizer N use efficiency.
- It reduces the risk associated with fertilizer N application.
- It saves nearly 26% fertilizer N.
- It helps to synchronized N supply and crop demand.

SPAD (Soil Plant and Analysis Development) meter

- It is a simple, quick and non-destructive in situ tool for measuring relative content of chlorophyll in leaf that is directly proportional to leaf N content.

MEASURING SPAD VALUES IN THE FIELD

- SPAD reading are taken at 9-15 day intervals, starting from14 DAT for transplanted rice and 21 DAS for wet direct seeded rice, Periodic readings continue up to the first (10%) flowering.
- The youngest fully expanded leaf of a plant is used for SPAD measurement.
- Readings are taken on one side of the midrib of the leaf blade.
- A mean of 10-15 readings per field or plot is taken as the measured SPAD value.
- Whenever SPAD values fall below the critical values, N fertilizer should be applied immediately to avoid yield loss.

FACTOR INFLUENCING SPAD READING

- Nitrogen fertilizer efficiency
- Rice cultivar
- Position of leaf on plant
- Deficiencies of P, Zn, Mn and Fe

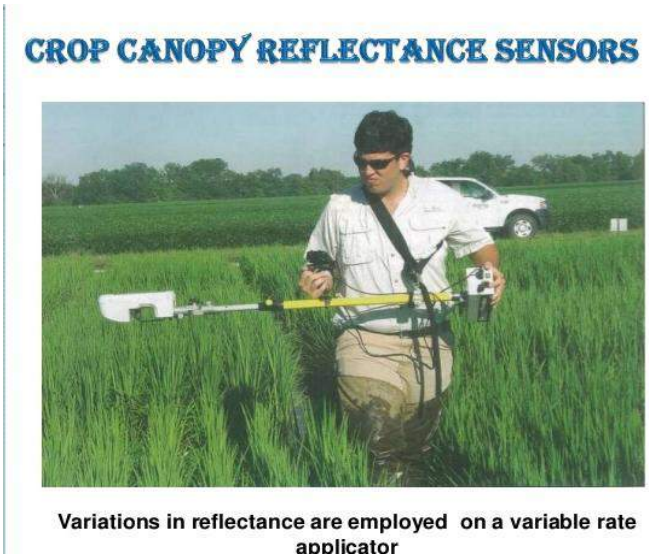
ADVANTAGES OF SPAD METER

- The SPAD meter is faster than tissue testing for N.
- Sample can be taken often and can be repeated if results are questionable.
- Chlorophyll content can be measured at any time to determine the crop N status.
- The SPAD meter allows “fine tuning” of N management to field condition.
- The SPAD meter would also help people who are not highly trained to make N recommendations.

CROP CANOPY REFLECTANCE SENSORS

Crop that needs N is

- Lighter in colour
- Smaller in size and
- Reflects light differently than a crop that has sufficient N



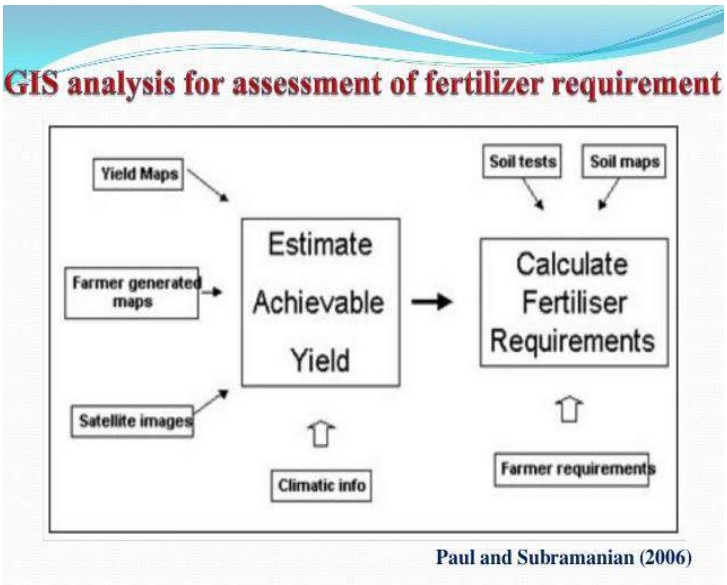
Variations in reflectance are employed on a variable rate applicator

OPTICAL SENSOR

- Optical sensor used rapidly through measurement of visible and near infrared spectral response from plant canopies to detect the nitrogen stress.

LIMITATIONS

- It can not work properly when the crop is too young.
- It can not work in transplanted rice in early stages.



BASED ON GIS

SITE-SPECIFIC N RECOMMENDATIONS

- Grid soil sampling
- Residual Soil-nitrate N value
- N availability maps
- N fertilizer recommendation maps

BASED ON REMOTE SENSING

- Develop Site-specific optional N rate recommendations based on condition of specific N response curve.
- Aerial or satellite photos or digital images.

MAJOR CHALLENGES

- To retain the success of approach
- To build on what has been already achieved using this approach while reducing the

Comparative evaluation of tools/tactics of enhancing N use efficiency

Tool / Tactics	Benefit : cost	Limitations
Site specific N management	High	Has to developed for every site
Chlorophyll meter	High	Initial high cost
Leaf color chart	Very high	Minimum limitations
Plant analysis	High	Facilities need to be developed
Controlled- released fertilizer	Low	Low profitability and lack of interest by industry
Nitrification inhibitor	Low	
Fertilizer placement	High	Lack of equipment, labour intensive
Foliar N application	High	Lack of equipment, risk involved
Breeding strategy	Very high	Varieties yet to be developed
N – fixation in non legumes	High	Technology yet to be developed for field scale
Models and decision support system	Medium	Tools are not available
Remote sensing tools	Low	Technology need to be fine-tuned
Geographic information system	Low	
Resource-conserving technology	High	Technology needs to be evaluated for long- term impacts
Integrated crop management	high	

Ladha *et al.* (2005)

complexity of the technology as it is disseminated to the farmers.

- The nutrient needs to rice are highly variable.
- Differ from field to field.
- Differ year to year.

OPPORTUNITIES

- Supply nutrient to optimally match the location specific needs of the crop for an achievable yield goal.
- Provide basis for plant based approach to nutrient management.

CONCLUSION

- We can use LCC bestly for the real time N management.

Retention of Fetal Membranes in Cattle

Nukala Ramesh[1*], Parthasarathi.B.C[1], Sushobhit Singh[1], A. Rajendraprasad[1] and N. Deepak[2]

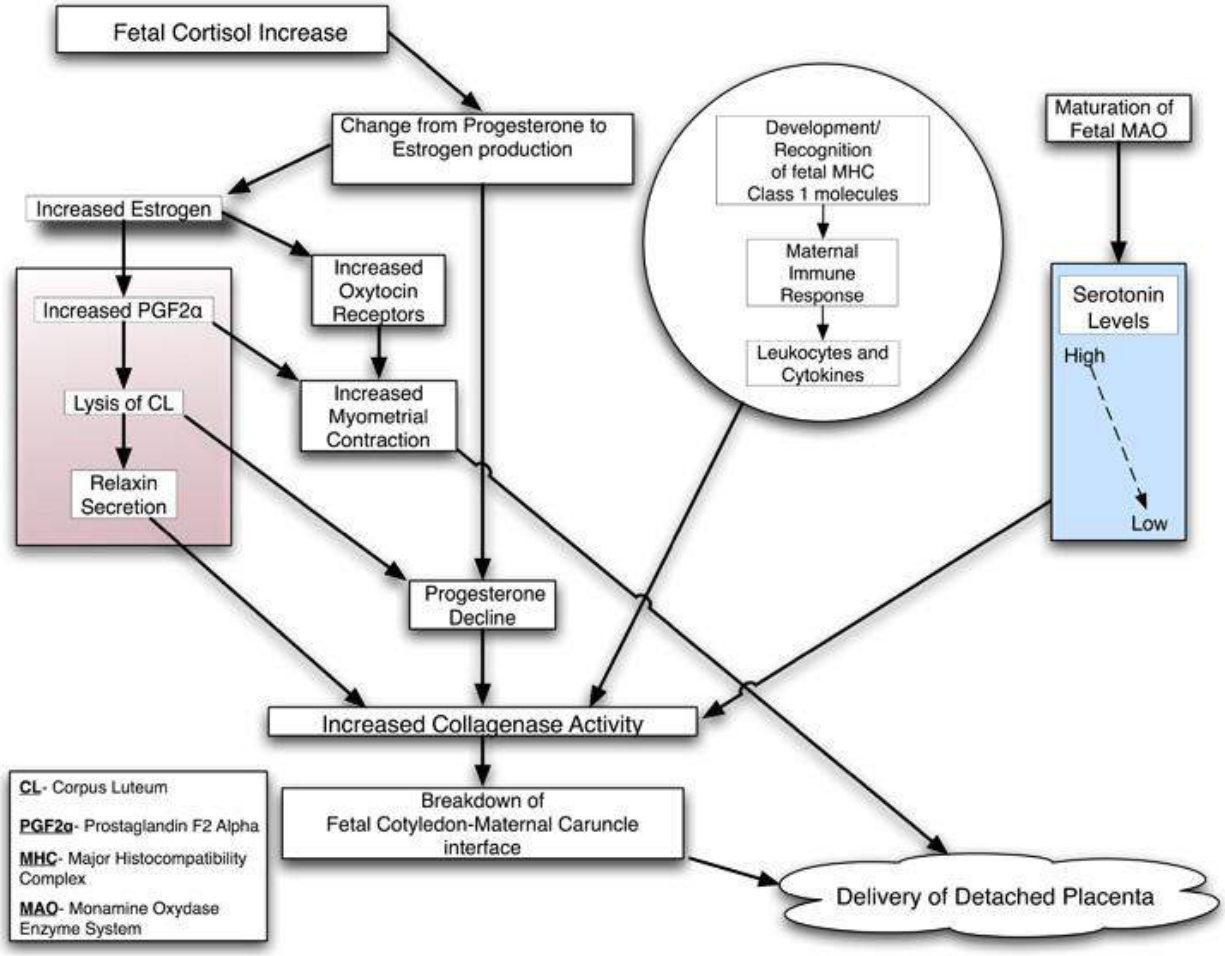
[1]Ph.D. scholars, Indian Veterinary Research Institute, Izatnagar- 243 122, Bareilly, U.P.
[2]Veterinary Assistant Surgeon-Andhra Pradesh
**Corresponding author: ramesh.vet80@gmail.com*

Retention of Fetal Membranes (RFM), also known as Retained placenta (RP) is one of the most common post-partum disorders encountered mostly in cattle and less common in other domestic species. It is usually defined as the failure to expel fetal membranes within 24 hr. after parturition.

Placenta**:** The fetal membranes or called "placenta" are the membranes that transfer nutrients from the dam to the fetus gestation. These membranes of the fetal origin connect to the maternal blood supply in the uterus. Across the thin connection between the membranes of the dam and the membranes of the fetus, the essential nutrients pass to the developing fetus. Usually, when the fetus is born, the placenta normally detaches within short time and is expelled. This separation of the membranes normally occurs after the calf is born (early separation is one cause of stillbirth). Normally, expulsion occurs within 3–8 hr. after calf delivery. The incidence in healthy dairy cows is 5%–15%, buffaloes 1.2-33.8% whereas the incidence in beef cows is lower.

WHY THE PLACENTA IS RETAINED?

The finger-in-glove fit of the placental cotyledons in the maternal caruncles provides the large surface area necessary for nutrient and gas exchange between maternal and fetal circulations. Collagenase secreted by the placenta at parturition leads to a weakening of the mechanical link between uterus and placenta. The mechanical actions of uterine contraction and compression of the placentomes loosen and begin the separation. After parturition, the shrinking of the cotyledons as the blood drains from the placenta normally allows smaller fingers of the placenta to slip from the glove of the caruncles. Mechanical events, inflammatory events, or bad timing due to delayed delivery can all lead to some edema formation in the caruncle and cotyledon that lock the placenta into the uterus. This grip persists until necrosis of the devitalized placenta allows it to detach. Action of leukocytes migrating from the caruncles into the surface of the placenta hastens the necrosis. Some bacteria hasten the necrosis but may also lead to systemic illness for the cow.



Physiologic processes leading to the detachment of the placenta (Beagley *et al.,* 2010)

Negative sequelae to RFM include delayed uterine involution, longer time to 1st service, increased services per conception, decreased pregnancy rates, and increased days open. RFM has also been associated with increased risk for endometritis, metritis, ketosis, and mastitis. These diseases can, in turn, lead to decreased fertility and potential losses in milk production.

CAUSES OF RETAINED PLACENTA

1. Dystocia - any trauma sustained by the uterus may cause release of substances Inhibit proteolysis.
2. Progesterone imbalance - elevated progesterone inhibits collagenase activity and slows
1. Uterine involution.
2. Stress - glucocorticoids, released in stressful conditions, reduces the physiologic inflammatory processes and may block proteolytic activity.
3. Prostaglandin - elevated levels in the pre-partum cow lead to RFM.
4. Leucocytes - reduced leukocytic activity is associated with reduced immune response and increased incidence of RFM.

5. Vitamin E/Selenium deficiency.
6. 7. Metabolic disorders like milk fever (calcium imbalance)
7. 8. Twin births.
8. 9. Infectious agents such as bovine viral diarrhea virus
9. 10. Immunosuppression.
10. 11. shortened gestation and abortion (improper maturation)

SYMPTOMS

- A portion of the fetal membranes hang from the vulva, 12 hours or more even after the expulsion of the fetus. Occasionally membranes do not hang from the vulva but are entirely within the vagina or uterus.
- Anorexia and depression may develop.
- A fetid odour develops since the placenta begins to macerate after 24 hours of foetal expulsion.
- Animal will show signs of discomfort.

TREATMENT

- Treatment should begin 12 h postpartum and continue daily until total expulsion of the membranes.
- Systemic penicillin can be given for possible septicemia.
- Ecbolic agent: Oxytocin and Prostaglandin $F_2\alpha$ injections are used within 72 h of parturition.
- Oxytocin injections (20-40 IU) are continued for 3 days after calving to contract an estrogen primed uterus. It should be given as IM injections in small doses and often.
- High doses exaggerate uterine contractions, may force premature closure of the caruncles, and favours retention.
- After 3 days, 25 mg of $PGF_2\alpha$ injections must be administered IM.
- It can be administered once or twice a day. $PGF_2\alpha$ are used because there is no withholding time for milk.

CONTROL

- Before arriving veterinarian, the hanging fetal membranes should be protected from dogs or other animals.
- The protruding membranes should be tied in a knot to prevent them touching the hocks.
- Manual removal can be attempted in 24- 48 hours after parturition.
- Manual removal after 48 hours is not advisable due to closer of cervix.
- Manual removal of placenta is contraindicated in cows with elevated temperature and also with vaginitis and vulvitis and sometimes eventually it may lead to uterine infections followed by poor uterine involution and onset of cyclicity is delayed.
- After removing the fetal membranes, tetanus toxoid injection is recommended to prevent tetanus infection.

PRECAUTIONS

- Tying extra weight to the hanging portion of the membranes should be strictly avoided, as it might cause tearing.
- The placental membranes should be kept moist. To do this - add tablespoon salt for every pint of water to be roughly isotonic. Pure water will irritate the endometrium.
- The placenta should be kept lubricated with the use of Nitrofurazone and petroleum jelly.

Cause	Prevention
Metabolic diseases impair uterine immunity	Proper nutrition in peri-partum period to avoid metabolic diseases.
Vitamin and mineral deficiencies can impair general immunity	Vitamin E and Selenium supplementation Maintenance of Ca: P ratio of 1.5: 1.0 and P supplementation
Infectious diseases	Proper immunization against specific infections

Pig production and management in India

Ashish Ranjan[1], Ranjana Sinha[2], Revanasiddu Deginal[1], Govind Mohan[1] and N. Anand Kumar[1]

[1]Ph. D. Scholar, Division of Animal Genetics and Breeding
[2]Ph. D. Scholar, Division of Livestock Production and Management
**Corresponding author: ranjanashish05@gmail.com*

Animal husbandry is important role in agriculture sector. Among various animals; piggery is the sector that directly influence the socio-economic status of the rural people. Smallholder farming systems improve livelihood and food security. Pig production provides a greater food security to urban households and increases incomes. Among tribal communities in India, smallholder pig rearing provides for nutritional, financial benefits as well as providing for conversion of household waste into fertilizer for agriculture crops. Pigs are known for pork production, which in terms of dressing percentage ranges from 75-80 in comparison to other livestock species whose dressing yields may not exceed 65%.

SCENARIO OF PIG PRODUCTION IN INDIA

As per 19th Livestock census, India's pig population is 10.29 million which amounts to about 2 % of the country's entire livestock. Total population of exotic/crossbred was 2.456 million while indigenous pigs were 7.83 million. Total population of exotic/crossbreds in rural areas was 2.12 million while it was 0.32 million in urban areas. In case of indigenous pigs, population in rural areas was 7.09 million while it was 0.73 million in urban areas. The total pigs in the country have decreased by 7.54% over the previous census. In rural areas the decline was 7.37 % while it was -9.06 % in the urban areas. Highest share of country's pig population was found in Assam (15.89%) followed by Uttar Pradesh (12.96%), Jharkhand (9.35%), Bihar (6.31%) and West Bengal (6.30%). Highest percentage increase in pig population as compared to previous census was observed in Tripura (37.48%) followed by Jharkhand (31.38%) and Karnataka (8.59%). Number of Pigs per Thousand Households in rural Areas was highest in Arunachal Pradesh (2221) followed by Nagaland (1424), Mizoram (1220), Meghalaya (1124) and Manipur (657). This elucidates the extent of popularity and acceptance of pig rearing in North-East hilly region of India.

As per Department of Agricultural Research and Education (DARE) report, during 2012-13, domestic production of pork was 0.45 mt with an average meat yield of

about 39 kg/animal, which is lower than the world average (79 kg/animal). The share of pork is around 8% of total meat production. Most of pork consumption takes place in unorganized sector in form of locally raised fresh pork meat. The Pork is not widely distributed in the organized retail sector.

Swine production in India has remained somewhat unexploited despite the country having an established pig population. Absence of properly defined production practices and organized breeding programmes are among main hurdles in improvement. In subsistence-driven systems, insufficient feeding, ineffective health care and inbreeding are the major hindrance to pigs expressing their full performance. In order to effectively address constraints in pig production systems, holistic approach involving feeding, breeding, health, management and marketing infrastructure. Swine rearing promotes better self-reliance along with greater food security to urban households and increases incomes.

FEATURES OF PIG PRODUCTION SYSTEM IN INDIA

- Pig farming has been adopted by small and landless farmers, and in tribal areas.
- Production is small-scale, backyard, marketed-oriented enterprise.
- Pigs are mainly dependent on locally available feed resources like vegetations, crop residues and kitchen waste which are of low cost.
- It is low-external input activity relying mainly upon women's labour for rearing
- Best breeding stock rarely goes to the market, resulting in the use of a foundation stock with poor breeding qualities.
- A wide gap still exists between the demand and supply of pork. The major reason is that the pigs reared by the farmers are of the nondescript local breed.
- Producers have inadequate knowledge about feeding, health care and breeding management
- The commercial pig production system in India is characterized by improved crossbred/ exotic breeds of pigs that are bred and reared under confinement

INDIGENOUS BREEDS OF PIGS

1. **Ghungroo** – Pigs of this breed are found along Indo-Nepal border, Jaipalguri and West Bengal and North Assam. Animals are mostly black coloured with typical Bull dog face appearance. Breed is popular among the local people because of high prolificacy, good mothering ability, docile nature and ability to sustain in low inputs.
2. **Jovaka** – Breed is found in Mizoram and Manipur. Animals have small, compact body with long legs and weigh around 40 -50 kg at maturity.
3. **Ankamali** – This breed inhabits states of Kerala, Karnataka, Maharashtra and Tamil Nadu. Typical characteristics of this breed include black to brown coat colour, small, body with long legs and mature body weight of 40 to 50 kg.
4. **Desi** – It is found in all states of India. Animals have Brown to Black coat colour, small, compact body with long legs and weigh around 40 to 80 kg at maturity.

EXOTIC BREEDS OF PIGS:

1. **Large white Yorkshire** – It is most extensively used exotic breed in India. White coat colour with occasional black pigmented spots, erect ears, snout of medium length and dished face are typical characteristics of this breed. Mature body weight ranges from 300 to 500 kg.
2. **Middle White Yorkshire** – Typical characteristics of this breed include white coat colour, long muscular neck and long back with a mature body ranging from 270 to 360 kg.
3. **Landrace** – Pigs of this breed are typically white coloured with black skin spots. They have a long body, large drooping ears and long snout. Mature body weight ranges from 250- 350 kg
4. **Berkshire** – Black coloured animals with white patches on feet, snout and tail. Small head, face depressed in middle and saucer shaped body with flexible ribs are typical characteristics of this breed. Mature body weight ranges from 280-350 kg.
5. **Hampshire** – Animals are black with white strip across forelegs to shoulder. Typical characteristics include small and erect ears, small and compact body. Sows have good mothering ability.

FEEDING MANAGEMENT

Pigs are monogastric animals and it utilizes fibrous food only to a limited extent. Adult pigs can utilize fibrous food better than young stock. Part of the protein in the diet of pigs should come from animal source such as fish, meat etc. Pigs should be fed at regular intervals. Fresh feed should be put only after removal of the previous feed from the feed trough. Pig rearing based on commercial pig feed is not economical and hence feeding based on swill is recommended. *Ad libitum* feeding using an automatic feeder (which can be fabricated using 200 litre oil drum) may be practiced for weaned pigs to avoid post-weaning weight depression.

MANAGEMENT PRACTICES

Care of Piglets

Care of new born piglets by providing guard rails. Disinfect the navel cord with tincture of iodine as it is cut with a sharp knife. Feed on mothers' milk for first 6-8 weeks along with creep feed. Needle teeth should be clipped shortly after birth. Vaccinate the piglets as per recommended vaccination schedule. Supplementation of Iron to prevent piglet anaemia. Male piglets not selected for breeding should be castrated preferably at the age of 3-4 weeks which will prevent the boar odour in the cooked meat thus it enables production of quality meat.

Care and management of sow

Care and management of sows are very essential since they are retained in the herd mainly for breeding. Good management and feeding will minimize problems related to breeding. Sows should be looked after with particular care so that the piglets are delivered normally and nursed properly.

Farrowing Sow and Litter

- Clean and disinfect the farrowing pen with a solution of 2 % of phenyl lotion and keep it vacant for a week. Keep the farrowing pen warm, dry and clean.
- The pregnant female may be dewormed 2-3 weeks before farrowing and prior to admitting into the farrowing pen. Spray with external parasiticide (1% solution of malathion/cythion, butox. 0.05 %). Provision of light bedding of chopped straw 2-3 days before farrowing.
- Appearance of milk in teats when pressed indicates the approach of farrowing time. Attend the farrowing throughout. It may last up to 24 hours.
- Wipe the piglets clean with towel. Disinfect the naval cord with tincture of iodine. Normal healthy piglets suckle teats within 10-30 minutes. Help small piglets to suckle.
- Placenta, dead piglets, soiled bedding etc. may be removed and buried in time with least delay. The placenta will be expelled generally within a short while.
- Provide 50 mg iron (Imferon 1 ml) on the second day intra-muscularly to prevent piglet anaemia. Oral administration of iron solution (1 g Ferrous sulphate in 25 ml of water) 1 ml per piglet once a week can be tried. A second injection may be given at 5 weeks of age.
- **Breeding management:** The sows come to heat once in about 21 days. Good feeding and management induces heat (estrus) makes breeding easy and larger litter size. Along with grains, fish meal. Skim milk or butter milk may be given 2-3 weeks prior to breeding to allow a body weight gain of 200-300 gm/day.

CARE AND MANAGEMENT OF BOAR:

The Boar should not be overfed nor underfed, since both will affect its breeding capacity. It should be fleshy, and thrifty but not too fatty. The feed requirements include both the demands for maintenance and reproduction. During off-season the boar should be given plenty of grasses and legume hay and 2kg of concentrate mixture. An additional 0.5 kg of concentrate may be given 2 weeks prior to breeding season. Boars should not be used for breeding earlier than 8 months of age. A young boar can be used for 15-20 sows in a season and older ones may be used for about 25-45 sows. A boar can be allowed to serve before being fed. Not more than one service per day is allowed during breeding season. Older sows may be used for breeding season. Older sows may be used for breeding with younger boars.

Pork consumption in India

Indian pork consumption can be divided into two segments:

1. The vast majority takes place in the informal sector in the form of locally raised fresh pork meat. This meat is not widely distributed in the organized retail sector.
2. The second segment of the pork market deals with high-value imported products. These products include cured meats such as sausages, ham, bacon and canned meat products, as well as small quantities of frozen meat.

SWOT ANALYSIS OF PIGGERY SECTOR:

The SWOT analysis identifies the farm's internal strengths and weaknesses and examines the external opportunities and threats that the farm business faces. The SWOT analysis helps to provide direction for the piggery business and serves as a basis for the farm's business plans. Once all of the strengths, weaknesses, opportunities, and threats to the farming operation have been listed, the information should be combined and strategies developed. Draw up plans to take advantage of the strengths and opportunities, counter the threats if possible, and minimize or reduce the weaknesses.

Strength:

A population of 13.84 million is the Strength to meet the animal protein deficiency experienced in the country. Ability of pig to survive and produce under adverse husbandry practices is Strength particularly for the weaker tribal and landless population of the country. Increase demand for pork and pork product like sausage, bacon etc. Pig by-products, namely bristle and inedible offal are Strength to support allied industries. Pork is rich in vitamins like thiamine, niacin and riboflavin and it is the highly preferred meat globally. Pig manure can be used as fertilizer and for generating energy in the form of biogas. Lard, obtained from pigs is a raw material for making poultry feed, soap, paints and other chemical industries. Both commercialization and organic path production are considered strength to give a meat revolution to the country and thereby provide employment to large section of rural poor.

Weakness:

Absence of sufficient number of breeder farmers throughout the country is a weakness. Religious taboo attached with pork consumption is also a weakness for which marketing of pork has to be confined to a selective group. Tendency of pig grower to raise pig to marketable age to negligible input is another weakness. Preference of the consumer for pork from the local pig is another weakness for promotion of improved pig with lean meat quality. Lack of adequate support from the development and financial bodies to establish pork based industries is hindering the growth of pig to desired extent. In the absence of supportive industries in and around the areas where pigs are grown, by-product utilization suffers a setback for which economic return is less.

Opportunities:

Pig being is a live source of insurance particularly for the weaker section of the community. Since regions like North East in the country where around 40% of pork consumption by way of procuring live pig from other part to the tune of around 1.0 lac

pig heads per annum, a very good opportunities exists for opening up employment generation for rural youth in this sector. Self employment to another set of pork product processor and worker s is yet another opportunities through pig husbandry not to mention about SHG personnel to be engaged in service delivery like A.I, Vaccination etc. Since pig is a prolific breeder, achieving the targeted growth of 10% in meat sector is another opportunity through pigs.

Threats:

More than 60% deficiency in concentrate feed sources is a Threat to pig industry which compete human for grains non availability of by-product utilization facility particularly in areas where pig concentration and slaughter is maximum is another Threat from public health point of view. For which general public might offer negative view for the growth of pig industry.

Evolutionary facts and techniques associated with food biotechnology

Dan Singh Jakhar[1*], Ashutosh[1], Saket Kumar[2] and Pavan Devesh[1]

[1]Department of Genetics and Plant Breeding, Institute of Agricultural Sciences & [2]Institute of Environment and Sustainable Development, Banaras Hindu University, Varanasi, India
[*]Corresponding Author: dansingh410@gmail.com

The term biotechnology comes from the two words biology and technology. Biology is the knowledge and study of living organisms and vital processes. Technology is an applied science and a scientific method for achieving a practical purpose. Food biotechnology is an umbrella term covering a vast variety of processes for using living organisms *viz* plants, animals, microbes, or any part of these organisms to develop new and improved food products. It is not new, for thousands of years people have been discovering that fruit juices ferment into wine, that milk can be used to develop products such as cheese or yogurt, or that beer can be made through the fermentation of malt and hops. In the 1860s, the scientist Mendel illuminated the genetic principles behind how parent plants donate certain traits to their progeny. These principles were used to breed hybrid corn, wheat and many other crops in which certain traits could be selected in order to increase plant yield. Such breeding methods largely accounted for the phenomenal gains in crop productivity during the 20th century and led to modern farming practices. The primary goals of food biotechnology are to provide a more abundant, less expensive and a more nutritious food supply in order to address the needs of our growing population.

EVOLUTION OF FOOD BIOTECHNOLOGY

Food biotechnology has been evolving for 10,000 years. Microorganisms have been used to enhance food production since before the turn of the 20th century. Food biotechnology as we know it today dates back to the 1970's when researchers first began to explore improving food through genetic enhancements. In 1990 the first food products enhanced via biotechnology were introduced. These were: an enzyme used in cheese production approved in the United States and yeast used in baking approved in the United Kingdom. In 1994 the first whole food produced using modern biotechnology entered the U.S. market place. This was the Flavr Savr® tomato. An herbicide-tolerant variety of soybeans was introduced in 1997. In 1998, the Hawaiian papaya industry was revived from near devastation with a genetically enhanced virus resistant strain. In April 2002, the genome of the first food crop "rice" was released.

DIFFERENT TECHNIQUES ASSOCIATED WITH FOOD BIOTECHNOLOGY

Food biotechnology techniques are often divided into old and new:

Old Techniques: Older food biotechnology techniques include conventional crossbreeding, which refers to the random recombination of genes through sexual reproduction leading to a new organism with improved traits. Crossbred plants, for instance, may require several generations to achieve a particular trait due to the randomness of gene transfer. Examples of such traits are improved crop yield, aesthetic qualities, increased tolerance to physical stress such as cold temperatures and increased resistance to disease and insects.

Modern Techniques: Modern food biotechnology techniques include the joining of two pieces of DNA from different organisms leading to a single piece of DNA. Individual "specific" genes are transferred from one organism to another in order to improve the nutrient levels of a food. These techniques are much faster and more precise. It is possible to quickly transfer a specific gene of interest rather than waiting on the random shuffling of genes over several generations.

FROM BREEDERS TO GENE JOCKEYS

Plant breeders have for many years used tools and techniques such as selective hybridization, grafting and cell isolation to improve crop quality and yield. And these early agricultural scientists made great advances, producing juicy ears of corn instead of hard kerneled corn, which must be ground into flour and present-day kiwi fruits rather than the hard berry from which they were developed. Scientists using the relatively new tools of biotechnology have been called "gene jockeys", because of the great degree of speed and control with which they can change the inherited traits of plants, animals and microorganisms. Today breeders can identify the gene(s) responsible for specific characteristics, such as disease resistance or nutrient composition and insert them into another organism.

HOW THESE FOODS ARE REGULATED

The FDA has issued the following guidelines to ensure the safety of foods developed using biotechnology:

- Genetically modified food products will be regulated just as traditionally produced foods are regulated.
- The products will be judged on their food safety and nutrition characteristics, not by the methods used to produce them.
- Any new ingredients will be regulated on the basis of the potential benefits and risks of including them in the food supply, just as traditional ingredients, like food additives, are regulated.

CHALLENGES

New technologies take time for acceptance. For crop biotechnology, key factors hindering acceptance are the public's limited understanding of modern agricultural practices and the science involved in biotechnology. Food, an emotional and personal

topic, combined with misunderstanding of biotechnology, sensationalized media coverage, and complex ethical and social matters have combined to generate fear in some consumers. Well-organized protest groups will likely continue to center the public debate on issues of uncertainty and mistrust.

Yet biotechnology is becoming more and more a part of our lives. Genome sequencing and analysis using new tools such as microarrays, allowing for very high throughput analysis of genes and gene expression patterns (Haseltine, 1998; Kell, 1999) are accelerating the discovery of genes with possible medical utility. Revenues are expected to increase for biotechnology-modified crops in general, as a result of the production of crops containing "output traits."

European consumers have expressed interest in identity preservation of GM foods. Undeniably, identity preservation adds cost and complexity to the system. For example, it is estimated that in 1999, 8% of Brazil's soybean crop was GM varieties, even though Brazil had not yet officially approved their use (Kepp, 2001). In addition, the government of Mexico recently announced that it had found genes engineered in corn among native maize varieties even though genetically modified corn seed has not been approved for sale in Mexico (Pollan, 2001).

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Heat treatment of oilseeds and its effects on ruminant nutrition

Tariq Ahmad Malik[1*], Shahid Hassan Mir[1], Sanjay Howal[1], Ravi Prakash Pal[1], Bibhudatta S. K. Panda[2], Digvijay Singh[1], Satyaranjan Barik[1]

[1]Animal Nutrition Division; [2]Animal Physiology Division
ICAR-National Dairy Research Institute, Karnal-132001
**corresponding author: drtariq093@gmail.com*

Oilseeds are rich in polyunsaturated fatty acids, particularly oleic, linoleic and linolenic acids. Due to rapid biohydrogenation of polyunsaturated fatty acids in the rumen, the lipid profile of contents leaving the rumen is very different from that found in the diet. However, feeding fat to dairy cows in a form that is protected from ruminal biohydrogenation will consequently modify the profile of fatty acids leaving the rumen and reaching the mammary gland. Feeding of heat-treated oilseeds might partially protect fatty acids from complete ruminal biohydrogenation by reducing the release of the oil in the rumen. Oilseeds have other advantages than only being rich in polyunsaturated fatty acids. They are also a good source of energy that can increase the energy density of dairy cow diets. This is particularly interesting for dairy cows in early lactation, which often face negative energy balance due to reduced dry matter intake. Moreover, oilseeds have a high content of protein, which could improve milk yield by providing increased quantity of limiting amino acids to the mammary gland. In order to achieve such improvement, heat treatment can be applied to the oilseeds to increase their rumen undegraded protein value and thus increase the quantity of amino acids being available for absorption in the small intestine (Van Soest, 1994). Oilseeds and oilseed meals are extensively used in the dairy feed industry as sources of protein and most of the research on ruminal undegradable protein has focus on those products (NRC, 2001).

METABOLISM OF POLYUNSATURATED FATTY ACIDS IN THE RUMEN

Dietary lipids are rapidly and extensive1y transformed by microorganisms after they reach the rumen so that very little lipids escape the rumen in their original form under normal circumstances (Harfoot and Haze1wood, 1997). The major steps in lipid metabolism by rumen microbes are hydrolysis and biohydrogenation.

Hydrolysis

Dietary lipids enter the rumen principally in their esterified form. Post-ruminal digesta when compared with the diet is usually rich in stearic acid while content of both linoleic and linolenic acid is reduced.. Esterified fatty acid are immune to biohydrogenation

process in the rumen due to lack of free carboxyl group. Therefore, hydrolysis of triglycerides into free fatty acids and glycerol is a mandatory step in the modification of fatty acids in the rumen. Lipolysis is usually rapidly and extensive1y performed by microbial lipolytic enzymes, however, this step could be a rate-limiting step to the modifications accomplished by rumen microbes on dietary fats. Rumen protozoa do not seem to play a major role in the hydrolysis process of fatty acids since rapid lipolysis also occurre in defaunated sheep. Lipolytic activity in the rumen thus seems to be mainly attributed to bacteria. Such bacteria have been isolated from rumen content of sheep and the most active seemed to be a non-cellulolytic strain of *Butyrivibro fibrisolvens.*

Biohydrogenation

The role of biohydrogenation has not been clearly established. It has been suggested that biohydrogenation produces intermediate fatty acids required for incorporation into microbial membranes or that the process could act as a disposal of reducing power. However, the major hypothesis is that biohydrogenation acts as a detoxification mechanism. There are some evidences that suggest that biohydrogenation is more extensively performed when food particles are present. Free fatty acids formed during the hydrolysis process have been found to be associated to rumen particulate matter by non-ionic bonds. Surface adhering bacteria would then perform biohydrogenation. As for lipolysis, protozoa are of minor importance in the biohydrogenation process and bacteria are mainly responsible for this process (Harfoot and Hazlewood, 1997).

Biohydrogenation is a multi-step process involving more than one species of bacteria. Many species of bacteria other than *Butyrivibro fibrisolvens* have been found to perform biohydrogenation and it is believed that many more remain to be discovered. The biohydrogenation process of linoleic acid (CI8 :2) starts by the isomerization of the 12-cis double bound of the cis-9, cis 12 C18:2 into all-trans isomer (Figure 1). This reaction is mediated by a ~cis-12, trans- 11 isomerase and results in the formation of cis-9, trans-11 CI8 :2, which is one the isomers of conjugated linoleic acid (CLA). This is followeding by the hydrogenation of cis-9 and trans-11 double bonds accomplished by reductases to obtain a saturated fatty acid; stearate. In case of linolenic acid (CI8 :3), an additional step for the hydrogenation of the cis-15 double bond would be required (Figure1). The biohydrogenation process of a polyunsaturated fatty acid to a completely saturated fatty acid is hardly accomplished by a single microorganism. Depending on the extent of the biohydrogenation process, a variety of fatty acids, from completely saturated fatty acids to undisturbed fatty acids and their intermediate products, leaves the rumen.

Lipolysis and biohydrogenation can be reduced to various extents by different means such as reducing the population of lipolytic and biohydrogenating bacteria, feeding a diet low in roughages, increasing concentration of dietary lipids and providing large quantities of free fatty acids. Other alternatives include heat treatments and providing fat in a protected form (Harfoot and Hazlewood, 1997; NRC, 2001).

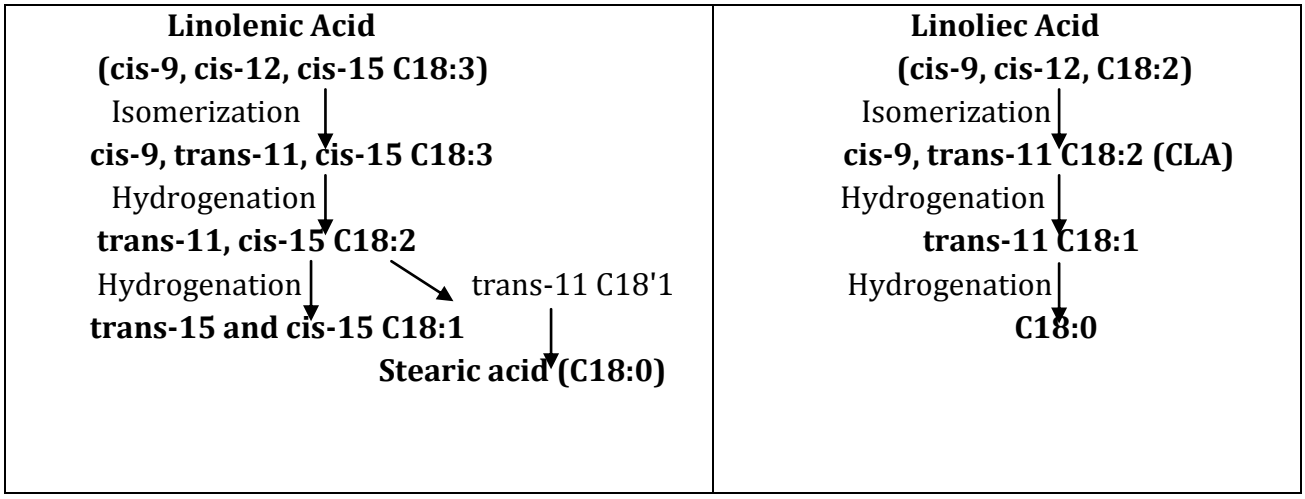

Figure 1. Scheme for the biohydrogenation of linolenic and linoleic acid (Harfoot and Haze1wood, 1997)

Heat Treatment of Oilseeds

Heat is the most commonly used treatment to protect dietary proteins from ruminal degradation.(NRC, 2001). Heat treatments reduce ruminal degradation of protein by denaturation of protein, creation of Maillard products and formation of protein to protein cross-links (NRC, 2001). This consequently increases the concentration of amino acids available for digestion in the small intestine (NRC, 2001). Heat treatments can also increase the concentration of polyunsaturated fatty acids reaching the small intestine thus increasing the secretion of polyunsaturated fatty acids into the milk. Several types of heat treatments have been used to protect oilseeds from ruminal degradation. These include moist heat treatment (autoclaving), micronization, jet sploding and roasting. Moist heat treatment or autoclaving involves the heating of the material with steam under high pressure. Micronization is a dry heat treatment in which infrared gas generators heat the feedstuff to temperature varying between 110 to 180^0 C for 30 to 60 seconds. A major advantage of micronization over other heat treatment methods is the shorter heating time. Moreover, micronization heats the seeds from inside avoiding shell damages. Jet-sploding involves rapid steam heat treatment under high pressure for a short period of time utilizing the moisture within the seed. Particulate medium thermal processing is another heating method that can be used to roast various oilseeds.

Impact of heat Treatment on Chemical Composition of Oilseeds

Heat treatment modifies the chemical composition of oilseeds and oilseed meals. Changes have been found to occur in the different fiber and protein fractions as well as in the individual amino acid concentrations.

Heat treatment of oilseeds and oilseed meals usually increases the neutral and acid detergent fiber fractions (Mustafa, 2002). The increase in those two fiber fractions

is mainly due to the increase in the concentration of neutral and acid detergent insoluble nitrogen.

Protein fractions are the chemical constituents mostly affected by heat treatments. The effects of heat treatment on protein fractions are based on the fact that dietary protein consists of different fractions, which respond differently to various heat inputs. According to Sniffen *et al.* (1992), five protein fractions can be identified namely non-protein nitrogen (A), rapidly degradable true protein (B1), intermediately degradable true protein (B2), slowly degradable true protein (B3) and unavailable protein (C). The non-protein nitrogen and the rapidly degradable true protein fractions denature at lower heat inputs and become intermediately or slowly degradable fractions depending on the level of heat input. The slowly degradable protein fraction responds at higher heat inputs and usually becomes unavailable (heat-damaged) protein via the Maillard reaction (NRC, 2001; Van Soest et al., 1994). An optimum heat input varies from one dietary protein source to another.

As heat input increases, the concentration of soluble protein decreases and that of neutral detergent insoluble protein increases. Moderate heat input has little effect on acid detergent insoluble protein. However, heat damaged protein generated by excessive heat input is usually characterized by elevated concentrations of acid detergent insoluble protein. Overheating can also result in changes in the individual amino acid concentrations, particularly lysine, cystine and arginine (NRC, 2001). Maillard products being resistant to acid hydrolysis during amino acid analysis might be responsible for the reduction in arginine and lysine concentrations.

Impact of Heat Treatment on Ruminal Degradation of Oilseeds

Oilseeds are considered a poor source of ruminaI undegraded protein (Deacon *et al.,* 1988; Mustafa *et al.,* 2003). Effective heat treatment increases the ruminal undegraded protein content by reducing the in situ soluble protein fraction and increasing the in situ slowly degradable protein fraction. Effective heat treatment also reduces ruminal degradability without impairing total tract nutrient utilization (Van Soest, 1994). However, overheating of oilseeds and other protein sources can reduce total tract nutrient utilization as a result of the formation of Maillard products.

Impact of Heat Treatment on Milk Yield and Milk Fatty Acid Composition

Dairy cows in early lactation have high requirements and potential milk production might not be achieved due to limiting factors such as reduced dry matter intake with consequent decrease in the quantity of essential amino acids reaching the mammary gland. Heat treatment of oilseeds increases ruminal undegraded protein and increases the availability of essential amino acids in the small intestine. Hence, increases the potential for essential amino acids to reach the mammary gland and to be available for milk synthesis. It is therefore expected that feeding heat-treated oilseeds or oilseed meals will increase milk yield of dairy cows in early lactation.

Heat treatment of oilseeds has the potential to change milk fatty acid composition by protecting polyunsaturated fatty acids from complete biohydrogenation in the rumen.

Roasting soybeans have resulted in a slower release of free fatty acids and reduced biohydrogenation in the rumen when compared with extruded and raw soybeans (Reddy *et al.,* 1994). Possible reasons include the intracellular location of the oil, the chemical changes occurring during the roasting treatment and the reduction in release rate of oil into the rumen due to reduced dry matter digestion after roasting. This protection could also originate from the denaturation of the protein matrix surrounding the fat droplets, which may increase quantity of polyunsaturated fatty acids reaching the marnmary gland.

CONCLUSION

Heat treatment may be applied to the oilseeds to reduce their ruminal degradation. This will enhance their feeding value in ruminants by increasing the quantity of long chain unsaturated fatty acids and amino acids available for absorption in the small intestine.

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Ruminal Acidosis in Ruminants:

Its Current Microbial and Nutritional Outlook

Sunil Kumar[1*], S. V. Singh[1], Priyanka Pandey[1] and Anshuman Kumar[2]

[1]Animal Physiology Division, ICAR-National Dairy Research Institute, Karnal, Haryana, INDIA
[2]AGB Division, ICAR-National Dairy Research Institute, Karnal, Haryana, INDIA
**Corresponding author: dr.sunil8507@gmail.com*

Ruminal acidosis is a metabolic disorder of ruminants. It occur when the pH of the rumen falls to less than 5.5 (normal is 6.5 to 7.0). Due to fall in pH rumen becomes atonic which results into depressed appetite and production of the ruminants. The change in acidity causes disturbance in the rumen flora, with acid-producing bacteria become dominant. They produce more acid, making the acidosis worse. The increased acid production is absorbed through the rumen wall, causing metabolic acidosis, which causes increases in the morbidity and mortality of livestock and in severe cases can lead to shock and death of the animals.

Definition

Ruminal acidosis is a metabolic disease of the ruminants associated with the accumulation of acid or depletion of alkaline reserves in blood and body tissues, and characterised by increased hydrogen ion concentrations in the body fluid (Blood and Studdert 1988). Ruminal acidosis occurs due to production of large quantities of volatile fatty acids (VFA) and lactic acid that causes decrease in rumen pH to non-physiological levels which simultaneously weakens the buffering capacity of the rumen and reduces the efficiency of rumen flora and fermentation. The decreases in rumen pH due to accumulation of VFA and lactic acid causes ruminitis, metabolic acidosis, lameness, hepatic abscessation, pneumonia and death (Wade et al. 2001).

TYPES OF RUMINAL ACIDOSIS

Ruminal acidosis is divided into two types- clinical and sub-clinical.

1. Clinical ruminal acidosis

Prevalence

Depending upon the type and amount of feed ingested clinical acidosis represents as a mild to severe form of the disease. Bramley (2006) found herd prevalence of clinical acidosis of approximately 3%.

Clinical signs

Ruminants with mild clinical acidosis exhibit anorexia, decreased milk production and scouring (Underwood 1992). The severe form of the disease shows metabolic acidosis, depression, dehydration, toxaemia and 'downer cow' syndrome (Bolton and Pass 1988). Depending upon the severity peracute form of acidosis may result in recumbancy, coma and death in eight to 10 hours whereas acute form develop within eight hours and precede the onset of metabolic clinical acidosis and peaks in 36 hours (Underwood 1992).

Sequelae

Sequel of acute ruminal acidosis includes hypocalcaemia, laminitis, polioencephalomalacia results due to calcium malabsorption, release of histamine and endotoxins into the circulation, thiamine deficiency respectively, (Bolton and Pass 1988).

Ruminitis and liver abscessation occurs due to bacterial implication Fusobacterium necrophorum and Archanobacterium spp in liver. These bacteria reach the liver through the portal circulation via damaged ruminal epithelium (Bolton and Pass 1988).

2. Sub-clinical ruminal acidosis

Prevalence

Sub-clinical ruminal acidosis is of greater significance than clinical disease because of higher prevalence (10%) and loss.

Clinical signs

Signs and symptoms shown by clinical acidosis include a reduction in milk fat content, feed conversion efficiency, feed intake and decreased digestion of fibre (Lean et al. 2001), laminitis, liver abscessation, scouring and a higher incidence of left and right displacements of the abomasum (Shaver 1997).

Sequelae

Sub-clinical acidosis often passed away unrecognised and undiagnosed until significant herd is affected and clinical signs are evident. In this case huge financial losses and high prevalence of herd lameness is noticed.

Proposed aetiology of ruminal acidosis in ruminants

Ruminal acidosis mainly caused by the following factor

- Access of preformed acids in feeds, such as some silages;
- Feeding of starch-rich concentrates
- Animals fed solely on pasture or pasture supplemented with grain
- A failure to produce buffering with endogenously derived buffers such as salivary bicarbonate;

- Production of lactic acid in the rumen; and
- Production of large amounts of weak volatile fatty acids, acetic acid, butyric acid and propionic acid.
- Pastures low in Neutral Detergent Fibre (NDF) and high in non-structural carbohydrates (NSC). (Lean et al. 2000)

Table 1: Rumen microbial populations

Microbe	Primary substrate	Optimum rumen pH	Primary requirement	Main fermentation products	Doubling times
Bacteria	About 630 different bacteria (50% of microbial mass)				
Fibre and pectin	Fibre and pectin	6.3 to 6.8	NH_3, isoacids	Acetate	8-10 h
Protein *C. aminophilum*	Protein	6 to 7	Protein, peptides, NH_3	NH_3, Isoacids	4-8 h
Allisonella histaminiformans	Histidine	4.5 to 6.5	Histidine, peptides from silage	Histamine	Rapid
Starch, S. bovis	Starch and sugars	5.5 to 6.5	Peptides, AA, NH_3	Propionic, lactic	15-30 m
Secondary – *M. elsdinii, Methanogens*	Lactic, H_2	6 to 6.8	Peptides, AA, malic	Propionic, CH_4	2-4 h
Protozoa	About 30 different protozoa (40-45% microbial mass)				
	Starch, sugars	6.3 to 7.0	Peptides, AA, bacteria	Propionic, H_2	15-24 h
Fungi	About 14-15 types of fungi (3-8% microbial mass)				
	Fibre	6 to 7	NH_3, AA, sugars	lactic, acetic, H_2	15-24 h
Bacterial viruses	(5-7 types and .0000001% TMM) Yeasts (0.1-0.2% TMM)				

Adapted from Lean, I. J., *et al*. (2007). in "Ruminal acidosis–understandings, prevention and treatment." Australia. Australian Veterinary Association.

CONSEQUENCES OF RUMINAL ACIDOSIS

1. Changes in rumen microbes

When large amounts of starch are added to the diet, it initially increases the growth rates of all bacteria in the rumen, causes an increase in total volatile fatty acid production and a decrease in ruminal pH. It provides increased substrates for microbial production i.e ammonia and peptides which will favour bacterial growth. The growth rate of Streptococcus bovis is faster than other species of rumen bacteria and produces lactic acid, 10 times stronger than acetic, propionic or butyric acid and accumulation of it exceeds the buffering capacity of rumen fluid. Glucose the breakdown product of starch and other carbohydrates are converted to fructose 1, 6-diphosphate which had a positive feedback on the conversion of pyruvate to lactate by activating lactate dehydrogenase. Fructose 1, 6-diphosphate is also converted to triose phosphate in

higher concentrations which acts to inhibit pyruvate formate lyase. The net effect of these changes is higher production of lactate than acetate and formate (Russell and Hino 1985).

1. **Changes to rumen organ motility**

The increase production of VFA concentrations initially decreases reticulo-ruminal motility by acting on receptors in the rumen wall. A decrease in rumen motility causes reduction in rumination and less production of salivary bicarbonate ions, an important buffer for the rumen.

2. **Changes in rumen pH and lactic acid absorption**

A decrease in bicarbonate and increase in lactic acid concentrations in the rumen decreases ruminal pH. When ruminal pH is maintained above 5.5, equilibrium exists between producers and utilisers of lactic acid and no accumulation occur in the rumen (Nocek 1997). When pH decreases to less than 5.5, no cellulolytic bacteria only relatively few saccharolytic bacteria such as P. ruminicola, a significant producer of VFAs, survive. The population of S. bovis multiplies until ruminal pH is less than 5.0, which allows an increase in Lactobacillus growth. Both of these bacterial species produce D and L-lactic acid which are absorbed across the rumen wall and depress blood pH. L-lactate is metabolised more rapidly than D-lactate and the metabolic acidosis is maily occur due to accumulation of it (Bolton and Pass 1988). The deceased pH creates a ruminal environment hostile to protozoa and fungi. It invades the rumen wall and causes ruminitis. Rumen papillae are damaged and slough from the rumen wall. Acute stages of the disease process causes release of endotoxins and histamine.

3. **Acidosis and diarrhoea**

The absorption of lactate during passage from abomasum to intestinal tract creates osmotic gradient which causes increase in fluid in the lumen. It results into profuse diarrhoea and subsequent dehydration during clinical acidosis.

PREVENTION OF RUMINAL ACIDOSIS

Adequate fibre

Chewing time is very important in the prevention of ruminal acidosis. It stimulates the flow of saliva and buffers the rumen pH in the range of 6 and 7. Chewing time increases when long-stem forages are fed and reducess when particle size is decreased, or increasing the processing of concentrates (Krause et al. 2002). It is advisable that when the pastures are lush or limited, good-quality cereal or legume hays, should be offered for prevention of acidosis. The diets of ruminants should contains more than 32% NDF, with atleast 80% from long forage.

Gradual adaption to starch-rich feeds

Cattles are often fed poor-quality fodder which have higher dietary NDF concentrations during the dry period. The sudden shift high-fibre diets to lower fibre diets or higher concentrate diets, combined with lower feed intake during the week before calving (Grant and Albright 1996), causes disruption in rumen function and place the animal at higher risk of metabolic disorders such as acidosis. Therefore, it is benificial to feed a transition diet for several weeks before calving, during which fibre levels in the diet are progressively reduced and concentrates are introduced to allow rumen microbial populations to adjust itself to a change in diet. (Lean et al. 1998).

Rumen buffers and neutralising agents

The compound which act as a buffer in the rumen, they must be water soluble, a weak acid, base or salt and have a pKa near the physiological pH of the rumen. A true buffer prevents the decrease in pH without causing a pH increase compared with a neutralising agent that elevates pH (Staples and Lough 1989). Buffers commonly used in the dairy industry include sodium bicarbonate, sodium sesquicarbonate, potassium bicarbonate, magnesium carbonate and calcium carbonate (Erdman 1988). Neutralising agents includes sodium carbonate, potassium carbonate, magnesium oxide, sodium hydroxide and calcium hydride (Staples and Lough 1989).

Ionophore rumen modifiers

Ionophore rumen modifiers prevent or help in prevention of digestive and metabolic disturbances caused by erratic feed intake or specific feed problems associated with bloat and acidosis. Ionophores helps in controling the acidosis by two distinct mechanisms. The first mechanism is to reduce lactic acid-producing strains of bacteria such as Streptococcus bovis and Lactobacillus spp. The other mechanism is by changing the eating dynamics. Subacute acidosis causes variation in dry matter intake (DMI) and decreases total DMI. Ionophores include monensin,lasalocid, narasin and salinomycin.

TREATMENT OF CLINICAL ACIDOSIS

Treatment of clinical acidosis is difficult and the chances of success depend on the severity of the case. Treatment of severe cases (dehydration >8%, collapsed and subnormal temperature, static rumen and evidence of scouring) is unrewarding, time consuming and expensive. Severe cases can be treated by giving intravenous fluids, e.g. hypertonic saline and access to water or balanced electrolyte solutions not containing lactic acid. Treatment of mild cases of acidosis includes withholding concentrates and feeding hay to stimulate saliva flow. Oral administration of antacids such as magnesium hydroxide, magnesium oxide or sodium bicarbonate @ 1 g/kg body weight initially to alkalinise the rumen, and electrolyte solutions, preferably those containing sodium bicarbonate to treat metabolic acidosis.

Antibiotics including penicillins, tylosin, potentiated sulphonamides and tetracycline may be given to reduce the risk of liver abscessation. Other supportive treatments include flunixin meglumine (1 mg/kg) for endotoxaemia, antihistamines to control histamine production, and calcium/magnesium solutions either intravenously or subcutaneously to counteract secondary hypocalcaemia and hypomagnesaemia. Thiamine (10 mg/kg) for three days to prevent polioencephalomalacia.

CONCLUSION

Sub-clinical acidosis is an important nutritional problem in dairy herds both in terms of economic impact and as a substantial health problem. Higher-quality pastures containing increasing concentrations of water soluble carbohydrates and less fibre. This good quality pasture combined with the supplementation of increasing amounts of highly fermentable concentrates, used as a tool to boost production, predisposes the herd to acidosis. The ruminants suffering from ruminal acidosis had significantly lower milk fat content higher prevalence of lameness and a higher ratio of NSC to NDF.

Mastitis: An overview

P K Rath[1*], B P Mishra[2], R Tripathy[3] and J Mishra[4]

[1]Assistant Professor, Department of Veterinary Pathology, [2]Assistant Professor, Department of Livestock Products Technology,[3]M.V.Sc Scholar, Department of Veterinary Pathology, C.V.Sc & A.H., OUAT, Bhubaneswar, Odisha, 751003,[4]Scientist (Animal Science), KVK, Sambalpur,Chipilima, OUAT, Odisha

[*]Corresponding author: drpkrath78@gmail.com

Abstract

Mastitis is considered a complex disease of multifactorial aetiology, occurs in both clinical and subclinical forms that results in pathological changes in the mammary tissue as well as physical, chemical and microbiological changes in milk. Many risk factors have been associated as important causal factors for ever increasing incidences of mastitis in dairy industry, thus completely devastating the economic backbone of the rural farmers. Recent strategies are aimed in reducing the incidences of new intramammary infections as well as antibiotic therapy to cure the already existing infection in cows. Potential control measures may be aimed to improve environmental as well as animal hygiene such as pre and Post teat / udder cleaning, good drainage facility with proper cleaning of the animal bed i.e. the floor. Prevention and control strategies in mastitis, considered as one of the costliest disease in dairy animals, though hard to adopt at farmer's level but the external validity needs to be closely monitored given production system specific risk factors and their interactions. Keeping in view of high incidence of mastitis along with it's multiple etiology and risk factors, the present objective of this article is to educate the rural youths as well as farmers and field veterinarians to have a detailed insight on various aspects of mastitis.

INTRODUCTION

Mastitis is the inflammation of parenchyma of mammary gland which is characterized by physical, chemical, compositional and usually bacteriological changes in milk and pathological changes in glandular tissues (Radostits *et al.,* 2000). It is one of the most widespread and damaging disease, hampering the expected growth of the dairy sector (Tripura *et al.,* 2014). In India, the dairy industry is facing a great problem due to high prevalence and incidence of mastitis in milch animals. An early screening of dairy cows for mastitis as well as adaptation of various hygienic measures by the farmers at cow shed to reduce the new intramammary infections and selection of suitable antibiotics through antibiotic sensitivity test is the need of the hour to control the ever increasing infections day by day and to save the animal owners from the devastating losses incurred due to mastitis in the days to come.

EPIDEMIOLOGY

Mastitis affects 15 to 50% of cows each year in major milk producing cows (Radostits *et al.,* 2007). It has been reported that the average incidence of clinical mastitis varies from 10 to 20 % in most of the herds and the prevalence of the subclinical mastitis (SCM) is 30 – 40 times more than the clinical mastitis (Bhanderi and Garg, 2012). As mastitis is a complex disease of multifactorial etiology, several risk factors are being associated directly or indirectly in increasing occurrence of the disease in dairy cattle such as age, breed, season, stage of lactation, parity, sanitation of the shed and distance from the ground to teat orifice etc. Several researchers have different opinions regarding the importance of various risk factors with the incidence of mastitis. The cows with higher age i.e. between 5 -8 years are more susceptible to mastitis which owes to maximum productions resulting more relaxation of teat sphincters in these periods. Rainy season favors multiplication of microorganisms as well as fly population thereby more occurrence of mastitis in Dairy cows during this period. Bad sanitation with absence of a good drainage facility and irregular use of teat disinfectants befor and after milking results more incidence of mastitis in lactating animals.

Etiology

Bovine mastitis is considered to be a multifactorial disease. Over 200 microbial species, subspecies and serotypes have been isolated from bovine mammary gland (Mallikarjunaswamy and Krishnamurthy, 1997) and incriminated as causative agents. The bacteria responsible for mastitis include *Staphylococcus spp., Streptococcus spp., the coliform gro*up (specifically *E. coli, Enterobacter, Klebsiella* spp., etc.), *Corynebacterium, Pasteurella, Mycoplasma, Leptospira, Yersinia, Mycobacterium, Pseudomonas, Serratia* spp. etc. In India, *Staphylococcus, Streptococcus and E. coli* generally cause 90-95 % of all infections of mammary gland (mastitis).

Clinical signs

Clinical mastitis is characterized by sudden onset, swelling and redness of the udder, pain and reduced and altered milk secretion from the affected quarters. The milk may contain clots or flakes or become watery in consistency accompanied by fever, depression and anorexia. The subclinical mastitis is characterized by having no visible signs either in the udder or in the milk, but the milk production decreases and the somatic cell count (SCC) increases, having greater impact in older lactating animals than in first lactating heifers. A negative relationship generally exists between SCC and the milk yield. Milk from normal uninfected quarters generally contain below 2, 00,000 somatic cells/ml. A value of SCC above 3, 00,000 is abnormal and an indication of inflammation in the udder. Hence, the milk production loss is more in subclinical mastitis as compared to clinical form, due to the increase in undesirable milk components like proteolytic enzymes, salts and also increase in somatic cell count, thereby resulting in decrease in the desirable components such as protein, milk fat and lactose. In addition, milk from affected animals may harbour the organisms which are potentially pathogenic to humans.

Hemato-biochemical Alterations

Alterations in hemato-biochemical parameters have been correlated to aid diagnosis as well as treatment. It has been observed that anaemia occurs in mastitic cows due to decrease in Hb, RBC, and PCV levels (Zaki *et al.,* 2010). Decrease in haemoglobin, total erythrocytic count with increase in total leucocyte count with Nutrophilic leucocytosis is a constant feature in most of the mastitis affected blood picture.

The serum total protein and globulin concentration is increased in mastitic cows. The serum calcium concentration decreases significantly whereas the phosphorus level do not exhibit any change in SCM. Stress in the form of muscular exertion causes alterations in the different blood constituents. It is suggested that a cow suffering from clinical hypocalcemia is 8.1 times more likely to develop mastitis than a cow without calcium deficiency. Ketosis increases the risk of mastitis by two-fold. It has also been observed that the risk of mastitis increases in cows suffering from retained placenta. Hence, coexistence of one or more periparturient diseases needs to be ruled out with appropriate therapeutic measures. Prevention of hypocalcaemic condition by dietary cation–anion balance (DCAB) during dry period is considered a dependable, economical and reliable preventive method (Radostits *et al.,* 2007). Besides, sanitary milking habits, proper use of milking machine, udder washing, examination of fore milk, post-milking teat dipping, culling, dry cow therapy and antimicrobial treatment using suitable antibiotics are proven procedures for control of mastitis.

Use of Antibiotics

Use of antibiotics, selected either by empirical means of *in vitro* sensitivity test, is a common practice to cure mastitis. Availability of antibiotic sensitivity profiles of the prevailing isolates can guide the veterinarian in selecting the most appropriate antimicrobial agent for treatment of the ailment. However, the use of antibiotics is not free from hazards especially in developing countries due to unwanted antibiotic residues in milk as well as development of variable degree of antibiotic resistance. Recurrent mastitis due to *Staphylococcus aureus* is the befitting example in many areas.

CONCLUSION

Despite significant advances in our understanding of the disease, mastitis, both clinical and subclinical, remains a problem in dairy herds and prevalence rates in many countries continues to be in an accelerating rate. In the complex social environment of the modern dairy farming, the interaction of production diseases like mastitis and their relationship with nutritional strategy, housing, environment and the fundamental influence of social and attitudinal factors make prevention and control a challenge. Investigation of etio-prevalence, effectiveness of different field level tests and bacteriological examination are very much essential for early detection to minimize the overall damage. Early detection with suitable tests, timely intervention with effective treatment and prevention is necessary to restrict the spread of mastitis (Guha and Gera, 2011). The gold standard for determining infection status of udder is bacteriological culture of milk which sometimes need cumbersome. Modified California Mastitis test

(MCMT), Somatic cell count (SCC) and electrical conductivity of milk are most frequently used tests in dairy cattle to diagnose mastitis.

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General Health and Management of Dairy Calves

Ajeet Singh[1*], Nadeem Shah[1], Uma Kant Verma[2], Hanuman Prasad Yadav[3], Shabir Ahmad Lone[3] and Mukesh Bhakat[4]

[1]Senior Research Fellow, ABRC, [2]Ph.D. Scholar, (AGB), [3]Ph.D. Scholar, (ARGO), [4]Senior Scientist
ABRC, ICAR-National Dairy Research Institute, Karnal, Haryana, 132001
**Corresponding Author: ajeetndri@gmail.com*

Calf diseases have a major impact on the economic viability of cattle operations, due to the direct costs of calf losses and treatment and the long term effects on performance. Calf health should be prioritized as one of the most important animal health issues. To ensure the production of sound dairy herd, some basic principles should be adopted. Under this article basic information regarding general health and management procedures are discussed.

Care of navel cord

First step to take care of navel cord of the new born calves. It should be cut with utmost care by ensuring the length of navel cord at least 2-3 cm from the body with new clean and sharp blade. Make a proper ligature of Navel cord and also wipe the navel with tincture iodine solution to prevent the infection. As the navel's umbilicus vessels directly attached to various internal organs so infection of the navel may be harmful to the newborn calves. Dipping of the navel should be done shortly after birth and before drying of the navel.

Colostrum feeding

Feeding of the colostrum should be ensuring just after birth (Within one hour of birth). As calves are very susceptible for the infections like pneumonia, calf scour diarrhea so the feeding of colostrums to calves provides immunity and help for optimum growth of the calves. One thing should be kept in mind that the quantity of colostrums (e.g. one tenth of body weight) and frequency of colostrums feeding (3-4 times in a day) should be assured.

Identification of calves

Identification of new born calves is very important for easy rearing and smooth day to day activities of dairy farms. Identification of calf should be positively determined before removing the calf from the dam. Correct identification helps in record keeping, genetic evaluation of animal, its progeny and parents. Numbered ear tag (plastic or metal tag), numbered neck strip, tattooing etc. may be used. For proper record birth

dates of calves, registration number, tag number, sires and dam's number should be maintained in farm record book.

Fig 1: Ear Tagging Machine with Plastic Ear Tag

Extra teats

Sometimes extra teats are present which should be removed at an early age to make the milking smooth in later life. Extra teats should be cut with sterile scissor and antiseptic should be applied to cure the wound.

Disbudding of calves

For commercial dairy horns serve no usefull purpose except in some breed specific identification. There are chances of body and udder injuries. For routine prevention of horn development the golden rule is the earlier the better. Smaller calves have smaller horn buds, which are easier to remove and much less likely to grow back. Small calves are also easier and safer to handle. Disbudding should be done at optimum age (e.g. 10 days after birth) when horn buttons are small. It is a technical work and requires expertisation. There are several method available for dehorning depending on the availability and easiness of the method.

Chemical methods

1) **Caustic potash sticks:** This is mostly used on calves over 3 weeks old. At very young age this method works very well. For this clip the hairs and clean the horn

bud area. Make the potash stick moist and rub till the redness appears. Precaution should be taken during application to avoid using too much caustic and also avoid contact with skin of the applicator.

2) **Electric dehorner:** This is basically used on calves over 4 month age. This just acts as soldering irons and used to destroy horn buttons by burning the nerves and blood vessels. During application of electric dehorning optimum voltage and time of contact at horn bud should be given prime attention.
3) **Saw or horn clippers:** For older animals horn clippers or saw can be used. In older animals horns are hard and long so require more labor. To avoid the infection and contamination, dehorning should be done in sunlight and winter season.
4) **Castration:** Castration of a bull (male) calf is the process of removal or destruction of the testicles. There are many reasons to castrate a calf as –To produce docile male that are easier to handle. To decrease rearing costs associated with feeding and handling facilities compared to bulls. It has been speculated that, because intact bull calves may grow more rapidly than steer calves, delaying castration until weaning (around 6 months old) can yield similar benefits to growth promoting implants administered when the calves are 1 to 3 months of age, but without additional cost. Most popular method for castration is Burdizzo which is easy to operate and less costly. The Burdizzo method crushes the blood vessels, interrupts the blood supply to the testicle and thus kills the testicle. Good restraint is essential because the Burdizzo must be in place about 10 seconds to crush the artery. The Burdizzo must be in good condition. The jaws must be parallel and close uniformly across their width so pressure will be evenly distributed across their length. Leave the Burdizzo slightly open when not in use.

Fig 2: Burdizzo Castrator

Calf scour

Calf scour is basically characterized by diarrhea and dehydration. Main source of infection is nutritional imbalance. During this problem continue to feed milk and add

electrolytes to compensate the salt and mineral loss. First step taken at this condition is to isolate the affected calves from others. Always provide luke warm water to affected calf. Try to replace the electrolyte solution with milk as the calf recovers. In severe cases take the assistance of veterinarian.

Pneumonia

Main causes of calf's pneumonia are lack of sanitation and hygiene of calf shed, stress and poor ventilation. To answer the question, how know that calf is suffering from pneumonia is to judge the respiration rate and rhythmic pattern of respiration. Labored breathing and rise in temperature is best indicator of the pneumonic condition. Rectal temperatures of calves affected with pneumonia have higher temperature (104^0F) then the normal temperature ($101\text{-}102^0$F).

Other management conditions

Along with these above explained health problems some other conditions also exists.
Bloat: It is basically accumulation of gas in stomach due to excessive feeding of carbohydrate rich feed. To avoid such problems extra care should be taken during feeding the calves. In severe cases immediate veterinary assistance should be taken.
Navel hernia: This condition basically exists when the abdominal wall of calves navel does not close properly. It can be easily diagnosed by observing a lump in the abdominal area of animal body. Case of hernia should be given proper attention and care.
Pink eye: Condition of pink eye characterized by reddening and swelling of eye membranes and watery discharge from the eye. Treat such cases swiftly by antibiotics and affected eye prevented from exposure of direct sunlight.

Parasitic conditions:

Fly control: To make the calf free from diseases it is very important to control menace of fly. Cleaning, sanitation and hygiene of calf pen reduce the chances of fly and use of fly repellant during breeding season proves effective for fly control.

Internal parasites

In newly born calves there are also chances of parasitic infection. To control the internal parasite deworming programme should be ensured. For diagnosis of parasitic infection, treatment and prevention plan veterinarian assistance may be taken.

PRINCIPLES OF CONTROL AND PREVENTION OF INFECTIOUS DISEASES OF NEW BORN CALVES:

(1) Removal of the cause of diseases from the environment:

- The newborn should be born in an environment which is clean, dry and conducive for the animal to get up after birth and such the dam.
- Then swabbing of the navel with tincture iodine to prevent the enter of infection.
- Disinfections of the uterus before conception is necessary also. Examination of swabs from the uterine contents before and after treatment in suspected animals.

(2) Removal of the newborn from the infected environment:

- Transfer the newborn to a non-infected environment either temporary or permanently in cases of over crowded barn.
- Removal of the newborn away from the main calving ground.
- Diseased calf should be transferred with his dam to hospital pasture during the period of treatment and convalescence.

(3) Increasing and maintaining the non – specific resistance of the newborn:

- Ingestion of colostrums from dam is so important as the only one source of immunoglobulin to newborn.
- Calf fed about 80 ml / kg body weight of colostrums at 6 hours of age.
- Special nutritional and housing requirements.
- Isolation of newborn calf in calf – rearing unit within few days after birth.
- Provision of suitable environment.

(4) Increasing the specific resistance of the new born:

- Vaccination of dam before parturition to stimulate the production of specific antibodies which are then transferred to the newborn via the colostrums.

VACCINATION SCHEDULE

Vaccination is the easiest and cheapest way to prevent diseases. For better growth, immunity and health of calves strict vaccination schedule should be followed. Prior to vaccination veterinarians suggestion should be taken. Vaccines which are routinely used are given in table below.

S.N.	Name of the disease	Age and booster dose	Route of vaccine administration	Vaccines available
1	Foot and mouth disease (FMD)	4 months,booster at 2-4 weeks after primary vaccination, Repeat every 6 months	3 ml S/C	Raksha, Futvac
2	Haemorrhagic septicemia (HS)	6 months and above	2 ml S/C	Raksha- HS, Bovilis HS
3	Black quarter (BQ)	6 months and above	2 ml S/C	Black quarter vaccine
4	Brucellosis	4-8 months of age (Only female calves)	2 ml S/C	Bruvax, Brucella vaccine living
5	Theileriosis	3 months of age and above	3 ml S/C	Rakshavac-T
6	Anthrax	4 months and above	1 ml S/C	Raksha Anthrax

POINTS TO BE REMEMBERED DURING VACCINATION:

- For better immune response deworming should be carried out before vaccination.
- The manufacturers' instruction on the route and dosage should be strictly followed
- The cold chain of the vaccines wherever prescribed should be maintained till the time of administration to the animal.

CONCLUSION

The health and management of calves are crucial component of profitable dairy farm. Time at the first colostrum feeding and vaccination programs are major factors that affect calves health. Though the causes of the diseases are diverse in nature, poor management practices (feeding, hygiene and sanitation) and poor health care practices are very important. Dairy Farmers have to follow good colostrum feeding management satisfying the quality, quantity and time of colostrum. Vaccination programs should be designed to protect against diseases that occur commonly in calves. The timing of the vaccination is also very important criteria. Good hygiene of calf pens and feeding equipment and Close attention to animal health to minimize the incidence of calf scours, pneumonia and other diseases should be carried out for better results. Don't hesitate to consult veterinarians and other animal health specialists to develop and implement effective calf health programs.

Indigenous technical knowledge: a pavement for modern technical knowledge for farmers

Suren Murmu[1], Apurba Pal[2] and Gayatri Kumari Padhi[3]

[1]Ph. D Research Scholar, Department of Soil and water conservation, F/Ag, Bidhan Chandra Krishi Viswavidyalaya, Mohanpur, Nadia-741252, West Bengal
[2] Ph. D Research Scholar, Department of Plant Physiology, F/Ag, Bidhan Chandra Krishi Viswavidyalaya, Mohanpur, Nadia-741252, West Bengal
[3] Ph. D Research Scholar, Department of Agricultural Entomology, F/Ag, Bidhan Chandra Krishi Viswavidyalaya, Mohanpur, Nadia-741252, West Bengal
**Corresponding author: suren.murmubckv@gmail.com*

The term indigenous technical knowledge (ITK) "local knowledge" and "Traditional knowledge" have been used in the literature inter–changeably. It is defined as "A sum total of knowledge based on acquired knowledge and experience of people in dealing with problems and typical situation in different walks of life". ITK is the local knowledge that people have gained through inheritance from their ancestors which pertains to various cultural norms, social roles or physical conditions. This knowledge has backgrounds of hundreds and sometimes thousands of years of adoption, while bearing odds and evens of the time. Indigenous Knowledge (IK) is the participant's knowledge of their temporal and social space. Indigenous knowledge as such refers not only to knowledge of indigenous peoples, but to that of any other defined community. Indigenous knowledge system (IKS) delineates a cognitive structure in which theories and perceptions of nature and culture are conceptualized. Thus it includes definitions, classifications and concepts of the physical, natural, social, economic and ideational environments. The dynamics of IKS takes place on two different levels, the cognitive and the empirical. On the empirical level, IKS are visible in institutions, artifacts and technologies.

Indigenous Technical Knowledge (ITK) is specifically concerned with actual application of the thinking of the local people in various operations of agriculture and allied areas.

Table.1: The differences between traditional knowledge system and scientific system are indicated below:

Traditional Knowledge system	Scientific System
All parts of the natural world are regarded as animate, all life forms as interdependent.	Human life is generally regarded as superior, with a moral right to control other life forms.
Knowledge is transmitted largely through oral media.	Knowledge is transmitted largely through the written word.
Knowledge is developed and acquired through observation and practical experience.	Knowledge is generally learned in a situation, which is remote from its applied context.
Knowledge is holistic, intuitive, qualitative and practical.	Knowledge is essentially reductionist, Quantitative, analytical and theoretical.
Knowledge is generated by resource users in a diachronic (long term) time scale.	Knowledge is generated largely by specialist researchers on a synchronic (short term) time scale.
The nature and status of particular knowledge is influenced by socio cultural factors such as spiritual beliefs, and is communally held.	The nature and status of particular knowledge is influenced by individual specialists
Explanations behind perceived phenomena are often spiritually based on subjective	Explanation behind perceived phenomena are essentially rational and objective
Knowledge is used to make suitable decisions under variable conditions	Knowledge is used to put forward hypothesis and to verify underlying laws and constants

DIVERSITY OF INDIGENOUS KNOWLEDGE

Indigenous knowledge systems are:

- ✓ Adaptive skills of local people usually derived from many years of experience that have often been communicated through oral traditions and learned through family members over generations.
- ✓ Time-tested agricultural and natural resource management practices, which have the way for sustainable agriculture.
- ✓ Strategies and techniques developed by local people to cope with the changes in the socio-cultural and environmental conditions.
- ✓ Practices that are accumulated by farmers due to constant experimentation and innovation.
- ✓ Trial-and-error problem-solving approaches by groups of people with an objective to meet the challenges they face in their local environments.

- ✓ Decision-making skills of local people that draw upon the resources they have at hand.

Characteristics of ITK

- ✓ ITK is not static but dynamic
- ✓ Exogenous knowledge and endogenous creativity brings change to ITK
- ✓ ITK is intuitive in its mode of thinking
- ✓ ITK is mainly qualitative in nature
- ✓ ITK study needs a holistic approach
- ✓ ITK, if properly tapped, can provide valuable insights into resources, processes, possibilities and problems in particular area
- ✓ ITK is recorded and transferred through oral tradition
- ✓ ITK is learned through observation and hands-on experience
- ✓ ITK forms an information base for variety
- ✓ ITK reflects local tradition

Classes of ITK in agriculture

- ✓ Climatology
- ✓ Local soil and taxonomy
- ✓ Soil fertility
- ✓ Primitive cultivar
- ✓ Inter cropping
- ✓ Agronomic practices
- ✓ Irrigation and water management
- ✓ Plant protection
- ✓ Post harvest technology and methods.

Roles of ITK

- ✓ ITK can aid development efforts
- ✓ ITK can facilitate local people's participation
- ✓ ITK is a valuable source of developing appropriate technologies

Scope of ITK analysis

- ✓ New biological and ecological insight
- ✓ Resource management
- ✓ Protected areas and conservation education
- ✓ Development planning
- ✓ Environment assessment

Some of these traditional practices are in the fields of agriculture such as crop production, mixed farming, water harvesting, conservation of forage, combined production system, biodiversity conservation, forestry and domestic energy etc. India is unique having a rich history of traditional systems of soil conservation and water harvesting in almost all the states. Conservation of both surface and ground water has

been an integral part of our country for many centuries. In fact, different types of ponds and tanks represent important community resources for drinking water and allied uses in rural India. Even today, the main attributes to their success are the sound scientific knowledge and methods on which they have been built. Moisture conservation begins right from seedbed preparation. Although farmers practice many indigenous technologies relating to soil and water conservation, there is a lack of documentation for identifying the constraints for possible refinements. There exists a need to evaluate the potential indigenous practices in the regions for their improvement and dissemination to new areas

The promotion of appropriate technology with indigenous knowledge base is gaining importance in the natural resource management programme for increasing their adaptability/acceptability and to bring down the dependence on cost intensive technologies. A detail study of Indigenous Technical Knowledge (ITK) on soil and water conservation was taken up through a National Agricultural Technology Project (NATP) entitled "Documentation & Analysis of Indigenous Methods of In-situ Moisture Conservation and Runoff Management" by the authors at Central Research Institute for Dryland agriculture (CRIDA), Hyderabad as the lead centre. The associated centres of the dryland project documented the ITKs from the target districts viz: Akola, Agra, Anantapur, Bhilwara, Bangalore, Bijapur, Faizabad, Hisar, Indore, Kovilpatti, Kanke (Ranchi), Phulbani, Targhadia (Rajkot), Rewa, S.K.Nagar, Solapur, Varanasi and Hyderabad situated in different agro-ecological regions. The outcome of the project in the broader perspective of addressing the researchable issues and taking the technologies further has been discussed here.

METHODS

In order to obtain the feedback of the farmers regarding soil and water conservation measures the survey using developed Performa was initiated in treated and untreated villages in different agro-ecological regions through the project centres. Farmers' awareness and adoption of soil and water conservation practices was attempted in the study. The process followed during documentation was as follows:

1. The ITK preformed consisting of general information of village, views and observations on soil & water conservation measures, in-situ moisture conservation practices, technical information on run-off management practices and Indigenous technical knowledge was developed.
2. The preformed for documenting ITKs on soil & water conservation and run-off management was finalized duly after getting the feedback from participants.

For the purpose of documentation and analysis of ITK, a simple ITK porforma was developed. This porforma contains Title, Purpose, Location, Ago ecological setting, Description, Advantages, Constraints, Replicability / Feasibility and Researchable issues. The researchable issue opens up new vistas for furthering the technologies towards development of farmer-friendly doable technologies. This is just an honest beginning of a validation process made by NATP, ICAR. Of the many available, a few ITKs could be documented in the limited time frame through the project centres located

in various SAUs. There is a lot more to be done in this direction by the R&D and implementing agencies involved in the community development.

Table.2: A list of some documented ITKs on soil and water conservation measures under different categories:

Sl.No	Categories	Name of ITK
1	Agronomic Measures	1. Intercropping 2. Cultivation and sowing across the slope 3. Wider row spacing and deep interculturing 4. Mixed cropping 5. Cover cropping 6. Criss –cross ploughing 7. Hoeing with local hoes 8. Application of manure (FYM) 9. Green manuring
2	Tillage	1.Conservation furrows with traditional plough 2. Deep pluoghing 3. Summer ploughing/ Off-season tillage 4.Repeated tillage during monsoon season
3	Bunding & Terracing (Mech. & Vegetative barrier)	1. Vegetative barrier 2. Stone bunding 3. Nala check with soil filled in cement bags 4. Peripheral bunding/ Field bunding 5. Cosnervation bench terrace 6. Strengthening bunds by growing grasses 7.Bund farming of pulse crops in kharif under rainfed situation 8. Earthen bunds 9. Stone-cum-earthen bunding 10. Live bunding by raising Cactus
4	Land Configuration	1. Use of indigenous plough for formation of broad bed & furrows 3. Leveling the plots by local leveler 4. Opening up set furrow
5	Soil Amendment / Mulching	1. Application of ground nut shells 2. Sand mulching 3. Gravel sand mulching 4. Retention of pebbles on the soil surface 5. Retention of sunflower stalks 6. Mulching of turmeric leaf 7. Crop residue application in the field

6	Erosion Control & Runoff Diversion Structures	1. Sand bags as gully check 2. Loose boulder checks 3. Grassed waterways 4. Nala plugging
7	Water Harvesting, Seepage Control & Ground Water Recharge	1. Harvesting of seepage water 2. Wells as runoff storage structures 3. Rain water management using indigenous rain gauge (Role) 4. Farm pond ,Percolation pond / tank 5. Ground water recharging through ditches and percolation pits 6. Well recharging through runoff collection pits 7. Dug wells 8. Earthen check dams 9. Field water harvesting 11. Rain water harvesting from roof top and road surfaces.

(Mishra, 2002)

REFINEMENT OF ITKS FOR PROMOTION OF THE TECHNOLOGIES

Some potential ITKs identified for further study, research and development of new projects is presented in Table 2.Prakash et al.,2007 found that a scientific study may change this Indigenous Technical Knowledge to Modern Technical Knowledge (MTK). Prevailing ITKs should invariably be given priority. All the ongoing projects on resource conservation and management should focus on the viable and appropriate ITKs relating to soil & water for sustainable development and dissemination of the local technology.

As an initiative, the ITKs on S&WC for other agro climatic regions may be documented and later validated and refined at local level. This will form a programme by itself to popularize indigenous knowledge with the developmental agencies.The exposure visit and farmer-to-farmer interaction may be encouraged for better adaptation of ITK. (Banarjee *et al*.,2006)The ongoing watershed programme should adopt the ITKs on S&WC in their project activities. During the first phase planning the local technologies should be documented.

The stakeholders in the conservation programme who can be partners for promoting the ITKs are:

1. Farmers
2. NGOs
3. Government Agencies
4. Research Institutes / Scientists
5. Administrators
6. Policy makers / people's representatives

The research findings may be disseminated through the extension agencies. The research results will benefit both farming community as well as the promoting agencies

i.e. the Govt. or non-government organizations. Some of the researchable issues pertaining to some ITKs have been identified and presented in table 2.

Table.3.Identification of researchable Issues of some selected ITKs

Name of ITK	Purpose	Researchable Issues
Furrow opening in standing crops	Rainwater conservation	1.Modification of implement with different serrated blades and introducing additional tines 2. Effectiveness in conserving soil moisture
Nadi farming system	To collect runoff during kharif for life saving irrigation during drought spell or pre sowing irrigation(Palewa) for rabi crops	1. Documentation and analysis of socioeconomic aspect of present nadi system for its sustainability 2. Evaluation of present nadi farming system
Mixed pulses as vegetative barrier	Resource Conservation	1. Proportion of pulses as vegetative barrier. 2. Cost effectiveness of the System
Stabilization of gullies using sand bags	Gully control and runoff management	1. Soil conservation efficiency. 2. Strengthening of sand bags structure with different vegetative barriers
Application of white soil as lining material in farm pond	To work as a sealant material for lining dugout farm pond	1. Standardization of application technique and economic feasibility for wider application. 2. Study on the seepage losses at different hydraulic heads
Wider row spacing in pearl millet	Rainwater conservation and weed control	1. Plant geometry and population research in different rainfall situations
Rainwater harvesting in kund/tanka	The harvested water in kund / tanka is used for drinking and establishment of tree	1. Research should be done on the use of stored water for arid horticulture 2. Design of tanks for different geo hydrologic Conditions
Crop stubbles and residue Management	Improve the organic matter and water holding capacity of soil	1. Quantification of soil and water conserved and yield advantage. 2. Better or improved implements for crop residue incorporation. 3. Alternate ways of composting and application

Brush wood waste weir	Safe disposal of excess runoff	1. Design and stabilization of structure
Mulching in turmeric	To conserve rainwater	1. Quantification of soil loss, improvement of soil quality and water availability 2. Use of alternative organic material to Sal leaves as mulch
Indigenous stone / brush wood structure across the slope	To check soil loss	1. Shape and size of brush wood structure depending on the runoff and site conditions.
Agave sp. As vegetative barrier	To reduce runoff velocity and to increase infiltration opportunity time	1. Different species of Agave can be evaluated. 2. Cost benefits analysis.
Broad bed and furrow practice	To harvest rain water and dispose of runoff	1.Width of broad bed needs to be evaluated for different crops and rainfall situations 2. Identification of suitable low cost tractor/bullock drawn implement for layout of BBF
Water harvesting and recycling	Rain water harvesting	1. Recharging of water table. 2. Cost effectiveness
Standardization of recharging technique	Augmentation of ground water	1. Design of filter and improvement in filtering efficiency with better filtering material. 2. Effect of geology/soil formation on recharge
Set-row cultivation	For harvesting rain water and maintaining soil structure	1.Quantification of rainwater conservation and water use efficiency (WUE) of the crops 2. Improvement in soil health and crop yield over years
Summer / pre monsoon tillage	Conservation tillage-to harvest early showers, facilitate timely seeding and weed control	1.Identification of appropriate tillage implements for soil and water conservation 2.Evaluation of root: shoot ratio and quantification of WUE of crops
Ridge & furrow planting for modulation of	Conservation of rain water, modulating excess water, control	1.Fabrication and development of ridge former accommodating required row spacing and ridge cross- section

overland flow	soil loss and boosting productivity	
Formation of Gurr	Reduction of runoff and soil moisture conservation	1. Effect of bullock and tractor made Gurr on runoff reduction, soil water conservation and crop productivity
Green manuring practice	To conserve soil water and improve soil health	1. Growing of green manure crop and its management in improving soil health and crop productivity. 2. Economic evaluation of the system by addressing sustainability issues
Application of tank silt	To increase the fertility and water holding capacity of soil	1. Method and quantity of tank silt application in different soils. 2. Improvement in soil water and fertility with tank silt application and its effect on crop productivity 3. Cost effectiveness of silt application especially with Government programme of tank desiltation.

(Mishra, 2002)

CONCLUSION

Many ITKs on in-situ soil and moisture conservation are not adopted everywhere throughout India because of constraints in adoption and unawareness of the effectiveness of such practices. The present documentation process has definite bearing on the future course of action in framing new projects. This short-term documentation project may lead to the following future activities:

- ✓ Similar exercise can be undertaken to document the ITKs from all the Agro ecological regions of the country.
- ✓ The potential ITKs may be tested for their suitability and adoption in other Agro ecological regions as a dissemination strategy.
- ✓ The documented ITKs may be published / translated in all regional languages for the benefit of the farming communities.
- ✓ Validation of the ITKs is a logical step to qualify and quantify the effectiveness of these practices. Suitable modifications of the traditional practices through on-farm research would help in developing appropriate and acceptable technologies for different local environments.
- ✓ The effect of conservation measures on resource losses can be studied in detail through experimentation and use of stimulation model.
- ✓ As a policy matter the local ITKs should be in built in the resource conservation programme.

Finally it may be concluded that refinement and promotion of ITKs should form the basis for implementing natural resource conservation technologies on watershed basis and according to agro-ecological condition.

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Substitutes to anti-microbial agents to overcome anti-microbial resistance

R.Y. Nanotkar[1], R. P. Singh[2] and S. S. Raut[3]

[1]Teaching Associate, Department of Veterinary Pharmacology and Toxicology, Post Graduate Institute of Veterinary Education and Research (PGIVER), Jaipur.
[2]Research Associate, Department of Veterinary Pharmacology and Toxicology, Nanaji Deshmukh Veterinary Science University, Jabalpur.
[3]Teaching Associate, Department of Livestock products Technology, Post Graduate Institute of Veterinary Education and Research (PGIVER), Jaipur.
Corresponding Author- drrahul923vet@gmail.com

Abstract

Antibiotic resistance among bacteria is becoming a major problem in the treatment of many infections in animals and human. Hence, there is need to find an alternative way to overcome the antibiotic resistance and source of novel drug for the treatment of these bacterial diseases. The use of antibiotics in animal feed as growth promoters has been complete banned by the European Union since 2006, based on their possible negative effects for human and animal health. The value and importance of antibiotics cannot be overestimated, and they must not be considered as commodities. Antibiotic have revolutionized the field of medicine and we are reliant on them to treat infectious diseases. Since the introduction of penicillin in 1943, there has been a mismanagement of antibiotics. Due to the modern concern about health, the potential development of antibiotic-resistant bacteria as well as at the same time the need to prevent economic losses of the farmers, alternatives to antibiotics has to be developed to prevent the health problems and to improve the growth performance in farm animals without side effects. New strategies and commercial products must be developed to improve animal health and performance, based on their safety, efficacy and cost effectiveness

INTRODUCTION

For several decades, the use of therapeutic and prophylactic levels of antibiotics in animals including birds and their feeds has been a common practice in many countries in order to improve growth performance and prevent from the adverse effects of pathogenic and non-pathogenic microorganisms. However, there are increasing concerns for the public health about the consequences from the use of antibiotics in livestock (Philips I, 1999). The risk of developing cross-resistance and multiple-antibiotic resistance in pathogenic bacteria both in human and farm animals, has been strongly linked to the therapeutic, metaphylactic or prophylactic uses of antibiotics in human and veterinary medicine, as well as growth promoters in animal feed .

The use of antibiotics as growth promoters has been complete banned by the European Union (EU) since 2006 (EC Regulation No. 1831/20031), based on their possible negative consequences for animal health and food safety (Gibson and

Roberfroid, 1995). This type of ban may be ordered in India in future. The ban will have led to animal performance problems and a rise in the incidence of certain diseases. Thus, there is an urgent need to develop substitutes to antibiotics, especially in India and Asian countries. As a consequence of the public health concerns and the demand of the farmers to prevent the economic losses, non-antibiotic sources and additives are need to searched and developed for prophylactic and therapeutic use against pathogens or as growth promoters.

The aim of this chapter is to summarize the beneficial effects of currently used alternatives to antibiotics, i.e. probiotics, prebiotics, organic acids, phytogenic compounds from medicinal plants source.

1.1Probiotics: Probiotics have been defined by the World Health Organization (WHO) as "microorganisms which, administered live and inadequate amounts, confer a benefit to the health of the host". Probiotics are considered to be able to destroy pathogenic microorganisms by producing antimicrobial compounds such as bacteriocin sand organic acids, improve gastrointestinal microbial environment by adherence to intestinal mucosa thereby preventing attachment of pathogens and competing with pathogens for nutrients, stimulate the intestinal immune responses and improve the digestion and absorption of nutrients.

Japan started using probiotics in1960s and China began the application of probiotics in 1980s. US-FDA approved 42 probiotic still. The effects by the use of probiotics in animals' feed depends on the combination of selected bacteria, doses in feed, and on their interactions with pharmaceuticals, feed composition, storage conditions and feed technology. Probiotics are generally recommended in ruminants' nutrition whenever a risk of rumen dysfunction exists, in order to improve anaerobiosis, stabilise pH and supply nutrients to microbes in their microenvironment. Probiotics are recommended in young ruminants to prevent diarrhoea caused by enterotoxigenic bacteria in the gut and also during weaning period to enhance the rate at which rumen flora and fauna become established. *Lactobacillus acidophilus* alone or in combination with other lactobacilli has been shown to reduce scouring and increase growth rate of calves in some trials (Bechman, 1977; Beeman, K., 1985). The commonly used probiotics in animals includes *Bacillus*, *Lactobacillus*, *Lactococcus*, *Streptococcus*, *Ente- rococcus*, *Pediococcus*, *Bifidobacterium*, *Bacteroides*, *Pseudomonas*, yeast-*Aspergillus*, and *Trichoderma*, etc.Microbiologicalfeed additivesusedmainlyinclude *Bacillus* (*B. cereus* var. *toyoi*, *B. licheniformis*, *B. subtilis*), *Enterococcus* (*E. faecium*), *Lacto- bacillus* (*L. acidophilus*, *L. casei*, *L. farciminis*, *L. plantarum*, *L. rhamnosus*), *Pediococcus* (*P.acidilactici*), *Streptococcus* (*S. infan- tarius*), and some fungi such as *Saccharomyces cerevisiae* and *kluyveromyces*. (Beeman K., 1985)

1.2 Prebiotics

Prebiotics are dietary short-chain carbohydrates (oligosaccharides). They have beneficial effects on health and growth performance in farm animals, stimulating the growth and/or activity of one or more of beneficial bacteria. The non-digestibility of prebiotics ensures that they can reach the colon and act as an energy source for bacteria, unlike normal sugars, which get digested directly by the host. As a result the

composition and/or the activity of the micro-biota are altered, leading to secondary effects such as increased gas production and a drop in pH. Prebiotics can also prevent the adhesion of pathogens to the mucosa, by competing with its sugar receptors and several studies have shown that supplementing feed with various oligosaccharides have led to reduced susceptibility to *Salmonella* and *E. coli* colonization. The most common non-digestible oligosaccharides (NDO), which are used as prebiotics in farm animals, are the following: Mannan-oligosaccharides (MOS), Galacto-oligosaccharides(GOS), Fructooligosaccharides (FOS), Soybean-oligosaccharides(SOS), Isomalto-oligosaccharides, Xylo-oligosaccharides(XOS), Lactulose and Inulin (Roberfroid, *et al*. 2001).

MOS have beneficial effects on the intestinal microflora by modifying the microbial gut ecology and preventing the colonization of bacterial pathogens (e.g. stimulate the growth of non- pathogenic bacteria such as *B. longum, L. casei, L. acidophillus or L. delbruckei* and suppress the growth of pathogenic bacteria such as *E. coli*, *Salmonella typhimurium, Clostridium botulinum and C. sporogenes* (Shim, *et al.*2005).

1.3 Organic acids - acidifiers

Organic acids are considered to be any organic carboxylic acid of the general structure R-COOH. They are widely distributed in nature as normal constituents of plants or animal tissues and also formed through microbial fermentation of carbohydrates, mainly in the large intestine. They are sometimes found as their sodium, potassium or calcium salts. Most organic acids with specific antimicrobial activity are short-chain acids (C1–C7, SCFA) and they have a pKa- between 3 and 5.

The most common organic acids (also called acidifiers) that are used in farm animal feed are formic, acetic, propionic, butyric, lactic, sorbic, fumaric, tartaric, citric, benzoic, and malic acids (Dibner and Buttin, 2002). According to their effects, they can be categorized into two groups: a) the 1st group (lactic, fumaric, citric acids) is characterized by indirectly reduction of bacterial populations by decreasing pH in the stomach, b) the 2nd group (formic, acetic, propionic and sorbic acids) is characterized by a direct effect of lower pH on the cell wall of Gram- bacteria in the gastrointestinal (GI) track.

The mechanisms of their action include reduction of gastric pH or buffering capacity of diets, increase of proteolytic enzymes activity and nutrient digestibility, improvement of pancreatic secretions, stimulation of digestive enzymes activity, balancing the microbial population and promotion of beneficial bacterial growth, reduction of pathogens survival through the stomach, and direct killing of bacteria.

Their effects depend on several factors as: type and pKa of acid, inclusion rate of supplemented acids, composition of diets and their acid-base or buffering capacity, level of intraluminal production of acids in GI tract by inhabiting microflora, feed palatability, intrinsic acid activity, receptors for bacterial colonization on the epithelial villi, maternal immunity by vaccinations, hygiene and welfare standards, age of animals (Partanen and Mroz, 2009; Partanen K, 2001). Many studies proved benefits from the use of dietary acidifiers in swine, including positive effects on growth performance as

well as on prevention and control of diseases. Their antimicrobial effects depend on their concentration and pH. For example, lactic acid is more effective in reducing gastric pH and effective against coliforms, whereas other acids (e.g. formic, propionic) have broader antimicrobial activities and they can be effective against bacteria (e.g. coliforms, clostridia, Salmonella), fungi and yeast. Several studies have reported reduction of coliforms burden along the GI tract, decrease of piglet scouring or mortality as well as effective control of post weaning diarrhoea and oedema disease in calves. (Papatsiros, *et al* 2011). Organic acids are formed through microbial fermentation of carbohydrates predominantly in the caeca of poultry. Acidifiers reported to have beneficial effects on poultry performance or health. For example, some (e.g. butyric acid) also decrease the incidence of subclinical necrotic enteritis caused by *C.perfringens*, which is highly relevant for the poultry industry. Picture showing some market preparations of organic acidifiers in poutry.

1.4 Medicinal Plants as antimicrobial (phytogenic compounds)

Herbal drugs have been used for several medication purposes throughout the world due to presence of important properties like antimicrobial, immunomodulatory, good health, therapeutic and healing properties that ensure prevention and cure of animal and human diseases. In last few years, the requirement of herbal drugs has been increased due to their efficacy and potency in the treatment of various bacterial infections (Rahal, *et al* 2014). There are number of herbal remedies which are constantly used as folk medicine in various tribal communities. Some of the most common herbal drugsare there like Tulsi (Ocimum sanctum), Cinnamon (Cinnamomum cassia), Black cohosh (Cimicifuga racemosa), Turmeric (Curcuma longa), Black pepper (Piper nigrum), Thyme (Thymus vulgaris),Ginger (Zingiber officinale), Ashawgandha (Withania somnifera), Neem (Azadirachta indica), Garlic (Allium sativum), Onion (Allium cepa), Clove (Syzgium aromaticum) etc.(Dhama, *et al* 2014). There are number of herbal drugs which have also shown adverse effects to when used on experimental animals. Antibiotics that results into multi-drug resistance among bacteria. Several studies have reported on potent antimicrobial properties of essential oils. It is observed that there are complex interactions between different functional groups of herbal drugs like phenols, aldehydes, ketones, alcohols etc. It is a fact that the herbs containing cinnamaldehyde, citral, carvacrol, eugenol or thymol (aldehyde or phenol as functional groups) possess the higher antibacterial activity in comparison to other herbs/essential plant oils. The herbal drugs including carvacrol, eugenol, cinnamaldehyde,thymol, terpenes are found effective against a number of bacteria like *Staphylococcus aureus* and

Escherichia coli . The combinations of carvacrol, menthol, eugenol and thymol have been found to have synergistic or additive effects against different microbes. The antibacterial activities of eugenol, cinnamaldehyde, thymol, carvacrol estimated as MICs (Minimum Inhibitory Concentrations) were 1600, 400, 400, and 400 mg/L, respectively. After combination, cinnamaldehyde/eugenol, thymol/eugenol, carvacrol/eugenol, and thymol/carvacrol the MIC got reduced to 400, 100, 100, and 100 mg/L, respectively, showing synergistic effects (Pei, *et al* 2009). Table 1. showing the list of important medicinal plants possessing antimicrobial properties.

Herbal drug	**Active constituent**	**Therapeutic action**
Ocimum sanctum	Eugenol, Urosolic acid	Analgesis, Anti-inflammatory, Antipyretic, Immunomodulatory,against enteric microbs
Cinnamomum cassia	Cinnamaldehyde, 2-Hydroxy Cinnamaldehyde	Ntimicrobial, Food borne pathogens, Skin infection
Cimicifuga racemosa	Cimicifugin, Racemosin, Actaealactone, Fukinolic acid	Anti-inflammatory
Curcuma longa	Cucurmin	Antimicrobial, Anti-inflammatory, Anti-neoplastic
Piper nigrum	Piperine, Penta-dienylpiperidine	Antimicrobial (Anti- Mycobacterial)
Thymus vulgaris	Thymol and carvacrol	Antibacterial, Anticandidal, Antioxidant
Zingiber officinale	6,8,10-gingerol, 6- shogoal	Analgesis, Anti-inflammatory, Antipyretic, Antimicrobia
Withania somnifera	Winthanolides, Withaferins, Dimeric thiowinthanolide	Analgesis, Anti-inflammatory, Antimicrobial, Anti-tumor
Azadirachta indica	Nimbin, Azadirachtin, gedunin, gallic acid	Antibacterial, Anti-malarial, Anti-leprotic, Antituberculosis
Allium sativum and *Allium cepa*	Allin, allicin, allyl sulfides	Antibacterial
Syzgiuma romaticum	Eugenol, Eugenol acetate, alpha and beta caryophyllene	Antibacterial (Food borne pathogens), Antiinflammatory, Analgesic
Morinda citrifolia	Anthraquinones glycosides, Flavanoids, Iridoids	Anti-inflammatory, Antimicrobial, Anti-oxidant, Anti-helminthic, Immunomodulating
Resveratrol	CIS, Transforms	Anti-oxidant, Cardioprotective, Anti-ageing,Anti-tumour, Immunomodulating.

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Brown Rice: Nutritional values and Health benefits of Brown Rice

Deepak Lall[1] and Nusrat Jan[2]

[1]Former Product Development Executive & Former (SRF- Horticulture)
[2]Ph. D. Research Scholar, [1]Department of Horticulture
[2]Department of Biological Sciences
Naini Agricultural Institute (NAI), SHUATS (Agriculture University)
Allahabad (U.P.) India- 211007
Contact: +91- 8173847022, +91- 9169470706
Corresponding author e-mail: p.lalsam@gmail.com

Abstract

Rice (Oryza sativa L.) is a primary food crop and forms staple food of majority of population of the world. It belongs to family Poaceae. Brown rice is unpolished whole grain rice and produced by removing only the hull or husk. Brown rice is a nutritious whole grain filled with beneficial nutrients like fibre, magnesium, thiamine, calcium, protein, antioxidant, healthy fats and potassium. Brown rice is an excellent source of manganese. It is also considered as a source of many bioactive non-nutrient compounds known as Phyto-chemicals. The consumption of brown rice is recommended to improve the health of general public/ or rural community. Hence, in this article the information's pertains the health and nutritional benefits of brown rice and its awareness regarding acceptability, demand and consumption among the general public/ or individual.

INTRODUCTION

Rice is one of the most important crops around the world. It is a staple food of a majority of people making it widely cultivated in over more than 100 countries. The total rice production area is about 154 million hectares and the annual production of rice is about 594 million metric tons globally. Rice accounts for over 22% of global energy intake. Asia is the major rice producer, wherein rice production accounts for about 92-94% of the world's total production. White rice (WR) or polished rice is manufactured by eliminating the fibre-r ich bran layer from unpolished rice, also known as brown rice (BR). Brown Rice contains more, nutritional components such as dietary fibres, phytic acid and B vitamins and γ-aminobutyric acid (GABA) than White Rice due to the presence of outer bran layer being the main source for the nutritional elements. Although, Brown rice is more nutritious than White rice, its intake is somewhat limited by the chewy texture and reduced digestibility. Now a day, consumption of brown rice (BR) is gaining momentum among health conscious people due to its better nutritive and organoleptic value than the white rice. Brown rice is a super whole grain which is packed with high degree of healthy components. It extends its beneficial effects to most of the organs

including healthy heart, digestion, brain, bones, muscles, cholesterol and blood pressure. Brown rice is also beneficial for treating skin ailments like psoriasis, promotes healthy skin and restores hair loss. It has anti-aging qualities attributing to the presence of ferulic acid, an antioxidant which helps in the prevention of skin-aging. Brown rice is rich in folate which is extremely essential during pregnancy for healthy growth of the fetus. Small portions of brown rice are also recommended for the patients suffering from candida infections attributing to its richness in digestive enzymes which is apt for a weakened digestive system. Brown rice tones up t

he body and mind and helps combat general weakness and deficits in the body. There are several different types of rice — including long-grain basmati, black rice, white rice and sticky (or glutinous) rice — but in terms of health benefits, not all are created equal. Brown rice is one of the healthiest and most-studied types of rice. In some parts of the world, the word "to eat" literally means "to eat rice." All varieties of rice are available throughout the year, supplying as much as half of the daily calories for half of the world's population.

WHY TO EAT BROWN RICE?

Most of us are aware about the fact that brown rice is better than white rice. The reason that makes the it stand out is the super quality and quantity of nutrients which the brown rice offers. Unlike white rice, it does not go through the process of milling and polishing and hence retains its immense treasure of healthful components. The process of milling that converts brown rice into white rice strips away most of its nutritional value. There are many varieties of brown rice available in the market with their unique flavor, aromatic components and varied concentration of fatty acids.

Fig.1 Cooked Brown Rice

PROCESS TO PRODUCE BROWN RICE (BR)

The brown rice (BR) is unpolished whole grain rice that is produced by removing only the outermost layer, the hull of the rice kernel or husk using a mortar and pestle or rubber rolls. The complete milling and polishing that converts brown rice into white rice destroys 67% of the vitamin B3, 80% of the vitamin B1, 90% of the vitamin B6, half of the manganese, half of the phosphorus, 60% of the iron, and all of the dietary fibre and essential fatty acids. Fully milled and polished white rice is required to be "enriched" with vitamins B1, B3 and iron.

Brown rice (BR) is better than that off white rice (WR). It's the majority of consumers typically choose white rice over brown rice because of the difference of appearance.

Fig.2 Raw & Processed Brown rice

While it's true white rice looks much more delicious than brown rice, it doesn't mean it is healthier too. According to the study conducted by the American Journal of Clinical Nutrition, brown rice is the top choice in terms of both nutritional and other inherent healthy benefits.

Nutritional Value of Brown Rice

Brown rice is a natural wholesome food rich in essential minerals such as manganese, iron, zinc, phosphorous, calcium, selenium, magnesium and potassium. Vitamin wealth includes vitamin B1 (thiamine), vitamin B2 (riboflavin), vitamin B3 (niacin), vitamin B6, folate, vitamin E (alpha-tocopherol) and vitamin K. It is a source of protein and adds good amount of fibre content to our diet. Along with this, it is also a provider of health-supportive vital fatty acids.

Health Benefits of Brown Rice

Brown rice in the diet brings tremendous health gains and benefits discussed as under:

Diabetes: Brown rice is beneficial for diabetic and hyperglycemic individuals. It has a low glycemic index which is helpful in reducing insulin surges and assists in the stabilization of blood sugar levels in the body. In this regard it is observed that it is rich in phytic acid, fibre, and essential polyphenols. It is a complex carbohydrate which helps in slower release of sugars as compared to white rice. American diabetes association also recommends choosing nutrient-dense brown rice over white rice for diabetics in order to accomplish the need of essential vitamins, fibre and minerals in their diet.

Antioxidant activity: Brown rice is rich in powerful antioxidants which extend their protection against the damage caused by oxygen free radicals. It contains an important antioxidant enzyme called superoxide dismutase which protects the cells from oxidation damage during energy production. A comparative study involving white and brown rice has suggested that brown rice exhibits superior radical scavenging activity and aids in the prevention of various oxidation-mediated diseases such as coronary heart diseases.

Obesity: Brown rice is instrumental in seeking weight control for the people combating with obesity. It contains manganese which helps to synthesize the body fats. The consumption of whole grains such as brown rice has positive effects on the body with respect to reduction in body mass index and body fat. It also enhances the activity of glutathione peroxidase, an antioxidant enzyme and helps elevate the levels of HDL cholesterol in the obese individuals.

Neurodegenerative disorders: Brown rice helps in the prevention of neurodegenerative complications such as Alzheimer's disease attributing to the abundance of gama-aminobutyric acid. Sprouted brown rice contains healthful components which helps in the inhibition of harmful enzyme called protylendopetidase which is associated with Alzheimer's disease. It is also

beneficial for other cerebral-related disorders such as dementia and amnesia.

Psychosomatic health for lactating women: Sprouted brown rice is beneficial for the mental health of the lactating mothers. It has also suggested that consumption of brown rice during lactation enhances body's ability to resist stress and improves overall immune defense.

Digestive health: Brown rice is healthful staple which can be added to the daily diet for keeping a healthy digestive system. Fibre present in helps regulate the bowel function and keeps a fuller feeling. It also shows that the effects of white rice and brown rice during gastric digestion has made it qualitatively evident that the bran layer on brown rice prevents the absorption of acid and humidity resulting in better texture retention. Fibre content also brings relief from other troubling conditions such as constipation and colitis.

Cardiovascular health

Brown rice is rich in selenium which is beneficial for a healthy heart. Consumption of whole grains such as brown rice helps reduce the blockage of arteries due to plaque buildup. This protective action is contributory in the reducing the risk of cardiac disorders such as high hypertension and vascular diseases. In this regard it is suggested that the tissue surrounding the grain of brown rice contains a healthful component which acts against the endocrine protein angiotensin II, implicated in the development of high blood pressure and atherosclerosis or hardening of arteries.

Healthy levels of cholesterol

Brown rice is a healthy option for maintaining healthy levels of cholesterol attributing to the presence of naturally occurring oils. It is observed that it possess hypo-cholesterolemic qualities and regulates cholesterol catabolism. It contains beneficial nutrients that help in lipid and glucose metabolism. The consumption of brown rice has shown significant improvement in the serum and HDL cholesterol concentrations in the subjects with chronic ethanol abuse. It has also suggested germinated brown rice extract helps in preventing the rise in the liver triglycerides due to excessive alcohol intake attributing to the presence of gamma-aminobutyric acid.

Anti-Cancerous properties:

Brown rice is helpful in the prevention of various cancers such as colon cancer, breast cancer and leukemia. This beneficial effect can be attributed to the presence of potent antioxidants and high fibre content in it. The fibre content present in brown rice has the ability to bind itself to the harmful cancer causing toxins in the body. This prevents the toxins from attaching to the walls of the colon and helps eliminate them from the body. The chemo-preventive properties of brown rice has validated that its bran contains essential phenols such as tricin, ferulic acid, caffeic acid which is present at much lower levels in white rice. These phenolic components are valuable in the inhibiting the proliferation of colon and breast cancer cells. It also seems that the stimulatory effect of germinated brown rice on the induction of apoptosis and its inhibitory effects on the production of leukemia cancer cells. Furthermore it has antitumor effects.

Brain & Nervous system: Brown rice is beneicial for the smooth functioning of the brain and nervous system. It helps in accelerating the metabolism in the brain attributing to the presence of vitamin B and essential minerals such as manganese. Magnesium present in it balances the activity of calcium in the body and helps in the regulation of nerves and muscle tone. It prevents the sudden surge of calcium into the nerve cells and activation of nerve. This aid in keeping the nerves and muscles relaxed and prevent excessive contraction. Vitamin E present in it also plays a vital role in preventing various brain diseases caused due to oxidative damage.

Anti-depressant properties:

Germinated brown rice possesses anti-depressant qualities and helps in combating anxiety related disorders. The germinated brown rice also contains essential amino acids such as glutamine, glycerin and GABA. These inhibitory neurotransmitters facilitate reduction in the allowance of messages associated with anxiety, depression and stress in the brain resulting in a relaxed state of well-being.

Insomnia: Brown rice helpful in the treatment of insomnia. It is a natural source of sleep hormone melatonin. It enhances the quality of sleep by relaxing the nerves and increasing the sleep cycle.

Strong immunity system

Brown rice is loaded with significant quantities of vitamins, minerals and essential phenolic components which help to boost the immune system of the body. It nourishes the body, accelerates healing and enhances its ability to fight infections.

Bone health:

Brown rice is helpful in the maintenance of healthy bones. It is rich in magnesium which along calcium provides the bones their physical structure. Magnesium-rich brown rice prevents bone demineralization and is beneficial for medical conditions such as arthritis and osteoporosis.

Culinary usage

Rice is a staple food ingredient not just in Asia but over a wide range of population across the world. Brown rice is available in many forms such as long grains which are perfect for cooking stir fried, salads or pilafs, short grains which has a soft and sticky texture perfect for molds or puddings. Sweet brown rice can serve deliciously for desserts. Brown rice syrup is considered as a healthful sweetener attributing to the presence of nutrients in the brown rice. It gives a sweet, nutty, buttery flavor to baked goods and hot drinks.

Perfect Baby Food:

Brown rice itself is the perfect baby's first food due to the dense natural nutrition and fibre contents. This is a much better choice than refined white rice cereal products as rapidly growing babies. It is nutrient rich diet helps to maintain rapid growth cycle.

Candida Yeast Infections

Brown rice is the perfect adjunct for candida yeast infection treatments given that high glycemic and otherwise sugary/starchy foods are prohibited during most candida treatment protocols.

The natural digestibility of brown rice coupled with the high fibre content can help sensitive digestive systems heal from an overgrowth of candida organisms. Finally, brown rice is simply delicious and a fantastic staple for both vegetarian and vegan diets. Brown rice can be used as a white rice alternative in most vegetarian recipes and provides a full, rich and somewhat nutty flavor. Brown rice flour can be used for vegetarian pancakes, breads and other baked goods. All in all, brown rice is clearly the healthy choice.

CONCLUSION

It is observed that Brown rice is a super whole grain packed with high degree of healthy components. It extends its beneficial effects to most of the organs including healthy heart, digestion, brain, bones, muscles, cholesterol, diabetes (blood sugar), obesity (loss in body weight) and blood pressure etc. Brown rice is also beneficial for treating skin ailments like psoriasis, promotes healthy skin, restore hair loss, skin-ageing. It is rich in folate which is extremely essential during pregnancy for healthy growth of the fetus. Brown rice tones up the body and mind and helps combat general weakness and deficits in the body. The whole-grain diets also improve insulin sensitivity and prevent the occurrence of diabetes compared with refined-grain diets. Brown rice (BR) decreased postprandial blood glucose and insulin levels compared with white rice (WR) in humans. Interestingly this article provides the knowledge and several health benefit aspects for switching the staple food from white rice to brown rice consumption among every individual as well as rural farming community (farmers).

Aflatoxicosis: an obstacle in poultry industry

Pooja Kundu* and Gulshan Narang

Department of Veterinary Public Health and Epidemiology
College of Veterinary Sciences,
Lala Lajpat Rai University of Veterinary and Animal Sciences, Hisar, Haryana, 125004
**Corresponding Author: kundu.pooja05@gmail.com*

Mycotoxins are natural food and feed toxic contaminants, secondary metabolites produced by fungi on agricultural commodities. More than 500 different mycotoxins are known. Aflatoxicosis caused by cosmopolitan fungi which are found in many countries, especially in tropical and subtropical regions, where the temperature and humidity conditions are optimal for the growth of moulds and the production of toxins. Contamination by Aflatoxin can take place at any point along the food/feed chain from the field, harvest, handling, shipment and storage under a wide range of climatic conditions. Aflatoxins have been found to contaminate a wide variety of important agricultural products world-wide, e.g., maize, wheat, oil seeds meal, rice, spices, dried fruits, and nuts. Ingestion of aflatoxin in contaminated feeds affects animal health and production, and is potentially dangerous to humans as the toxic metabolites are excreted in animal meat, milk and eggs. When aflatoxin-contaminated feed is consumed by poultry, important production parameters including weight gain, feed intake, feed conversion efficiency, and reproductive performance are compromised. Aflatoxicosis in poultry and animal also causes changes in biochemical and hematological parameters liver and kidney abnormalities, and impaired immunity, which may enhance susceptibility to infectious diseases. Aflatoxins are known to inibit the synthesis and transport of lipids in the liver. Deficiencies of fat-soluble vitamins (A, D, E, and K) are also sometimes seen in aflatoxicosis. Mycotoxins are not only dangerous for the health of consumers, they also deteriorate the marketing quality of the contaminated products; thus, involving strong economic losses. Different countries have imposed different legal limits on various food items and animal feeds. The aflatoxin level in animal feeds is generally higher than for human consumption. US- Food and Drug Administration (FDA) have set the maximum tolerable levels (MTL) for aflatoxin B1 (AFB1) and total aflatoxin B (AFBs) in cereals for human consumption as 2 and 4 µg/kg, respectively and recommend 20 µg/kg AFBs as the worldwide range of MTL /permissible levels for poultry.

Causes: Aflatoxins are produced by toxigenic strains of *Aspergillus flavus* and *A. parasiticus* on peanuts, soybeans, corn (maize), and other cereals either in the field or

during storage when moisture content and temperatures are sufficiently high for mold growth. Usually, this means consistent day and night temperatures >70°F.

Species affected: Ducks, turkeys, geese, pheasant, chicken and other birds. Ducks are 10 times more sensitive than chickens, turkeys are intermediate in sensitivity between ducks & chicks.

Age affected: All, young ones are most susceptible. Chronic disease seen in birds older than 5 weeks which are exposed to low levels of aflatoxins (ppb) for several weeks.

Effects:

- Sleepiness, depression, paleness, reduced egg production, fertility and hatchability. Depressed growth, feed conversion, increased bruising and downgrading can occur.
- In acute outbreaks, deaths occur after a short period of inappetence; other acute signs include vomiting, depression, hemorrhage, and icterus.
- Subacute outbreaks are more usual, with unthriftiness, weakness, anorexia, reduced growth and feed efficiency, and occasional sudden deaths.

Postmortem lesions

Lesions include scattered haemorrhage in the muscles, skin and intestinal tract, fluid around the heart, enlarged pale kidneys, and pale enlarged fatty livers with haemorrhage and anaemia.

Figure 1: Pale enlarged fatty liver

Diagnosis:

The clinical history, and gross and microscopic lesions are important. Microscopically, the liver shows fatty change, swollen hepatocytes and bile duct hyperplasia. An ultra violet (UV) light can be used to test corn for the presence of cogic acid (blue green fluorescence) producing fungi. Feed analysis using column chromatography method can be done for diagnosis. Test kits are available for aflatoxin B1 using ELISA methodology or minicolumns.

CONTROL MEASURES

- Quality control of feeds is important. Check grains for greater than 16% moisture. Contaminated feed should be diluted with noncontaminated grain or treated with ammonia, which inactivates aflatoxin. Heat-treatment will kill the fungi.
- Contaminated feeds can be avoided by monitoring batches for aflatoxin content. Contaminated feed may be given to older pullets, which are less susceptible.
- Antifungals as organic acids, copper sulphate, gentin violet, thiabendazde, ammonium hydroxide, must be added routinely to the feeds to prevent fungal growth in storage pins or finished feeds, other method of prevention include ozone treatment of grain.
- Increasing the protein content of feed by 1%, increasing vitamin and mineral content of feed and adding Gentian violet to feed have a sparing effect on aflatoxin-induced disease.

- Numerous products are marketed as anticaking agents to sequester or "bind" aflatoxins and reduce absorption from the GI tract. One effective binder for aflatoxins is hydrated sodium calcium aluminosilicates (HSCAS), which reduce the effects of aflatoxin when fed to pigs or poultry at 10 lb/ton (5 kg/ton). They also provide substantial protection against dietary aflatoxin.

Retail Environment in India: an outlook of Growth, Employment, Investment and Challenges

Shalini Sinha and Shyam Prakash Singh

Department of Agricultural Economics, Faculty of Agriculture, Bidhan Chandra Krishi Viswavidyalaya, Mohanpur-741252, West Bengal, India
Corresponding Author Email:shalini5621@gmail.com

India at the top position among 30 developing countries on ease of doing business in the retail sector and has become seventh largest consumer market in world (AT Kearney, 2017). As per the estimates of the Associated Chamber of Commerce and Industry (ASSOCHAM) presented in one of its recent retail reports, the contribution of both organised and unorganised retail stood at 22% of GDP. This would mean that Indian retail sector size should measure closer to Rs 19.2 trillion in 2012-2013. The Retail Industry in India has come forth as one of the most dynamic and fast paced industries with several players entering the market. But all of them have not yet tasted success because of the heavy initial investments that are required to break even with other companies and compete with them. The Indian Retail Industry is gradually inching its way towards becoming the next boom industry.

TERM AND DEFINITION OF RETAILING

Retailing is the final stage of any economic activity. It encompasses the business activities involved in selling goods and services to customers for their personal, family or household use. The word 'retail' is derived from the French word 'retailer' which means 'to cut a piece off' or 'to break bulk'. A retailer is a person, agent, agency, company or organization which is instrumental in reaching the goods, merchandise or services to the ultimate consumer.

RETAIL SECTOR IN INDIA

In 2004, The High Court of Delhi defined the term 'retail' as a sale for final consumption in contrast to a sale for further sale or processing (i.e. wholesale), a sale to the ultimate consumer. Thus, retailing can be said to be the interface between the producer and the individual consumer buying for personal consumption. This excludes direct interface between the manufacturer and institutional buyers such as the government and other bulk customers retailing is the last link that connects the individual consumer with the manufacturing and distribution chain. A retailer is involved in the act of selling goods to the individual consumer at a margin of profit.

Division of Retail Sector:

The retail industry is mainly divided into two segments

(1) Organized Retailing

(2) Unorganized Retailing

1. Organized Retailing

Organized retailing refers to trading activities undertaken by licensed retailers, those who have registered for sales tax, income tax, etc. These include corporate-backed hypermarkets and retail chains, and also privately-owned large retail businesses.

a. Single Brand Retail

Single Brand implies that foreign companies would be allowed to sell goods sold internationally under a 'Single Brand', viz., Reebok, Nokia and Adidas. FDI in 'Single Brand' retail implies that a retail store with foreign investment can only sell one Brand. For example, if Adidas were to obtain permission to retail its flagship Brand in India, those retail outlets could only sell products under the Adidas Brand and not the Reebok Brand, for which separate permission is required. If they get permission, Adidas could sell products under the Reebok Brand in separate outlets.

b. Multi Brand Retail:

FDI in Multi Brand retail implies that a retail store with a foreign investment can sell Multiple Brands under one roof. Opening up FDI in Multi-Brand retail will mean that global retailers including Wal-Mart, Carrefour and Tesco can open stores offering a range of household items and grocery directly to consumers in the same way as the ubiquitous 'kirana' store.

2) Unorganized Retailing

Unorganized retailing refers to the traditional forms of low-cost retailing, for example, local kirana shops, owner operated general stores, paan/beedi shops, convenience stores, hand cart and street vendors, etc.

SHARE OF ORGANISED AND UNORGANIZED RETAILING IN INDIA

Organised Retail Penetration (ORP) in India is low (8 per cent) in 2015 compared with that in other countries, such as the US (85 per cent). This indicates strong growth potential for organised retail in India In 2019, it is estimated that organised retail penetration share would reach 13 percent and unorganised retail penetration would hold a major share of 87 percent.

Employment generation

Retailing has the major business activities in India and leading sources of employment generation in India. Due to extreme change in the behaviour, taste and preferences of the consumer, and the growing economy, earning capacity, less time and fast track life makes the emerging challenge in the retail sector of India. Retail sector is the second largest employer after agriculture, employing more than 35 million people with wholesale trade generating an additional employment to 5.5 million crore. The enormous growth of retail industry has created a huge demand for real estate.

Table 1: Percentage Growth of Total Employment Generation in Organised Retail Sector in India.

SL. No.	Year	Total Employment in Public & Private sector (A)	Total Employment in Retail Sector (B)	% (B)/(A)*100	% Growth of Total Retail Employment
1	2000-01	27960000	493000	1.76	-
2	2001-02	27790000	502000	1.81	(+) 02
3	2002-03	27205000	492000	1.81	(-) 02
4	2003-04	27001000	542000	2.01	(+) 10
5	2004-05	26443000	532000	2.01	(-) 02
6	2005-06	26459000	559000	2.11	(+) 05
7	2006-07	26959000	569000	2.11	(+) 02
8	2007-08	27242000	588000	2.16	(+) 03
9	2008-09	27512000	437000	1.59	(-) 26
10	2009-10	28086000	646000	2.30	(+) 48

Source: Ministry of Labour and Employment, Director General of Employment and Training, Economic Survey 2011-12

CONSTRUCTIVE ENVIRONMENT

According to the 16th GRDI report of AT Kearney *(The Age of Focus, 2017),* India is having a very favourable retail environment and it is placed at 1st position in the GRDI. The main reasons behind that is the 9% real GDP growth in 2010, forecasted yearly growth of 8.7% through 2016, high saving and investment rate, increased consumer spending. In India the vast middle class and its almost untapped retail industry are the key attractive forces for global retail giants wanting to enter into newer markets, which in turn will help the Indian Retail Industry to grow faster. Indian retail is expected to grow 25 per cent annually. Modern Retail in India could be worth US$ 175-200 billion by 2016. The Food Retail Industry in India dominates the shopping basket. The Mobile phone Retail Industry in India is already a US$ 16.7 billion business, growing at over 20 per cent per year. The future of the India Retail Industry looks promising with the growing of the market, with the government policies becoming more favourable and the emerging technologies facilitating operations.

- The Government to initiate Foreign Direct Investment (FDI) in various sectors is bringing a new interest to the investment climate in India and more and more foreign marketers attracting towards Indian retail market.
- Higher incomes motivating the purchase of essential and non essential products which is contributing in the growth of the retail sector.
- Consumption patterns of Indian customers are changing.
- Increase in easy access to credit and consumer awareness.

- New technology and lifestyle trends creating replacement demand.
- Increase in rural income as well as urbanization of the population.

GROWTH TREND OF RETAIL SECTOR IN INDIA

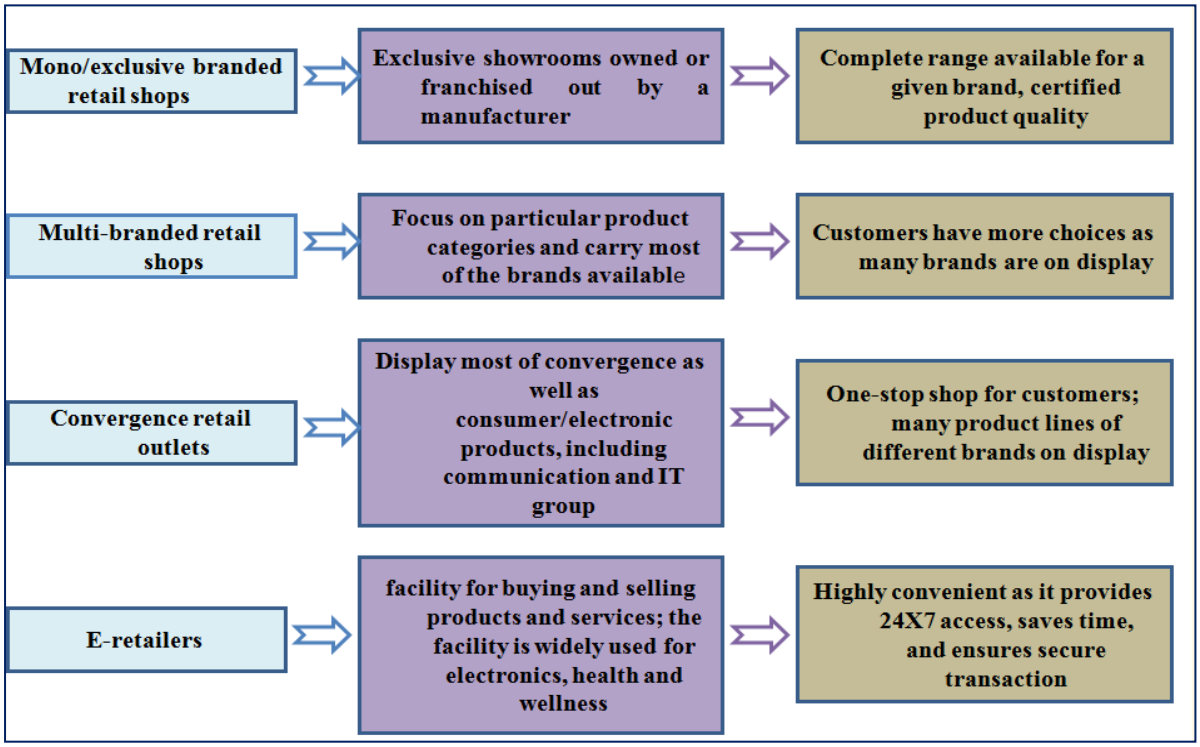
The Indian retail sector has witnessed an unprecedented growth over the last decade, driven by robust economic growth, rapid urbanisation and changing lifestyles and aspirations of the Indian retail consumer. From less than 1 million sq. ft. of mall space in 2001, the Indian organised retail sector has increased manifold. However, the ups and downs of the Indian economy had always taken its toll with changes in absorption and vacancy over the years. Leading research institutions such as AT Kearney and ASSOCHAM estimate the retail realty sector to grow at around 15% y-o-y, over the next three–five years as against a 12%–13% nominal growth of India's GDP estimated by the International Monetary Fund (IMF). Going by that logic, the sector should reach a size of Rs 34 trillion by 2018.

The sector is also an important contributor towards the socio economic well being of the economy as it employs close to 9.4% of India's labour force, as per the association. In its current form, the retail sector in India is mostly unorganised in its structure, with the organised retail contributing a small 7% to the total sector as of FY2012. However, this industry is witnessing a fast transition and it is estimated that the organised sector will record a growth rate of close to 24% CAGR to increase its share to 10.2% of the total sector by 2016–2017, as per ASSOCHAM. As of 2016, the organised retail sector have therefore touched the size of Rs 3.5 trillion. India's overall retail sector is expected to rise to US$ 1.3 trillion by 2018, at a compound annual growth rate (CAGR) of 10 per cent. As a democratic country with high growth rates, consumer spending has risen sharply as the youth population (more than 33 percent of the country is below the age of 15) has seen a significant increase in its disposable income. Consumer spending rose an impressive75 per cent in the past four years alone. India's retail market is expected to grow at a Compound Annual Growth Rate (CAGR) of 10 per cent to US$ 1.6 trillion by 2026 from US$ 641 billion in 2016. While the overall retail market is expected to grow at 12 per cent per annum, modern trade would expand twice as fast at 20 per cent per annum and traditional trade at 10 per cent.

Key Players in Indian Retail Industry

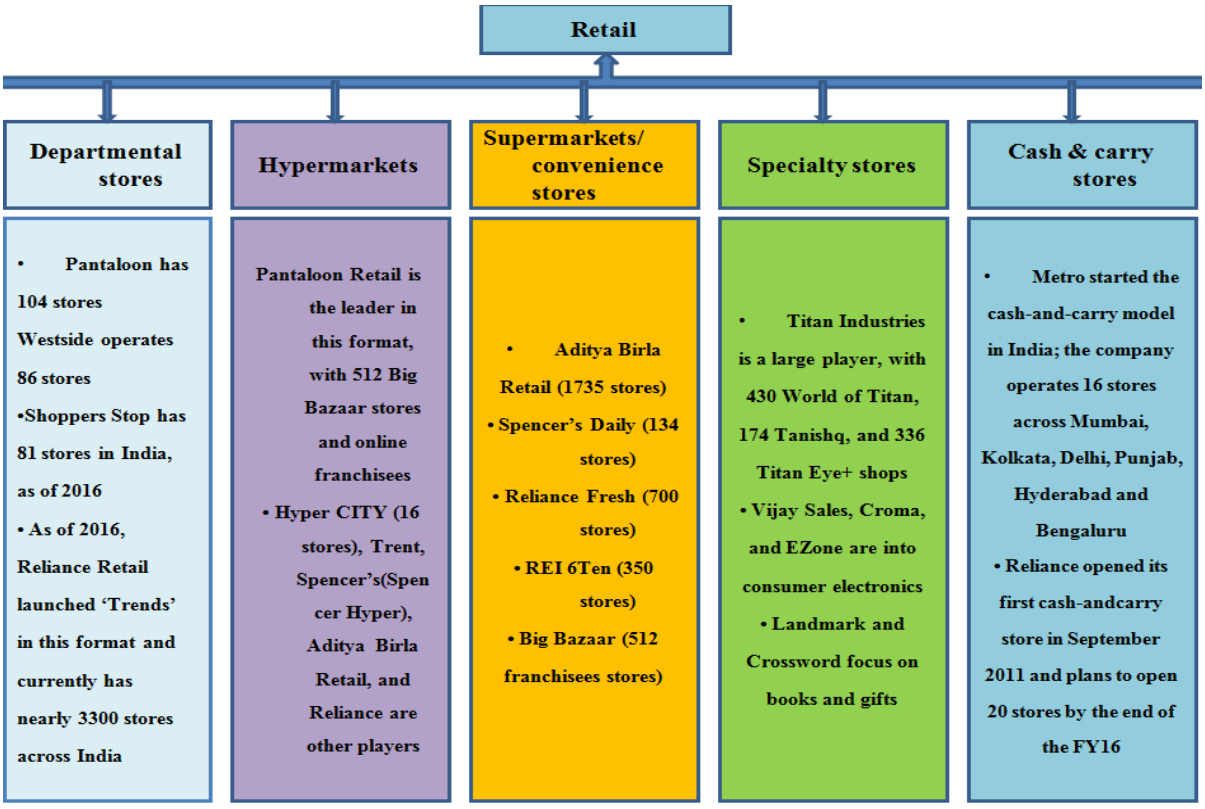
- Grocery
- Food and Beverage
- Clothing and Textile
- Furniture and Fixtures
- Pharmacy
- Books, Music and Gift
- Durables, Footwear & Leather, Watch & Jewellery

Retail Formats in India



Source: TechSci Research Note: IT - Information Technology

Competitive Landscape in Indian Retail Sector



Source: Company websites, Press Release, TechSci Research

INVESTMENT SCENARIO

The Indian retail trading has received Foreign Direct Investment (FDI) equity inflows tolling US$ 935.74 million during April 2000–December 2016, according to the Department of Industrial Policies and Promotion (DIPP).With the rising need for consumer goods in different sectors including consumer electronics and home appliances, many companies have invested in the Indian retail space in the past few months.

- IKEA, the Netherlands-based furniture company, has purchased 14 acres of land in Bengaluru for setting up its third retail outlet in the country.
- Future Group, a consumer goods company in India has entered into a joint venture with Khimji Ramdas Group in UAE for selling garments in Oman with both the companies having invested US$ 11.7 million each. The joint venture will first launch four to five stores in Oman and gradually increase the count to 17 to 18.
- Amazon India plans to double its storage capacity in India by adding 14 new warehouses by June 2017, aimed at maintaining rapid growth in sales and catering to the remote parts of India.
- Bang and Olufsen, Danish stereo and speaker system maker, has plans of setting up about eight to ten standalone satellite stores by the end of FY 2017-18 in cities like Kolkata, Hyderabad, Ahmedabad, among others.
- Walmart, global retail giant, plans to open 50 new cash-and-carry stores in India over the next three to four years and locate half of the stores in Uttar Pradesh and Uttarakhand while creating over 40,000 jobs in the two states.
- Global e-commerce giant, Amazon is planning to enter the Indian food retailing sector by investing US$ 515 million in the next five years, as per Mr Harsimrat Kaur Badal, Minister of Food Processing Industries, Government of India.
- US apparel retail major Gap Inc, has tied up with Arvind Group's fashion portal NNNow.com to sell its products online, which will help the retailer expand its presence beyond metros and tier-I cities.
- Hamleys, has stated that India is one of the most important markets for Hamleys globally, and outlined plans of opening six more stores, taking its total store count in the country to 32 by the end of March 2017.
- Roche Bobois Group, outlined plans of opening new stores in cities like Hyderabad, Chennai, Pune, Kolkata and Ahmedabad, in order to make India one of its top five markets by 2022.
- A joint venture between Dutch asset manager APG Asset Management and real estate asset platform Virtuous Retail, has acquired a portfolio of three shopping malls for US$ 300 million, and has committed an additional US$ 150 million as equity capital to expand the portfolio.
- Future Consumer Ltd has formed a joint venture (JV) with UK's largest wholesaler, Booker Group, with an investment of Rs 50 crore (US$ 7.5 million), to set up 60-70 cash-and-carry stores in India in the next 3-4 years.

- Adidas India Private Limited, outlined plans of opening around 30-40 big flagship stores across Delhi, Mumbai and Bengaluru, by 2020.
- Mad over Donuts (MoD), outlined plans of expanding its operations in India by opening nine new MOD stores in Hyderabad and Chennai by March 2017.
- Switzerland's luxury retail brand Bally, plans to re-enter the Indian market in a joint venture with Reliance Brands Ltd, by opening its first store in New Delhi in March 2017, and thereafter aiming to expand to four stores in Delhi, Mumbai, Kolkata and Chennai over the next 3 to 4 years.
- Urban Ladder, an online furniture store, is in advanced talks to raise around US$ 25-30 million from existing investors Kalaari Capital, SAIF Partners and Sequoia Capital, along with one new investor, which will be used to fund its expansion plans.
- Hennes & Mauritz (H&M), the Sweden-based clothing retailer, is in advanced talks with Mumbai-based Prakhhyat Infraprojects Pvt Ltd to lease around 275,000 square feet of space at Bhiwandi, Maharashtra, to set up its first warehousing hub in India.
- Future Group has partnered with UK clothing and hardware retailer Laura Ashley to make and sell merchandise as well as wholesale distribution in India.
- Parle Agro Pvt Ltd is launching Frooti Fizz, a succession of the original Mango Frooti, which will be retailed across 1.2 million outlets in the country as it targets increasing its annual revenue from Rs 2800 crore (US$ 0.42 billion) to Rs 5000 crore (US$ 0.75 billion) by 2018.

Policy support

- ✓ About 51 per cent FDI in multi-brand retail
- ✓ FDI of up to 100 per cent in single-brand retail and for cash and carry (wholesale) trading and exports
- ✓ Introduction of Goods and Service Tax (GST) as a single unified tax system from next fiscal year
- ✓ To provide a level-playing field to stakeholders, the government is planning to synchronize policies of retail, FMCG and e-commerce within a single policy framework

Challenges of Retailing in India

Retailing as an industry in India has still a long way to go. To become a truly flourishing industry, retailing needs to cross the following hurdles:

- ✓ Automatic approval is not allowed for foreign investment in retail
- ✓ Regulations restricting real estate purchases, and cumbersome local laws
- ✓ Taxation, which favours small retail businesses.
- ✓ Absence of developed supply chain and integrated IT management
- ✓ Lack of trained work force
- ✓ Low skill level for retailing management
- ✓ Intrinsic complexity of retailing – rapid price changes, constant threat of product obsolescence and low margins

- ✓ Organised retailing to create a "customer-pull" environment that increases the amount of impulse shopping
- ✓ Retail chains like MusicWorld, Baristas, Piramyd and Globus are laying major emphasis & investing heavily in store design
- ✓ Large cineplexes, and malls, which are backed by the corporate house such as 'Ansals' and 'PVR'the unorganized sector is getting organized
- ✓ Lack of necessary infrastructure
- ✓ Low coverage of modern infrastructure services

CONCLUSION

The Indian retail industry has emerged as one of the most dynamic and fast-paced industries due to the entry of several new players (national and International). It accounts for over 22 per cent of the country's Gross Domestic Product (GDP) and around 8 per cent of the employment. India is the world's fifth-largest global destination in the retail space. India is the ones and new retail leader in the global due to more favourable foreign investment environment, strong economic growth and boom consumption expenditure by the consumer. Another hand the government is taking steps to eliminate the federal and state rules that curtail retail development and new rules and regulation are being developed to attract investment and increase consumption. The enthusiasm around the initial public offering of India's most profitable food and grocery chains shows that modern retailers are well positioned for profitable growth. This environment has propelled India to the top spot in the Global Retail Development Index (GRDI).

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Tomato pinworm (*Tuta absoluta* (Meyrick)): Invasive pests of tomato and their Management

C. Selvaraj[1] and C. Mohan[2]

[1] Ph.D Research Scholar, Department of Agricultural Entomology, BCKV, Mohanpur, West Bengal-741 252.
[2]Ph.D Research Scholar, Department of Agricultural Entomology, TNAU, Coimbatore, Tamil Nadu-641 003.
Corresponding author: selvaarjun665@gmail.com

The tomato pinworm,*Tuta absoluta* (Meyrick) (Lepidoptera: Gelechiidae) is one of the global major destructive invasive pests was found to be occuring in India in the year 2014. The pest has spread from South America to several parts of Europe, entire Africa and has now spread to India. Plants are damaged by direct feeding on leaves, stems, buds, calyces, young fruit, or ripe fruit and by the invasion of secondary pathogens which enter through the wounds made by the pest. It can cause up to 90% loss of yield and fruit quality under greenhouses and field conditions.

Pest status in India

Tomato pinworm was recently detected in Pune, Maharashtra. Subsequently, infestation has been noticed in major tomato growing districts of Maharashtra such as Pune, Ahmadnagar, Dhule, Jalgaon, Nashik, and Satara. In Bangalore and Kolar areas of Karnataka too, this pest has been observed to cause moderate to severe infestation. If left unchecked, it could be a potential threat to tomato cultivation in India.

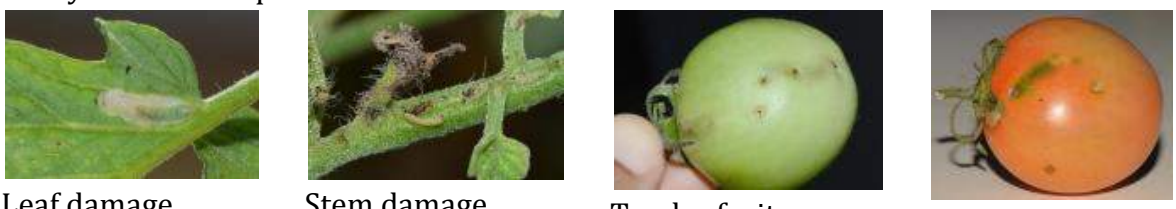
Host plants

Tuta absoluta prefers to feed on tomato, though other solanaceous plants, including potato, have been recorded as hosts. It is known to have many generations in a year and affects tomato in all growing stages.

Damage

The tomato pinworm attacks both the leaves and fruits of tomato. Tunnelling or mining by larvae in the leaves is the most common type of injury. Initially, the mine is long and narrow, but it later widens to become blotch-shaped. Older larvae may fold the leaf over itself, or knit 2 leaves together, between which they continue to feed, causing large blotches. In severe infestations, all leaves on a plant are attacked giving the crop a burnt appearance. More direct damage is caused to the crop when the older larvae may

penetrate nearby fruits by burrowing under the calyx into the fruit. Very small pinholes are left at the points of entry, which are often marked by the presence of a small amount frass or droppings. Points of entry under the calyx are inconspicuous and can easily be overlooked during packing. Larvae may also bore into the sides of tomato fruits in heavily-infested crops.



Leaf damage Stem damage Tender fruit Ripened fruit

Fig. Damage caused by *Tuta absoluta* to tomato crop (Source: NBAIR)

Life History and Habits

The TPW passes through 4 stages (egg, larva, pupa and adult), and completes its life cycle in 26 days at 24-26°C, and 100 days at 10-13°C. The newly-hatched larva moves about on the surface of the leaf for a short while until it finds a suitable place to enter the leaf. Then it eats its way into the leaf between the upper and lower leaf surfaces. The larva feeds within the mine until about half-grown, then emerges and may fold the leaf onto itself, or join 2 leaves by means of threads produced from its mouth. Here, the larva continues to feed between the leaf surfaces and forms large blotch mines. When fruits are present, larvae may enter fruits instead of folding the leaves. The number of larvae that enter fruits increases as the population density increases. The fully-grown larvae usually lower themselves by a thread to the ground to pupate, but pupation can also occur in leaf folds and fruits. The adults emerge from the pupal cells, mate, lay eggs and repeat the cycle. Mating occurs within 24-48 hours after emergence and most eggs are laid within a few days after emergence. The adults hide during the day and may fly erratically for short distances when leaves closest to the ground are disturbed. Flight and egg-laying usually begin at twilight and continue through the night if the temperature is above 16°C.

Description of Stages

Egg Larva Pupa Adult

Fig 1. Life stages of tomato pinworm (*(Source: NBAIR)*

Egg

Eggs are laid scattered, or in small groups of 3-7, mainly on the upper leaves, and on both upper and lower leaf surfaces. The egg is oval in shape and very tiny

(approximately 0.4 mm long). Its colour is pearly white at first, and then becomes pale yellow before hatching. The egg stage lasts from four to eight days at 22-24°C.

Larva

The larva molts 4 times. The newly-hatched larva is tiny (about 0.7 mm long), with a black or dark brown head capsule, and a cream-colour body. The fully-grown larva is 6-8 mm long, and has brownish to purplish markings along the body. Tomato pinworm larvae are characteristically very active and wriggle when touched. The larval stage lasts 10 days at 24-26°C.

Pupa

Pupation takes place within a loosely-spun cocoon in several possible locations including under debris on the ground, just under the soil surface, within the folds of leaves, on strings supporting tomato plants, or, rarely, in the fruits. The pupa is spindle-shaped; greenish at first, but soon changes to a dark chestnut brown colour. The pupal stage lasts 8-20 days depending on temperature.

Adult

The adult resembles a clothes moth in size and colour. It is greyish-brown in colour and is 6-8 mm long. Adults live for about 7-9 days at 24-26°C, and for about 23 days at 13°C.

CONTROL STRATEGIES

Use of a combination of techniques is the best approach for managing TPW. Such techniques are as follows:

1. **Monitoring:** is key to detecting initial populations and preventing any build-up. This is most efficiently done by weekly inspection of pheromone traps that are placed in the greenhouse throughout the season to detect male adults. Place traps at the same height as the tops of the plants. Note that the pheromone lures placed in the traps must be replaced regularly according to the manufacturer's instructions.
2. **Sanitation:** Thorough clean up of an infested crop is essential to preventing, or at least minimizing, carryover of populations to the next crop. Ensure that all crop debris is properly destroyed by burning or burying deeply. Adults cannot emerge normally if the pupal stages are buried at least 7-9 cm in the soil.
3. **Physical Hand Removal**: By regularly inspecting the crop from the very start, and hand removing and destroying infested leaves, a build-up in a population could be prevented or at least minimized.
4. **Disinfest Crates**: Ensure crates or boxes are properly disinfested before moving them from one operation to another. Adults, infested leaves, or fruits resting in crates can serve as a source of infestation.
5. **Biological Control**: One predator, *Nesidiocoris tenuis* (Reuter) (Hemiptera: Miridae), commonly found on tomato, is an effective predator of this pest. *Neochrysocharis formosa* (Westwood) (Hymenoptera: Eulophidae), a common parasitoid of serpentine leafminer of tomato in India and Southeast Asia, has been recorded as a parasitoid of *T. absoluta* as well.

Nesidiocoris tenuis (Reuter)

Neochrysocharis formosa (Westwood)

Fig 2: Natural Enemies of Tuta obsoluta *(Source: NBAIR)*

6. **Mating Disruption:** Slow release of the TPW sex pheromone into the atmosphere serves to confuse male TPW in their search for female TPW. This confusion results in the disruption of mating. When TPW populations in a greenhouse are low, and when there are no neighbouring sources of infestation, use of mating disruption is effective in suppressing populations of TPW.
7. **Light traps:** Tomato pinworm adults are attracted to lights and commercially-available light-traps can assist in reducing adult populations.
8. **Chemical control:** Spraying of any one of the following insecticides can control the pinworm incidence.

Insecticides	Dosage (gm/ml)	Waiting period (days)
Spinosad 45.0 SC	160	3
Indoxacarb 14.5 EC	400-500	5
Bt var. *kurstaki* 5 % WP	500-1000	-
Azadiractin	1000-1500	3

CONCLUSION

The tomato pinworm (TPW) [*Tuta obsoluta*] is primarily a pest in tropical and subtropical areas of the world. Its first incidence in Canada was reported in 1946. Its occurrence in greenhouse tomatoes in Ontario was during 1991, and it has been observed in a few operations every year since that time. Its Most recent occurrence were noticed in India during 2014 and still it is continuing throughout southern parts of India such as Tamil Nadu, Maharastra, Karnataka, Andra pradesh.

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Termites, their behaviour and management in Agri-horti crops

A. Rama Devi[1], R.D. Solanki[2] and P. S. Chintkuntlawar[3]

[1]Senior Research Fellow, National Institute of Plant health Management, Rajendranagar, Hyderabad-500091, Telangana, India.
[2]Department of Agricultural Entomology, Samarth Agriculture College, Deulgaon Raja, Buldana 443204, Maharashtra, India.
[3]Department of Agricultural Entomology , college of agriculture, Udgir,Latur, VNMKV. Parbhani
**Email of corresponding author: ramaento33@gmail.com*

Termites are well known to cause enormous damage to woodwork in buildings, to agricultural, horticultural and forest crops, to timber in storage and in use, and to books, records and other stored products of cellulosic origin. The total loss thus caused in India alone runs into several millions of rupees per year, Thus, the study of termite society, which has a rigid caste system, their behaviour and management techniques is here under reviewed briefly.

INTRODUCTION

Termites are most primitive social insects in the Animal kingdom and also known as "White ants". Termites live underground in soil, in wood and construct lofty attractive earthen mounds / carton nests making by its colony. Termites are important pest of agricultural crops in tropical and sub-tropical regions of the world. Infested plants showed wilting symptoms, dry up and can be easily pulled up. Activity of termites can be seen right from sowing the crops till harvest.

In India, about 270 termite species have been recorded, of which, 40 species have been found injurious to economic plants. It belongs to three important genera; Angulitermes, Microtermes and Odontotermes, where in *Microtermes obesi* (Holm) and *Odontotermes obesus* (Rambur) account for almost 80 % of total losses in south Asia (Chhillar *et al*, 2006). Termites generally attack field crops and cause damage up to 24% during January and reached to the highest 66 % level during month of May in Pigeon pea. The maximum (7.0%) damage trees were recorded second fort night of June in Aonla. They are abundant in tropical and subtropical environments, and are able to decompose cellulose, the main component of wood. Where they help in breaking down and recycling one third of the annual production of dead wood. But they become economic pests when they start destroying wood and wooden products of human homes, building materials, forests, and other commercial products.

Life history

Reproductive capacity of queen of termite species is tremendous, which deposit thousands of eggs per day for a numbers of years. The individuals comprising a colony of termites consists several castes, which are morphologically and functionally distinct. Newly hatched individual (larva) is capable of developing into any caste depending upon requirement of it colony. Eggs hatch into larvae that are genetically capable of developing into any caste. Diet, pheromones and time of the year are important factors in determining this. Workers **c**omprise the bulk of the population. In lower termites there is a false worker caste called pseudergates who retain the potential to become alates. Workers feed all the dependent castes, larvae, nymphs, soldiers and reproductives. They also dig tunnels, locate food and water, maintain colony atmospheric homeostasis, build and repair the nest. Soldiers develop from nymphs, pseudergates or workers. They moult twice. The transition stage is called a presoldier. Soldiers provide colony defense against numerous predators such as ants and centipedes. Various insects and arthropods present in a termite nest are called termitophiles. Reproductives develop either form alates or neotenics. Alates are winged termites. Each species produces alates at a particular season. The alates fly at a unique time of day, break off their wings along a basal suture and are then called dealates. Dealates form tandem courtship pairs and after a brief courtship run, dig into the soil adjacent to wood, mate and start a family. The offspring constitutes a colony. The founding reproductive pair is now the queen and king of the new colony..

Termites behavior

Communication:- Termites live in dark, so sensory and chemical communications are very important. Communication is a resultant effect of a stimulus triggered by a sense organ present in/on the termite body. Pheromones are chemicals that termites produce in special glands on their bodies. The termites use the pheromones to communicate with each other in their dark environment. One of the situations when termites use pheromones is trail marking. When termites find a food source, they use a pheromone to mark the trail from the food to their nest. They deposit the pheromone from a gland on the underside of the abdomen. When they return to the nest, the termites recruit other termites to follow the pheromone trail back to the food

Feeding behaviour:- a) Trophollaxis:-It is the process of exchanging the secretion /liquid food between individuals. b) Wood feeding: - Wood eating termites hold the wood fibers between their mandibles and tear pieces off by moving their head to the side. c) Fungus garden: - In the nest, globular or ovoid cavities are found, which usually are walnut to a coconut in size and occupying these cavities are strange looking nodules of a friable but hard consistency.

Defence behaviour:- The soldiers mainly carry out the defence of colony against intruders. Mechanical defence by mandibles, head shape and chemical secretion were found in soldiers of many termites.

Foraging behaviour:-The most efficient foragers are able to build over non-woody materials to forage over a long distance. *Odontotermes* spp. and *Macrotermes* spp. can forage long haul at least 50 meters.

Nest building:-Termites produce wide range of nests. Nest building initially evolved from a defence reaction. Nest can be inside the wood, building, subterranean, above ground as a mound and arboreal.

Causes of termite outbreaks

- Presence of termite nests/mounds around the paddy field or farm.
- Warm and dry climatic conditions (i.e. lack of rainfall) – uneven rainfall due to climate change.
- Introduction of exotic crop species. Indigenous crop species capable of coping with termite infestation as they have evolved some level of resistance
- Presence of unhealthy crop species that have been subjected to biotic and abiotic stresses such as drought, weeds, diseases, etc.
- Lack of effective termite control measures and lack of suitable integration of termite control tactics.
- Some grassland termites make permanent nests composed of many tunnels deep in the soil. Other species make nests as mounds above the ground. The tunnels are lined with body waste to seal the walls so that high humidity can be maintained.

Nature of damage

Most grassland termites lack symbiotic protozoa to digest cellulose. Instead they culture fungi in underground fungal combs. Fungal gardens (=combs) are made by termite workers of partly digested plant material. This plant material becomes inoculated with the fungi and the termites later feed on the combs. Workers constantly construct and eat the fungal combs in their nests. Termites prefer dead to living plants but when their preferred food is gone, they feed on living roots. After land preparation, the termite workers feed on living plants. They tunnel through plant stems and eat roots, causing the plants to become stunted. Damaged plants can easily be pulled by hand.

Paddy - feed on roots, foliage, stem and fallen heads.

Sorghum - feed on roots and stem resulting in wilting and death of the plant.

Groundnut- feed on main stem which is bored at or just below the ground level. Mature and developing pods are also penetrated and filled with mud.

Sugarcane- enter the sets through buds and cut ends and devour the inner portion, roots are also damaged. Sometimes earthen sheeting at the base of plant, mud filled galleries in shoots, drying of shoots.

Potato- damage stems and roots in dry or late season result in poor growth and rotting.

Mango- construct mud galleries on tree trunk, if earthen sheet is removed, eaten bark of trees is observed. Young plants will die and dry up.

Coconut –construct mud galleries on trunk. Bark and stem are eaten below the mud galleries. Nursery and transplanted fields show wilting of central shoot and stunted growth.

Management

Cultural control

Monthly irrigation with hoeing was found to be most effective cultural practice for the control of *Odontotermes obesus* (Rambur) in mango orchard (Singh and Singh, 2003a). Singh and Madan (2002) screened 43 genotypes of sugarcane at karnal of which 3 genotypes *viz*; CoH 110, Co 93026, and CoLK 9411 were found moderately tolerant, 21 as susceptible and 19 as highly susceptible.

Mechanical control

Termite foraging activity reduced by artificial breaking up of the soil. Removing mud tubes is required as part of a complete termite control program.The tubes are an indication that termites are active around the house and this provides a way of assessing the effectiveness of a termite treatment. Termite mounds in and near the paddy field to be located and exterminated by manual digging and dequeening.
Populations of soil-dwelling pests of crops (such as white grubs, mole crickets, termites, ants,) can be reduced by increasing the number of tillage operations.

Biological control

Termites have a wide variety of predators, both opportunist and specialist, but ants are the greatest enemies of termites in all regions of the world. Naturally termites are predated upon by various animals – frogs & toads, lizards, snakes etc. *Beauveria bassiana* also most effective fungal pathogen, when applied @ 10^7 conidia/ ml against termite and caused 84% mortality (Khan *et al.,* 1992). More than 50% mortality rate of *Coptotermes formosanus* was seen when they expose to *B. bassiana* strains 26037 and 90519, and *M. anisophiliea* strain ESC1. Worker community was more susceptible against the isolate 4-23 and 4-10 of *B. bassiana* and showed 20-25% mortality after two days of the treatment (Padmaja, 2001).

Botanical control

To control termite in the field some farmers cut approximately 5 kg each of *Calotropis* and Kheemp (*Leptadenia pyrotechnica*) twigs into small pieces and put them in an earthen pot. Then add 1 kg salt and 10 L water/cow/human urine. The pot is kept in a pit for 15-20 days. The suspension is filtered through cotton cloth and filtrate is applied as an insecticide @ 10 L/ha in irrigation channel (Source: *Integrated Disease Pest Management in Sri Paddy. SRI Secretariat (SDTT), Bhubaneswar, 24p*.). Biopesticides such as neem seed oil (22 L of neem seed oil concentrate in 220 L of water/ha) and neem powder (800 kg/ha) may be used. Herbal extract (Hexane) of *Ageratum conyzoides* (L.) was most effective botanical pesticide causing 70.6 per cent mortality of termite *Microcerotermes beesoni* followed by *Lantana camara* (Varma *et al.,* 2006).

Chemical control

Seed treatment:

Various insecticides can be used as seed treatment for the management of termite. Monocrotophos 36 WSC@ 17.0 ml and phenthoate 50 EC@12.0 ml/kg were found most effective as seed treatment in chickpea.

Soil treatment:

Fenvelerate 4 % D, Carbaryl 5 % D and quinalphos 1.5 % D @ 50 kg/ha gave effective control of termite in rainfed rice. Heptachlor 20 EC and chlorpyriphos 20 EC 1.25 kg a.i./ha were found superior than the rest of insecticides tested against termite in sugarcane. Soil application of chlorpyriphos @ 2 litre after impregnation on 25 kg sand/ha and methyl parathion dust 2 % @ 25 kg/ha were found effective treatments to check the termite infestation in wheat crop (Sharma *et al.,* 2002). Singh and Singh (2003b) reported that sett treatment with 0.2 % solution of imidacloprid 70WS (gaucho), soil treatment with Phorate 10 G @ 2.50 kg a.i./ha and application of chlorpyriphos @ 2.50 kg a.i./ha or Chlorpyriphos 20 EC @ 1 kg a.i./ha found effective and significantly reduced the infestation of termite in sugarcane.

The generally accepted chemical method of termite control over the years has been liquid insecticides. However chemicals can be expensive and have many harmful effects to environment but in severe condition, Chlorpyriphos 20%EC (2-3 ml/L water) and imidacloprid 17.8%SL (1 ml/L water) is the liquid solution to be poured into the mounds (Mahapatro, 2013).

Some indigenous methods used to eliminate the termite mounds

- Wood ash is used to control termites by putting it inside the mounds or sprinkling around it.
- Pouring the sand inside the initial new mound, termites will immediately abandon the mound.
- Dig hole on top of mound, insert wood and grass and set fire to it, then seal to confine the smoke and heat. OR fill hole with dry cow dung, set it on fire and leave to burn slowly.
- When alates emerge, blow smoke of opium or tobacco into the mound through the alates exit holes. A lot of alates come out and the remaining castes (queen, workers and soldiers) all die.
- Dig hole on top of mound, put in 1 basin of cow dung and pour 20 litres of boiling water through the same hole.
- Effective traditional practices against termites include: smoking the termite nest, use of salt, and flooding of termite nests with water.
- The application of red palm oil mixed with papaya is an indigenous biological control practice. The mixture attracts soldier ants that attack and drive away the termites.

CONCLUSION

Termite is a social insect with different castes, cause serious damage to crops. It can be managed through integrated approach using resistant varieties, mulching, mechanical control by killing of queen and digging of termetaria and other ecofriendly approaches such as biological control and use of botanical pesticides. In severe condition *viz*; chlorpyriphos, or imidacloprid can be used to overcome this pest. In the future, study regarding mechanical control of termite, suitable mating disruption practices should be developed in monsoon season and location based crop rotation practices should be developed. Research needs for seed treatment must be given due importance for termites

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An Overview- Plant Based Vaccines for Cattle

S. Chitradevi*, K. Sukumar, P. Suresh and A. Raja

Department of Veterinary Microbiology,
Veterinary College and Research Institute, Namakkal, Tamil Nadu
**Corresponding author email id: chitradevi.dr@gmail.com*

Vaccination is the most effective known way of preventing outbreaks and spreading of viral and bacterial infections. Traditional vaccines contained attenuated or inactivated pathogens, however the development of molecular biology, genetics, medicine and biotechnology in past decades resulted in many novel vaccine types and production systems. Plant-based vaccines are recombinant protein subunit vaccines. Ideally, the choice of plant species used to produce the selected antigen should allow for oral delivery in the form of an edible vaccine. These vaccines are well suited to combat diseases where there is a clear antigen candidate, and where the costs of production or delivery for any current vaccine are prohibitive. Several academic and industrial research groups are currently investigating the use of plant-based vaccines in animals

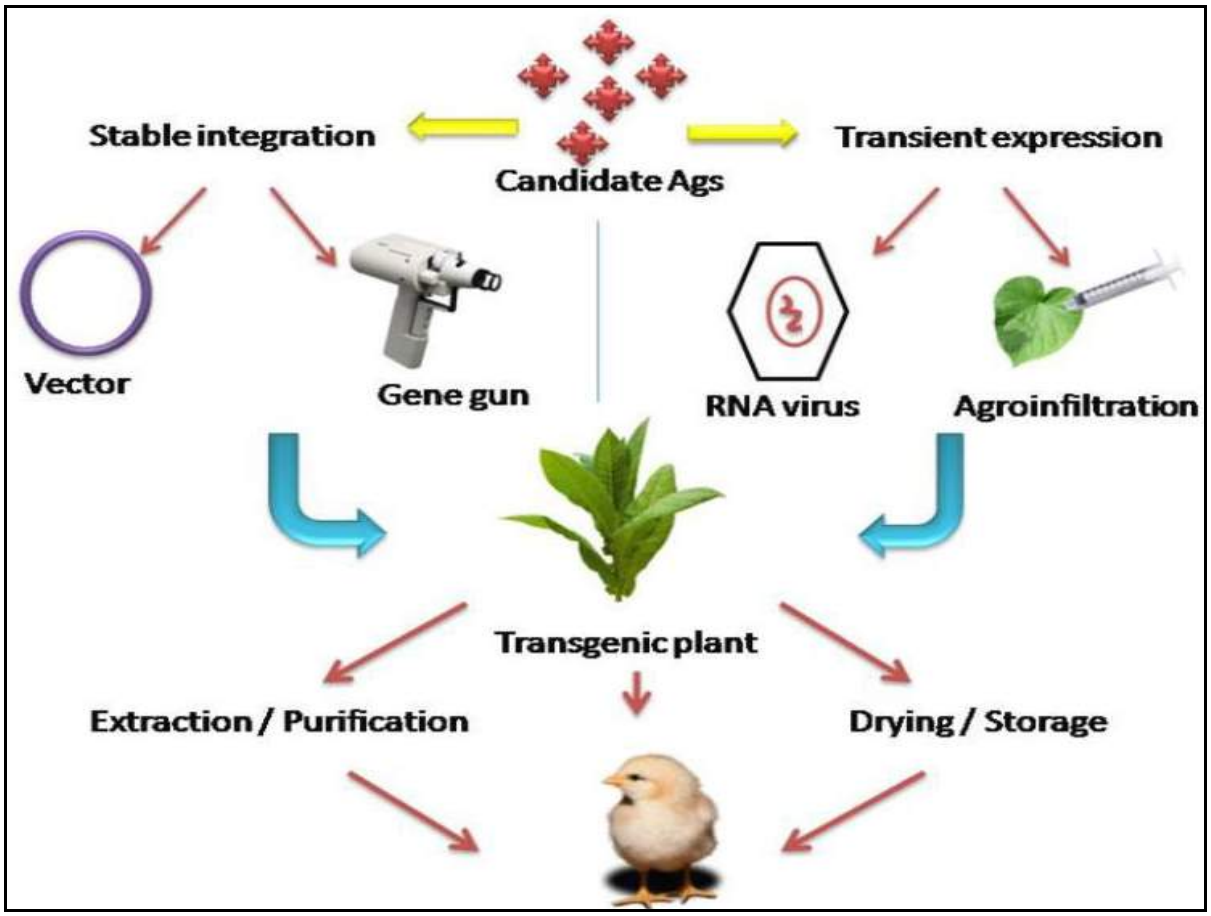
EXPRESSION HOST

An extensive list of plant types have been used for expression of vaccine antigens these include various Nicotiana spp., Arabidopsis thaliana, alfalfa, spinach, potatoes, duckweed, strawberries, carrots, tomatoes, aloe and single celled algae. Proteins have been expressed in seeds of maize, rice, beans and tobacco, in potatoes, tomatoes and strawberries, suspension cell cultures of tobacco and maize, hairy root cultures and transformed chloroplasts of a variety of plant species. (Rybicki, 2010)

STEPS INVOLVED IN PRODUCTION OF PLANT BASED VACCINES (Gunn, *et al.*, 2012)

- Selection of the desired gene and plant
- Vectors with plant-specific super promoters
- Plant transformation
- Transgenic plant screening
- Evaluation of the protein in animal model

Schematic diagram showing various methods of production of plant based vaccines



PLANT BASED VACCINES FOR CATTLE

FOOT AND MOUTH DISEASE

Foot-and-mouth disease virus (FMDV) is the causative agent of an economically important disease of cattle, sheep, pigs, and other wild and domestic cloven-hoofed animals. Strategies that have been developed for the expression of FMDV antigens in plants include fusion of immunodominant epitopes of FMDV capsid protein VP1 with plant virus capsids. The earliest attempt at producing a plant-derived vaccine to FMDV was by fusion of an immunodominant peptide epitope VP1 from the O serotype into the β B – β C loop of cowpea mosaic virus (CPMV). Although CPMV containing the inserted epitope did not spread systemically in infected plants. (Porta *et al*. 2003). A tobacco mosaic virus (TMV)-based vector was also employed to express similar immunogenically dominant FMDV VP1 epitopes as a fusion with the TMV capsid protein. TMV recombinants, expressing either an 11- or 14-aa epitope of VP1, systemically infected tobacco plants, and the epitopes were stably expressed in the virus particles. The authors estimated that 0.3– 0.4 g of the FMDV epitope was expressed per kilogram of infected leaf tissue. Guinea pigs either immunized parenterally or by oral administration of purified virus were protected at some level

against an FMDV challenge given at 42 days after the first immunization dose. Although the oral presentation had some protective effects, it was less effective than parenteral administration.

The complete FMDV VP1 structural protein [serotype O1 Campos (O1C) 23 kDa] was expressed in transgenic plants under control of the CaMV 35S promoter in, alfalfa and potato.. When the immunized mice with foliar extracts of transgenic potato plants were experimentally challenged with infectious FMDV by intraperitoneal inoculation, 90% of the vaccinated mice were protected against infection as compared to the control group (Wigdorovitz *et a*l. 2004). The research described above demonstrates the feasibility of a plant virus-based vaccine against FMDV and indicates that its commercialization could be possible in the near future.

BOVINE VIRAL DIARRHOEA

A plant-made subunit vaccine against Bovine viral diarrhea virus (BVDV) has been developed in Argentina. The structural protein E2 of BVDV was expressed in transgenic alfalfa as a fusion to a peptide for targeting the product to antigen-presenting cells. Partially purified antigen was administered intramuscularly to calves and protected them against BVDV challenge.

BOVINE HERPES VIRUS 1

Bovine herpesvirus type 1 (BHV-1) is the causative agent of a group of respiratory and reproductive disorders in cattle, commonly referred to as infectious bovine rhinotracheitis. The TMV viral-based expression system was used to produce a truncated, cytoplasmic subunit form of BHV-1 Gd protein in plants. The amount of recombinant protein was estimated at 15–20 µg per gram of fresh leaf tissue. Both humoral and cellular-specific responses recognizing the gD antigen were induced, and the candidate vaccine was able to induce protection in the natural bovine host to challenge, intranasal viral infection with the BHV-1 LA strain.

BOVINE PNEUMONIC PASTEURELLOSIS

Bovine pneumonic pasteurellosis (PP) is a major caused by the bacterium, *Mannheima (Pasteurella) haemolytica* serotype A1 is the principal microorganism responsible for the disease. A noninvasive alternative vaccine candidate for PP has been developed by (Lee *et al*. 2001) and is based on the expression of one of the major virulence factors of *M. haemolytica* A1 leukotoxin (Lkt). According to the report, experiments are in progress to assess the immunogenicity of the candidate vaccine in cattle and to test the efficacy of feeding the transgenic clover to cattle in stimulating a mucosal immune response to Lkt .

RABIES

In case of rabies, stable expression of the rabies surface protein was noticed in transgenic tomato but immunoprotective ability was not reported . A synthetic gene coding for the surface glycoprotein (G-protein) of rabies virus identified as the major

antigen that induces protective immunity was strategically designed to achieve high level expression in transgenic plants.. Tobacco plants were genetically engineered and expressed the chimeric G-protein at 0.38% of the total soluble leaf protein. Mice immunized intraperitoneally with the G-protein purified from tobacco leaf microsomal fraction elicited high level of immune response as compared to the inactivated commercial viral vaccine. This gives complete protective immunity in mice against intracerebral lethal challenge with live rabies virus. The result established that plants can provide a safe and effective production system for the expression of immunoprotective rabies virus surface protein.

STOAGE / SHELF LIFE/ PURIFICAION

Plant-based expression systems raise the possibility that antigens can be produced in a form that is stable during storage and is amenable to extraction and purification procedures . Dried or lyophilized leafy biomass, as well as plant storage tissues, such as seeds, retain unchanged levels of accumulated recombinant proteins for years at normal room temperatures (Streatfield, 2005).

ADVANTAGES OF PLANT BASED VACCINES

Plant based vaccines possess a number of potential beneficial features - cheap, safe, produced rapidly, easy to store, distribute and deliver, no cold chain management and remove injection nervousness (Streatfield *et al*., 2005). The additional advantage of stimulating both mucosal and systemic immunity help prevent strongly various diseases of respiratory and gastrointestinal systems.

- Similar to conventional vaccines, plant based antigens can induce effective neutralizing antibodies in hosts.
- It can be stored for extended periods in food grains.
- Heat-stable recombinant proteins can be generated.
- Production is cost-effective.
- Expensive fermentation and purification procedures are not required.
- Need of refrigerated storage transportation under cold-chain maintenance and sterile delivery systems are eliminated.
- Large scale production can be achieved in time bound fashion.
- Free from conventional vaccine contaminants - bacterial or viral pathogens.
- Needle-free delivery vaccine delivery is painless, time and labor-saving and also reduces the cost of syringes and needles.
- Administration is safe and without stress: no muscle damage as compared to needle based injections or local abscess formation in meat animals.
- Herd immunity can be easily achieved due to mass immunization potential.
- Mucosal adjuvants can be incorporated to augment induction of immunity and protection level.
- Plants can be grown easily and locally, so have wide applicability probabilities especially in developing countries also.

LIMITATIONS

1. Searching for suitable plant which will give ideal antigen expression.
2. Identification of proper dosage (whether plant parts, plant products, pill, intramuscular or intravenous injection of purified antigen) can produce proper dose.
3. Verification of allergens in the plant and plant products.
4. Study the impact of plant derived vaccines on the environment and human health.
5. Genetically altered crops producing plant derived vaccine could get mixed with human food supply or animal feed, causing potential threat to public health.
6. Cross pollination and their problems.
7. Effects on insects and soil microbes.
8. Regulation of plant derived vaccines in the form of food, drug or agricultural product.
9. Cultivation of plant derived vaccines and their delivery in capsule or pill form.
10. It requires residual virulence, extensive safety precautions, production difficulty and larger cost.

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Gender mainstreaming: prospects and issues

Shaik. Neema Parveen, Darshan, N.P and B. Rajashekar

Ph.D. Students, Department of Agricultural Extension,
PJTSAU, Rajendranagar, Hyderabad.

Despite the high percentage of female farmers involved in Indian agriculture as key agri-food stakeholders, the extension system has traditionally overlooked their specific farming needs. However, in India, there has been a transformation of agricultural extension which has mainly been influenced by the changing international and national economic, political and social climates. As part of this transformation, the Indian government has initiated moves toward mainstreaming gender concerns into agricultural extension delivery using a number of different approaches. There are also concerns about how terms such as 'gender' are interpreted under these new mainstreaming approaches. "Gender" meaning- Gender refers not to male and female, but to masculine and feminine – that is, to qualities or characteristics that society ascribes to each sex. Gender defines the process by which individuals who are born into the biological categories of 'male' or 'female' become the social categories of 'men' and 'women' through the acquisition of culturally defined attributes of masculinity and femininity as well as the resources and responsibilities associated with these categories.

GENDER MAINSTREAMING

Gender mainstreaming incorporates a GAD perspective. It aims to look more comprehensively at the relationships between men and women in their access to and control over resources, decision making, and benefits and rewards within a particular system.

Gender mainstreaming is an institutional transformation process that integrates efforts to achieve gender equality into the core of development activities. The approach requires specific consideration of the distinctive implications for men and women of resource allocations, policies, procedures, and institutional norms and structures.

As defined by the United Nations, gender mainstreaming is:

"… the process of assessing the implications for women and men of any planned action, including legislation, policies or programmes, in all areas and at all levels. It is a strategy for making women's as well as men's concerns and experiences an integral dimension of the design, implementation, monitoring and evaluation of policies and programmes in

all political, economic and societal spheres so that women and men benefit equally and inequality is not perpetuated."

Gender mainstreaming is not only a question of social justice, but is necessary for ensuring equitable and sustainable human development by the most effective and efficient means.

The objectives of mainstreaming gender issues in rural development projects are-

- ✓ Reduce gender inequities that may exist in a given project area;
- ✓ Encourage both men and women to participate in project activities; ensure that their specific needs are satisfied, that they benefit from the project and that the project impacts positively on their lives;
- ✓ Create the conditions for the equitable access of men and women to project resources and benefits;
- ✓ Create the conditions for the equitable participation in project implementation and decision making processes.

Importance of gender mainstreaming-

The most important reasons to emphasize gender mainstreaming are as follows:

- More Effective Policy and Legislation- Policy-makers will have to pay attention to the broad effects of policies on citizens' livelihood—and that, as a result, may mean a more human and less economic approach to the management of contemporary societies.
- More Effective Governance- If gender mainstreaming is used, policymaking will be better informed and show that policies are never gender neutral. Buy-in of men and productive collaborative efforts between women and men utilize a diverse human resource. As the stakeholders are getting involved in the process and implementation of gender mainstreaming, a clear shift will take place from isolation to integrate both genders, in particular involve men in gender equality work.
- Visible presence of gender equality in the mainstream of society- Based on a successful track record and good practices, mainstreaming will show that gender equality is an important societal issue with implications for the development of society.
- Diversity among women and men- Equality policies usually target women as a whole—but gender mainstreaming should be able to target the diverse situations of different groups of both women and men (migrant women, young women, old men, etc.

General steps involved in gender mainstreaming

The 10 Steps for Gender Mainstreaming include:

1. A Mainstreaming Approach to Stakeholders: Who are the Decision-Makers?
2. Mainstreaming a Gender Agenda: What is the Issue?
3. Moving Towards Gender Equality: What is the Goal?
4. Mapping the Situation: What Information do we Have?
5. Refining the Issue: Research and Analysis
6. Formulating Policy or Project Interventions from a Gender Perspective

7. Arguing Your Case: Gender Matters!
8. Monitoring: Keeping a (Gender-Sensitive) Eye on Things
9. Evaluation: How Did We Do?
10. En-gendering Communication.

DIFFICULTIES THAT ACCOMPANY GENDER MAINSTREAMING

- Misunderstanding the concept of gender mainstreaming,
- Need for a broader concept of equality.
- Current approaches to policy-making.
- Mainstreaming may require procedural changes.
- Lack of adequate tools and techniques.
- Lack of sufficient knowledge about gender equality issues.
- Mere taking about gender mainstreaming without implementing it in reality.

CONCLUSION

Gender mainstreaming in local government will have a major effect in rural development. Women, along the side with men, can jointly develop a strategic plan on a community-based level to strengthen rural development planning with aggressive women's participation in local government. In conclusion, successful gender mainstreaming in rural development can only be achieved or attempted through a sound policy process, government commitment and a thorough understanding of the goals and benefits by the community members.

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Role of Livestock in Doubling the Farmer Income:

A National Perspective and the Way Forward

Punita Kumari[1], Putan Singh[2] , Asit Das[3] and A.K. Verma[4]

[1]Ph.D. Scholar; [2, 3]Principal Scientist and [4]PS & Head
Animal Nutrition Division, ICAR-IVRI, Izatnagar-243122, UP

The multidimensional potential of various animals has been ever attracting feature that has created an inevitable bond of relation with Indian economy. Livestock sector has been renowned as a back bone of Indian agriculture. Livestock play multiple roles in the livelihoods of people in developing communities, especially the poor. They provide food and nutrition, work, economic and social status, and ensure environmental sustainability. With the livestock sector experiencing rapid change-mainly driven by the rapidly changing livestock production systems, demographics, environmental impacts, technologies, policies and institutions – this "multi-functionality of livestock" becomes even more complex issues, intertwined with other research and development challenges. Strategies to improve economic security at the farm level include reducing production costs, increasing the value of farm products, and diversifying income streams. Investment in livestock raises farm production by extending the area of land utilized, diversifying productive activity for crop cultivators or intensifying production, and that changes from grassland-based systems to mixed farming systems and hence to landless production systems represent stages of increasing intensity.

In almost all farming systems it is essential for converting inedible by-products and waste materials into food and hence it is no coincidence that as crop production intensifies so too does livestock production. For most of the people depending on smallholder farming systems livestock production is essential for diversifying income sources and maintaining soil fertility and providing draught power and transportation. Apart from the supply of consumable milk, meat, eggs as a protein source for ever increasing Indian human population, animals not only been contributing to concrete the animal based industries by producing hide, fiber, wool, bone meal, blood meal, but also been boosting Indian traditional art and crafts by providing feathers, hooves and horns etc. The drought power, a bio-gas and dung cake are utilized in rural India, have their own landmarks by saving considerable amount of fuel and electricity and thereby contributes in pollution control up to some extent. This is particularly important to

women for whom the value adding activities in processing and marketing products such as eggs, butter, cheese, leather goods and wool and woven products make vital contributions to their household budgets. The options for landless production provided by livestock are critical to the livelihoods of millions especially in urban and peri-urban communities.

Livestock is a source of subsidiary income for many families in India especially the resource poor who maintain few heads of animals. Cows and buffaloes, if in milk will provide regular income to the livestock farmers through sale of milk. Animals like sheep and goat serve as sources of income during emergencies to meet exigencies like marriages, treatment of sick persons, children education, repair of houses etc. The animals also serve as moving banks and assets which provide economic security to the owners. A large number of people in India being less literate and unskilled depend upon agriculture for their livelihoods. But agriculture being seasonal in nature could provide employment for a maximum of 180 days in a year. The landless and less land people depend upon livestock for utilizing their labour during lean agricultural season. The livestock products such as milk, meat and eggs are an important source of animal protein to the family members of the livestock owners. The animals offer social security to the livestock owners in terms of their status in the society. The families especially the landless which own animals are better placed than those who do not. Gifting of animals during marriages is a very common phenomenon in different parts of the country. Rearing of animals is a part of the Indian culture. Animals are used for various socio religious functions. Cows for house warming ceremonies; rams, bucks and chicken for sacrifice during festive seasons; bulls and cows are worshipped during various religious functions. Many owners develop attachment to their animals. The bullocks are the back bone of Indian agriculture. The farmers especially the marginal and small depend upon bullocks for ploughing, carting and transport of both inputs and outputs. In rural areas dung is used for several purposes which include fuel (dung cakes), fertilizer (farm yard manure), and plastering material (poor man's cement) for earthen walls and roofs of a house.

India's livestock sector is one of the largest in the world with a holding of 11.6 % of world livestock population. It has 53% of world's buffaloes (108.7million-m), 14% cattle (190.9 m), 20.4% small ruminants (sheep-65.07m & goats-135.2m), 2.4% camel, 1.4% equine, 1.5% pigs (10.3m) and 3.1% poultry (729.2m). Total livestock population in the India is 512.05 million and poultry population is 729.20 million in 2012 according to 19th livestock census. Contribution of livestock and fisheries sectors to the national economy in term of Gross Domestic Product (GDP) is 4.1 and 0.8% respectively. Agriculture and allied sectors contributed about 15.1% to the total GDP. Out of the total agricultural GDP, livestock sector contribute about 27.25 % during 2014-15.The livestock sector is an important source of foreign exchange too and is performing well in the manner of production, value addition and export of dairy, fishery, wool, poultry and other products. Livestock product comprised 32% of the total value of agriculture and allied activities in 2014-15. Thus livestock rearing is significant in poverty alleviation programmes. Government of India during the Budget 2016-17 announced that farmers

income will be doubled by 2022.Growth in agriculture allied sector especially Dairying and poultry production in India during the last 10 years had increased from 4-12%.Of the total income Indians spend 40% of daily income for food. Annual growth rate in dairying is 5% and in poultry, it is 10%.

India is now the world's largest producer of milk (137.7 Million tonnes), 3rd largest producer of eggs (74.75 billions nos), 5th largest producer of broilers (42 million tonnes) and 2nd largest producer of Fish (95.79 Lakh Tonnes). The availability of per capita animal protein in the country is 10.8g whereas the requirement as per world average is 25 g. The availability of per capita milk is 340 g per day in 2015-16. National sample survey reports that 70-75 % of their food budget is for milk and milk product. India contributes about 17% of the global milk output but its share in global export is insignificant at 0.4%. A large quantity of milk still remains unprocessed. While buffalo meat is the major item of Indian meat export, accounting for 59%, share of Indian meat in world market is less than 2%. Therefore livestock is a growth engine for skilled, semi skilled and unskilled population. Since meat sector provides livelihood to 40 million people, most meat sold in the domestic market needs proper sanitary inspection by the veterinarians. The average yield of wool at National level from Ram/Weather is 1.31 kg/ season, Ewes is 0.78 kg/season and Lamb is 0.9 kg/ season during 2013-14.

About 20.5 million people depend upon livestock for their livelihood. Livestock contributed 16% to the income of small farm households as against an average of 14 % for all rural household. Livestock provides livelihood to 2/3 of rural community. It also provides employment to about 8.8% of the population of India. Support for livestock rearing has contributed significantly to the empowerment of women and an increasing role in decision making at both the household and village level.

Irrigation, soil health, water conservation, organic farming, value addition, connectivity to market and e-commerce are given coverage in recent budget which facilitate market led production. Hundred per cent foreign direct investment has been allowed in e-commerce and food processing industries. Government of India recently has taken many initiatives like National Dairy Plan, National Mission on Bovine Productivity, 'Mera Gaon Mera Gaurav'Scheme, 'Gokul Gram' under public private partnership mode, Rashtriya Gokul Mission, Animal Health Card, 'Pashu Sanjeevani' Scheme. Recently 'e- pashuhaat' portal has been developed for connecting breeders and farmers regarding availability of livestock germ plasm and additional related services and will connect farmers with co-operative, milk federations, and private agencies at centre and state level. Government of India provides for set up of Dairy Processing and Infrastructure Development Fund in National Bank for Agriculture and Rural Development (NABARD) in budget 2017-18.

The National Dairy Development Board (NDDB) was created to promote, finance, and support producer-owned and controlled organizations. NDDB'S programmes and activities seek to strengthen farmer cooperatives and support national policies that are favorable to the growth of such institutions. The aim is to help self -reliant and professionally managed cooperative institutions, responsive to the economic and social expectations of their members. NDDB set up an Animal Disease Diagnostic Laboratory

at Anand to undertake scientific research activities. NDDB has expanded its research activities to include Animal Genetics, Animal Health and Animal Nutrition for supporting its Productivity Enhancement Programme for dairy cooperatives. Veterinary Council of India is a statuary body constituted under the provision of India Veterinary Council Act, 1984. Veterinary Council is responsible for regulating veterinary practices as well as for maintaining uniform standard of veterinary education through Minimum Standard of Veterinary Education Regulation in all veterinary institutes across the country. Central Cattle Development Organizations include seven Central Cattle Breeding Farms (CCBF), one Central Frozen Semen Production & Training Institute (CFSP & TI) and four Central Herd Registration (CHRS) Units established in different regions of the country to produce genetically superior breeds of bull calves, good quality frozen semen and for identification of superior germ plasm of cattle and buffaloes, so as to meet the requirement of bull and frozen semen in the country. In order to produce frozen semen of uniform quality, a Minimum Standard Protocol (MSP) for semen production was developed in consultation with experts from BAIF, NDDB, NDRI (Karnal) and CFSP&TI. At present, forty four Semen stations are ISO certified. Seven semen stations located at Mattupatty, Dhoni, Kulathupuzha (Kerala), Haringhata (West Bengal), Salboni, Beldanga (West Bengal) and Bhadbhada (Madhya Pradesh) are also Hazard Analysis Critical Control Points certified semen stations. The most important reasons for low conception rate are lack of access to good training facilities and ill-trained government Artificial Insemination (AI) workers. During 2014-15, many AI technicians and professionals have been trained at reputed training centres in the country. Artificial Insemination Training Institutes (AITI) operate under the umbrella of State Governments, Cooperatives, NDDB, NGOs and private agencies across the country. As AI training is one of the most important tools for delivery of AI services to the dairy farmers in the country, the quality of training imparted by AITI is essential in order to produce technicians with desired skill and competencies to undertake artificial insemination services successfully. For sustainable and continuous growth of livestock sector by emulating the success achieved in Dairy and Poultry sectors, across species and regions, the National Livestock Mission (NLM) has been launched in 2014-15. “National Kamdhenu Breeding Centres” for development, conservation and preservation of Indigenous Breeds are being set up one in north and one in south India, as a Centre of Excellence to develop and conserve Indigenous Breeds in a holistic and scientific manner. ‘Risk Management & Insurance’ as component of sub-mission on Livestock Development of NLM is to management of risk and uncertainties by providing protection mechanism to the farmers against any eventual loss of their animals due to death and to demonstrate the benefit of the insurance of livestock to the people.

To overcome the shortage of feed and fodder and to improve the nutritive value, government of India is also implementing the sub-mission on Feed and Fodder Development. It is to mention here that India with only 2.29% of the land area of the world, is maintaining about 10.71% of the livestock population. Hence, country is facing shortage of feed and fodder, to feed the present livestock population on scientific basis. There is shortage of Dry Fodder 40%, Green Fodder 36% and Concentrate 57% in India.

The area under fodder cultivation is only about 4% of the cropping area, and it has remained static for the last four decades. Owing to the importance of food crops and other cash crops it is very unlikely that the area under fodder cultivation would increase substantially in near future.

The Chaudhary Charan Singh National Institute of Animal Health (CCSNIAH) has been established at Baghpat, Uttar Pradesh to undertake the testing of vaccines and biologicals for their quality. Establishment and Strengthening of Existing Veterinary Hospitals and Dispensaries (ESVHD), National Animal Disease Reporting System (NADRS), Professional Efficiency Development (PED), Assistance to States for Control of Animal Diseases (ASCAD), Central/Regional Disease Diagnostic Laboratories, Animal Quarantine and Certification Service etc are other Government of India initiative.

Increasing density of population, small and fragmented land, increasing cost of production, decreasing productivity, monsoon and climatic issues, lack of mechanization, poor use of online marketing and e-platform for livestock products, land and soil degradation, inefficient use of water, availability of quality input, slow diversification process, inadequate extension, inadequate research and development and integration, non adaption of special methods, regional imbalances, poor co-ordination among stakeholder and institution, remunerative price of livestock product, low insurance coverage, supply demand mismatch of livestock product, inadequate food processing industries and weak linkage between appropriate stakeholders and institutions are some of the challenges existing in this sector.

The need of the hour is to increase in production, productivity and improvement in the marketing channel. In the case of failure in agriculture, livestock sector forms the source of income and gives insurance to any intervals of agriculture failure. Scientific breeding, feeding and management practices along with quality inputs and extension support services are required for achieving better productivity. Strategic programmes are required for reaching out among small holder population for facilitating technology transfer and extension support. Indian livestock industry needs appropriate production, marketing, trade policy and its periodic revival to keep the pace with the rest of the world and remain competitive to grab opportunities through international trade. Production of traditional livestock products, which fetches good price, should be promoted by exhibiting its inherent strengths and proper branding strategies. Changes in the extension approaches, market forecasting system, value addition, awareness on diseases affecting trade of livestock products, changes in the consumer behaviour, production of livestock products based on the demographic characteristics of the population, good manufacturing and retail practices, best production practices and implementation of food safety norms, branding etc need to be given more importance. There should be smooth credit facilities to animal owners, ceiling of cross breeding, supply of concentrate feed on subsidy, maintenance of animal health cards, rigorous veterinary extension education, research for organic livestock faming, establishment of special economic zone for animal husbandry, suitable pricing policy and separate budgetary provision for animal husbandry sector.

CONCLUSIONS

To conclude, the Indian Livestock scenario is slowly and steadily moving on the roadmap for development. Being low cost, economical and available in their backyard, it is the most important and reliable source of income for the poor and economically backward, tribal and the women. With a little more efforts and focus, this can prove to be the key to the livelihood for millions residing in villages in their food security, development, economic empowerment and prosperity.

Hypothyroidism in animals

Vishal Thakur[1] and Richa Thakur[2*]

[1]MVSc, Veterinary Pathology, College of Veterinary and Animal Sciences, Palampur – 176061, HP
[2]Research Scholar, Veterinary Pharmacology & Toxicology; College of Veterinary and Animal Sciences, G. B. Pant University of Agriculture & Technology (GBPUAT), Pantnagar-263145, UK
**Corresponding Author: richathkr81@gmail.com*

Hypothyroidism is an endocrinopathy caused by decreased production of thyroid hormone. The signs of hypothyroidism in humans include a subnormal body temperature, cold hands and feet, weight gain, hair loss, and constant fatigue. Among animals, this disorder is most common in dogs but also develops rarely in other species, including cats, horses, and other large, domestic animals.

ETIOLOGY

Primary hypothyroidism: The most common form (>95% of clinical cases), results from destruction of the thyroid glands. The two most common causes of adult onset primary hypothyroidism in dogs include lymphocytic thyroiditis and idiopathic atrophy of the thyroid gland. Lymphocytic thyroiditis, probably immune mediated, is characterized histologically by a diffuse infiltration of the gland by lymphocytes, plasma cells, and macrophages and results in progressive destruction of follicles and secondary fibrosis. Idiopathic atrophy of the thyroid gland is characterized histologically by loss of thyroid parenchyma and replacement by adipose tissue.

Secondary hypothyroidism: In dogs, the most common cause of secondary hypothyroidism is destruction of pituitary thyrotrophs by an expanding, space occupying tumor. Because of the non-selective nature of the resulting compressive atrophy and replacement of pituitary tissue by such large tumors, deficiencies of other (one or more) pituitary hormones also usually occur. Secondary hypothyroidism, caused by decreased thyroid stimulating hormone (TSH) release from the pituitary, has rarely been reported.

Tertiary hypothyroidism: It is caused by hypothalamic dysfunction, has not been proven in dogs.

Congenital hypothyroidism: Due to thyroid peroxidase deficiency has been seen in rat terriers and toy fox terriers. In foals, congenital hypothyroidism may develop when pregnant mares graze plants that contain goitrogens, or are fed diets either deficient in or containing excessive amounts of iodine. Most commonly, congenital hypothyroidism develops in association with a specific syndrome of neonatal foals characterized by thyroid gland hyperplasia together with multiple congenital musculoskeletal anomalies.
Iatrogenic hypothyroidism: It is the most common form in cats. Hypothyroidism develops in these cats after treatment for hyperthyroidism with radioiodine, surgical thyroidectomy, or use of an anti-thyroid drug.

CLINICAL FINDINGS

Common metabolic signs include weight gain, lethargy, and weakness cold intolerance or heat-seeking behavior; and mental dullness. Dermatologic changes are common like alopecia, seborrhea, and pyoderma. Bilaterally symmetric alopecia in areas of increased wear (e.g. lateral thorax, tail), slow regrowth of clipped hair, dry and brittle hair coat, hyperpigmentation, hyperkeratosis, myxedema, and otitis externa, increased incidence of pyoderma, folliculitis, generalized demodicosis and Malassezia infections as a result of immunosuppression. Recent studies suggest that abnormalities in the limbs are more related to muscle than nerve. Cranial nerve dysfunction (V, VII, VIII) and peripheral and central vestibular disease have been reported. Cardiac abnormalities (eg, weak apex beat, bradycardia) are uncommon. Reproductive abnormalities include periparturient mortality and lower birth weight in pups born to hypothyroid bitches, and inappropriate galactorrhea in females. Ocular changes may include corneal lipid deposits, lipemia retinalis, uveitis, secondary glaucoma, and keratoconjunctivitis sicca.

In cats, clinical signs associated with advanced or severe hypothyroidism include lethargy, dullness, non-pruritic seborrhea sicca, hypothermia, decreased appetite, and occasionally bradycardia. Obesity may develop, especially in cats with iatrogenic hypothyroidism, but it is not a consistent sign. Bilaterally symmetric alopecia has observed.

DIAGNOSIS OF HYPOTHYROIDISM

Hypothyroidism is probably one of the most over diagnosed diseases in dogs. Many diseases and conditions can mimic hypothyroidism, and some of the clinical signs, even in dogs with normal thyroid function, can improve after administration of exogenous thyroid hormone. In addition, a variety of non-thyroidal factors (eg, non-thyroidal illness and prior administration of certain drugs) can lead to low serum thyroid hormone measurements in euthyroid dogs, cats, and other species.

Definitive diagnosis of canine hypothyroidism requires careful attention to clinical signs and results of routine laboratory testing.

- Tests that may confirm the diagnosis include measurement of the serum concentrations of total T4, free T4, and TSH; Provocative thyroid function tests (eg, TSH stimulation test); thyroid gland imaging; and response to thyroid hormone supplementation. Clinical signs can also be related to test results.

- The classic hematologic finding associated with hypothyroidism, found in 40%–50% of cases, is a normocytic, normochromic, non-regenerative anemia.
- The classic serum biochemical abnormality is hypercholesterolemia, which occurs in ~80% of dogs with hypothyroidism. The serum cholesterol determination a sensitive and inexpensive biochemical marker for this disease in dogs. Other clinicopathologic abnormalities may include high serum concentrations of triglycerides, alkaline phosphatase, and creatine kinase.
- Total T4 concentration is the most commonly performed static thyroid hormone measurement and is a good initial screening test for hypothyroidism, with a diagnostic sensitivity of ~90%. Compared with the total T4 assay, the free T4 assay by dialysis has greater diagnostic sensitivity and specificity.
- T3 is the most potent thyroid hormone at the cellular level, it would seem logical to measure its concentration for diagnostic purposes.
- Determination of serum TSH concentrations by use of a valid species specific TSH assay can be a useful adjunctive test for hypothyroidism in dogs, cats, and horses. The TSH stimulation test evaluates the response of the thyroid gland to exogenously administered TSH and is a test of thyroid reserve. It is an accurate test of thyroid function in dogs but its use is limited by the expense and limited availability of TSH.

DIAGNOSIS OF THYROIDITIS

Circulating antithyroglobulin antibodies can be detected in half of dogs with hypothyroidism and are believed to reflect a state of autoimmune thyroiditis. Measurement of these antibodies in breeding studs and bitches has been proposed as a method to identify dogs with autoimmune thyroid disease. Serum thyroglobulin autoantibody determinations may be a useful adjunctive diagnostic aid for hypothyroidism. However, the test can never be used alone to confirm a diagnosis of hypothyroidism, because a positive antithyroglobulin antibody titer may occur in euthyroid dogs with early stages of lymphocytic thyroiditis.

Identification of these autoantibodies supports the diagnosis if the dog has clinical signs and other laboratory data consistent with the disorder. Although extremely rare in dogs, circulating thyroid hormone autoantibodies (antiT3 or antiT4 antibodies) are occasionally detected and also are believed to reflect a state of autoimmune thyroiditis. These antibodies, which can be formed against either T3 or T4 (or both), produce a spurious increase in the apparent T3 or T4 concentrations, into the hyperthyroid range in most dogs. Of all the thyroid hormones, only measurement of free T4 (by dialysis) is not affected by autoantibodies directed at T4 or T3, because the serum autoantibodies are removed in the dialysis step. Therefore, if hypothyroidism is suspected in a dog with circulating thyroid hormone autoantibodies, serum free T4 concentration should be determined to help confirm the diagnosis.

Non-thyroidal factors that affect interpretation of thyroid function tests

- Certain breeds have normal thyroid hormone ranges that differ from most other breeds. Few have been evaluated, but Greyhounds have serum total T4 and free T4

concentrations that are considerably lower than those of most other breeds. Alaskan sled dogs have serum total T4, T3, and free T4 concentrations that are below the reference range of most pet dogs, particularly during periods of intense training or racing.

- Illness not involving the thyroid gland can alter thyroid function tests and has been labeled "non-thyroidal illness" or "euthyroid sick syndrome." Any illness can alter thyroid function tests, causing a fairly consistent decrease in total T4 and T3 concentrations in proportion to the severity of illness. Serum TSH concentration is increased in 8%– 10% of dogs with non-thyroidal illness. Serum free T4 measured by equilibrium dialysis is less likely to be affected but can be increased or decreased. Testing of thyroid function should be postponed until the nonthyroidal illness is resolved. If this is not possible, measurement of T4, TSH, and free T4 are indicated.
- Glucocorticoids, phenobarbital, sulfonamides, clomipramine, and aspirin are known to commonly alter thyroid function tests. Glucocorticoids suppress total T4 and sometimes free T4 concentrations. Phenobarbital causes decreased total T4 and mildly increased TSH. Sulfonamides can induce overt primary hypothyroidism with clinical signs and thyroid function tests that support the diagnosis. All changes are reversible when the medication is discontinued.

TREATMENT

Thyroxine (T4) is the thyroid hormone replacement compound of choice in dogs and cats. With few exceptions, replacement therapy is necessary for the remainder of the animal's life; careful initial diagnosis and tailoring of treatment is essential. The reported replacement dosages for T4 in dogs and cats range from a total dosage of 0.01–0.02 mg/lb (0.02–0.04 mg/kg), daily, given once or divided bid without food (on an empty stomach). The most important indicator of the success of therapy is clinical improvement. Reversal of changes in coat and body weight should be assessed only after 1–2 months of therapy. When clinical improvement is marginal or signs of thyrotoxicosis are seen, the clinical observations can be supported by therapeutic monitoring of serum thyroid hormone concentrations ("postpill testing"). With once daily administration of T4, the peak serum concentration of T4 generally should be slightly high to high normal 4–6 hr after dosing and should be low normal to normal 24 hr after dosing. Animals on bid administration probably can be checked at any time, but peak concentrations can be expected at the middle of the dosing interval (4–6 hr). After the dosage is stabilized, serum T4 (with or without T3) concentrations should be checked 1–2 times per year. If clinical signs of hypothyroidism remain despite the use of reasonable doses of thyroid hormone, the following must be considered:

1) The dosage or frequency of administration is improper
2) The owner is not complying with instructions or is not successfully administering the medication
3) The animal is not absorbing the medication well, or is metabolizing and/or excreting it too rapidly
4) The medication is outdated

5) The diagnosis is incorrect.

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Ornamental edible flowers and plants

*Raghupathi B.[1], Manavi G. H.[2], Manasa G. H.[3] and Sony B. D.[4]

[1]Ph.D. Scholar, Dept. of Floriculture and Landscape Architecture, (F/Horticulture), B.C.K.V Mohanpur, WB-741 252
[2]M.Sc. Dept. of Floriculture and Landscape Architecture, COH- Bangalore, UHS- Bagalkot, KA
[3]M.Sc. Dept. of Nematology, Dr Yashwant Singh Parmar University of Horticulture and Forestry, Nauni, Solan, HP-173 230
[4]M.Sc. (Agri.) Horticulture, Dept. of Floriculture and Landscaping, Sam Higginbottom Institute of Agriculture Technology and Sciences, UP-211 007
*Corresponding Author: raghuabrhortico@gmail.com

The culinary use of flowers dates back 1000's of years with the first recorded mention being in 140 B.C. The Romans used mallow, rose and violets. Italian and Hispanic cultures gave us stuffed squash blossoms and Indians used rose petals in many recipes. Chartreuse, a classic green liqueur developed in France in the 17 century by making use of carnation petals. Dandelions were one of the bitter herbs referred to in the Old Testament of the Bible. The popularity of the edible flowers has increased since the late 1980's as evidenced by upscale restaurants where edible flowers garnish meals. In the India, tribal people are having the more knowledge of these edible flowers which are grown widely in the forest.

In the present context of life people are in stress condition because of heavy work. When we give the plain food or drink, people or children's will not prefer to eat. If we give the colourful foods person who is in stress and children's will prefer to eat. One of the possible ways to improve the appearance and attraction of the any dish is by the use of edible flowers. Edible flowers are the new range in haute cuisine. The look is elegant, yet preparing flowers for eating is sample and fun to do. The fact is they are nutritious and many have powerful healing properties.

Edible flowers are rich in nectar and pollen, and some are high in vitamins and minerals. Flowers are also nearly Calorie-free. Example: Roses-especially rose hips are rich source of vitamin C (426mg/100g), marigolds and nasturtiums contain vitamin C, and dandelion blossoms contain vitamins A (5588 IU / 55g) and C vitamin C (35 mg/100g).

DEFINITION OF EDIBLE FLOWERS

Edible flowers are flowers that can be eaten. These are organically produced, non-toxic flowers containing certain specific properties through which they enrich our meals and also simultaneously cure us of our diseases. These flowers are fairly inexpensive, devoid of side effects, act in tune with our body's natural response system and are used in treating ailments across the world. It may be preserved for future use using techniques such as drying, freezing or steeping in oil. They can be used in drinks, jellies, salads, soups, syrups and many dishes. Flower-flavoured oils and vinegars are made by steeping edible flower petals in these liquids. Candied flowers are crystallized using egg white and sugar (as a preservative).

SELECTION AND USAGE

With the wide spread use of pesticides by commercial growers, it is important to select edible flowers from a supplier who grows them specifically for consumption. Do not eat flowers obtained from a florist. Your best bet is to grow them yourself, so you know they are completely pesticide free. If you are choosing home grown flowers to eat be certain that you know all flowers are not edible. Some can cause serious stomach problems and some are quite poisonous.

Pick the home grown flowers in the morning or afternoon when the watch content is high. Select the flowers that are freshly opened and free of any bug-eaten or diseased spots. Normally the petals are the only portion to be eaten with the notable expectation of safflower and crocus (Saffaron) whose stigma are prized as an herb. Wash the flowers thoroughly by bathing them gently in a bath of salt water.

Put them up by dropping into a bowl of ice water for 30-60 seconds and drain on paper towels. Then carefully remove petals or other parts where it consumed. You may wish to trim off the whitish part of the petal where it connects to the stem as it can often be better.

- Decide what purpose you want edible flowers: Candied flowers (candied violets), sugared (roses) Adding to pickles, jams, vinegars, syrups, sugar, etc. Cooking baked products (such as cookies or cakes) Desserts, such as ice cream, cheesecake, custards etc. Decorative purposes - garnishes for plates, cakes and more
- Familiarize yourself with some common culinary flowers. E.g.: Nasturtiums: stuffed, crystallized flower, garnish etc. Rose: garnishing on ice cream, dessert, jellies, jams, flavoured butters, rosewater etc. Hibiscus: syrup and alcoholic beverages. Carnation: salads and garnishing
- Use flowers according to recipe and garnishing needs
- Find out more about edible flowers
- Use flowers free from pest and disease

Top 10 edible flowers and ornamental plants: Borage, Daylily, Chrysanthemum, Lavender, Nasturtium, Pansies, Dianthus, Scented Geranium, Squash, Campanula, Rose, Canna, Tigridia, Oxalis, Violas, Allium, Lillium, Camassia

Table: 1 List of wild edible plants

Botanical name	Habit	Edible part
Baccaurea sapid	Tree	Fruit
Citrus medica	Shrub	Fruit
Cycas pectinata	Tree	Fruit
Diospyros kaki	Tree	Fruit
Elaeagnus latifolia	Shrub	Fruit
Ficus auriculata	Tree	Fruit
Ficus hirta	Tree	Fruit
Garcinia cowa	Tree	Fruit
Garcinia tinctoria	Tree	Fruit
Pyrus pashiya	Tree	Fruit
Rubus ellipticus	Shrub	Fruit
Begonia palmata	Herb	Leaves
Begonia roxburghii	Herb	Leaves
Caryota urence	Tree	Fruits
Cayratia japonica	Climber	Fruits
Centella asiatica	Herb	Leaves
Rhododendron arboreum	Tree	Leaves
Bauhinia purpurea	Tree	Flowers
B. variegata	Tree	Leaves,buds
Buddleja asiatica	Shrub	Flowers
Corchorus capsularis	Herb	Leaves
Hovenia dulcis	Tree	Peduncles

MEDICINAL USES OF EDIBLE FLOWERS

In the historic times it is thought that the flowers were eaten because of their medicinal and healing properties. There are many edible flowers which are medicinally recognized or in combination with other plant sources to combat many human diseases and disorders.

Table: 2 List of edible flowers with medicinal uses

Flower	Medicinal uses
Ixora chinensis	Antimicrobial, anti-oxidant, anti-mitotic and anti-inflammator
Leucaena leucocephala	Anti-diabetes
Nelumbo nucifera	Anti-obesity, anti-oxidant, anti-diabetic, anti-inflammatory and antifungal
Plumeria obtusa L.	Antifouling, anticancer and algicidal
Tagetes erecta	Skin complaints, wounds and burns, conjunctivitis and poor eyesight, antiviral and antitumor

Malvaviscus arboreus	Antifungal
Antigonon leptopus	Anti-inflammatory and anti-diabetic
Bougainvillea hybrida	Antidiabetic, anti-inflammatory, antimicrobial
Cassia siamea	Treatment of fever, skin disease, constipation, diabetes
Clitorea ternatea	Sore throat and fever, hectic fever, severe bronchitis, asthma, remedy for snakebite and scorpion sting
Cosmos sulphureus	Jaundice, anti-inflammatory, antioxidant and antimicrobial

Edible flowers for natural colour extraction: Edible flowers are the rich source of natural colours. For the different type of colour we can use the different type of flowers. Natural flower colours have various advantages like

- Used to colour food and drinks.
- Used in poultry and fishery feeds.
- Used in the textiles to colour the fabrics.
- Used in the preparation of cosmetics.
- Used in the preparation inks and paints.
- Used in pharmaceuticals for the preparation of medicines.
- Eg: Marigold, Calendula, Bachelor's button, Golden rod, Hibiscus, Chrysanthemum, Corn flower, Pansy, Sage, Saffron, etc.

. **Table: 3 List of edible flowers for natural colour extraction**

Pigments	Flowers	Colour
Anthocynidins	Hibiscus, Rose hips.	Red to pink
Betalaines	Portulaca spp.	Red to pink
Carotenes/Carthemine	Safflower	Yellow-orange
Crocetin	*Crocus sativus*	Yellow-orange
Lutein / Xanthophyll	Tagetes, Solidago, Antirrhinum	Yellow-orange
Azulene	Chamomile	Blue

Points to remember about edible flowers:

1) Eat flowers only when you are confirming about that they are edible. Consult a good reference book before consumption.
2) Anything which is on the plate is not edible, we should ask prior to consumption.
3) If pesticides are necessary, use only those products labelled for use on edible crops.
4) Do not eat the flowers from florists, nurseries or garden centres. In many cases these flowers have been treated pesticides not labelled for food crops.
5) Do not eat flowers picked from the roadside.
6) Remove pistils, stamens from flower before eating.
7) Different flavour occurs in plants when grown in different locations because of soil types, fertilization and culture. Environmental conditions play a very big role.

8) Introduce flowers into your diet in small quantities one species at a time. Too much of good things may cause problems for your digestive system.
9) If you have allergies, introduce flowers gradually.
10) Enjoy the different flavour and colours that edible flowers add to many foods. Flowers of vegetables and herbs are safe to eat.
11) Important edible flowers include chrysanthemum, day lilies, rose, jasmine, etc
12) If the flowers are limp, they can be revitalized by floating them on icy water for a few minutes.
13) Flowers can be stored in the proper refrigerator for up to 10 days.

Risks of edible flower

- Some flowers are toxic; others may be edible only after appropriate preparations.
- Toxic flowers and plants may be misidentified as edible when gathered.
- Allergic reactions are possible, especially from eating pollen.
- Flowers and plants from a commercial grower may be sprayed with toxic pesticides.
- Insect damaged and dirty flowers and plants may be unsafe to eat.
- Large consumption cause digestive complications.

Poisonous flowers and ornamental plants

Eating any flowers is not recommended unless you are certain about its entity and even edible flowers can cause indigestion if eaten in large amounts. Do not assume that the flowers you see in food magazines are edible. Larger consumption of toxic flower leads to the death. Example: Rhododendron, Oleander, Lilies, Azalea, Lathyrus odoratus, Daffodil, Castor, Doll's eyes, Rosary Pea, Wolfsbane, English Yew

Marketing of edible flowers

As with any crop, it is extremely important to decide on a marketing strategy before planting. Edible flowers are produced and marketed in much the same way as herbs, although the market for edible flowers is not as large as the market for herbs. In order to recognize the unique opportunities that may provide entry into this market. The grower must keep up with food trends. Get in touch with a local chefs association or state restaurant association or magazines to anticipate the competitive environment. Since, many people will be unfair with using edible flowers; it is always a good idea to provide free samples and free recipes.
Remind your customers that edible flowers can be mixed in with summer salads for unique colour and taste. Often customers will use these flowers for special events, for example placing crystallized violets on wedding cakes. It is up to the grower to rend consumers of these special uses. As for pricing the grower must decide what the market will bear. In general, prices for edible flowers have dropped in the past coupled, due to lack of demand.

Products which are commercially available in restaurants and markets

Candies(crystallized) flower blossom, Curried daylilies, Rose water and Rose oil Pickled Peaches, Rose Glazed Brie, Rose Gulkhand, Jamaican Hibiscus, Rhubarb Rose, Lavender Rose Petal, Flower salad, Violet Jelly, Violet Syrup, Herb Flower Beer, Chicken with Lilac, Marigold Custard, Corn Marigold, Salad, Nasturtium Dip, Crystallized Flowers, Salmon Nasturtium Pizza, Sweet wine Lavender cookies, Juice and Edible flower cake.

CONCLUSION

Edible flowers are the emerging part of food industry mainly due to improvements in the organoleptic properties of different dishes and foodstuffs and also important in human diet. It is very important to know their nutritional composition as well as other functional and beneficial properties related to their phenolic compounds and antioxidant properties. Exploring these properties and health benefits of edible flowers will improve their market value in the present context.

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Mushroom: health benefits and value addition

Monika Sood* and Julie D. Bandral

Division of Food Science and Technology
Faculty of Agriculture
SK University of Agricultural Sciences and Technology of Jammu, Chatha, Jammu
**Corresponding Author: monikasoodpht@gmail.com*

The focus of Indian mushroom industry is predominantly on trade of the fresh produce rather than the real value-addition. Almost entire domestic trade is in the fresh form while most of the export is in the preserved form (canned or steeped). Current era is characterized by greater awareness about quality and, above all, with the demand for the readymade or ready-to-make food products. As mushrooms contain high moisture and are delicate in texture, these cannot be stored for more than 24 hours at the ambient conditions of the tropics. This leads to weight loss; veil opening, browning, liquefaction and microbial spoilage of the product making it unsaleable. Effective processing techniques will not only diminish the post harvest losses but also result in greater remuneration to the growers as well as processors. Value can be added to the mushrooms at various levels, right from grading to the readymade snacks or the main-course item. Improved and attractive packaging is another important but totally neglected area in mushrooms- it is still unprinted plain polypouches whereas, attractive and labelled over-wrapped trays are in vogue in the developed countries. Real value-added product in the Indian market is the mushroom soup powder. Technologies for production of some other products like mushroom based biscuits, nuggets, preserve, noodles, *papad*, candies and readymade mushroom curry in retort pouches have been developed but are yet to be popularized. Attractive packaging of the value-added products is yet another area which may be called the secondary value-addition. While small growers may add value by grading and packaging, industry may go for the processed products for better returns as well as improvement in the demand, which shall have cascading positive effect on the production (Rai and Arumuganathan 2008).

NUTRITIONAL BENEFITS

Protein - Most mushrooms have a high protein content, usually around 20-30% by dry weight. This can be useful for vegetarians or anyone looking to increase the protein content in their diet.

Fiber - Helps lower cholesterol and is important for the digestive system.

Niacin and other important B vitamins - As certain B vitamins are found in animal tissue but not plants, this can be another good supplement for vegetarians.
Vitamin D - Essential for the absorption of calcium.
Copper - Aids in helping the body absorb oxygen and create red blood cells.
Selenium - An antioxidant that helps neutralize free radicals, thus preventing cell damage and reducing the risk of cancer and other diseases. Mushrooms contain more selenium than any other form of produce.
Potassium - An extremely important mineral that regulates blood pressure and keeps cells functioning properly. Mushroom is said to have more potassium than a banana.
Other important minerals - Such as phosphorous, zinc, and magnesium.

- **Low levels of fat, calories, and sodium**
- **No cholesterol**

HEALTH BENEFITS OF MUSHROOMS

Edible mushrooms have been widely utilized as human foods for centuries and have been appreciated for texture, flavor as well as some nutritional and medicinal attributes. However, the awareness of mushrooms as a healthy food and as an important source of biological active substances with medicinal value has recently emerged. Now a day, mushroom is being relished throughout the world as food and medicine.

Lower Cholesterol

Mushrooms have no cholesterol or fat and have very low carbohydrates. The fiber and certain enzymes in them also help to lower cholesterol levels. Moreover, the high lean protein content found in them helps to burn cholesterol when they are digested.

Treat Anaemia

Mushrooms are a good source of iron, and over 90% of the nutritive iron value can be absorbed by the body, which promotes the formation of red blood cells and keeps people healthy and functioning at their full potential.

Prevent Cancer

Mushrooms are very effective in preventing breast and prostate cancer due to the significant presence of Beta-Glucans and Conjugated Linoleic Acid, which both have anti-carcinogenic effects.

Prevent Diabetes

Mushrooms are an ideal low-energy diet for diabetics. They have no fats, no cholesterol, very low levels of carbohydrates, high protein content, and a wealth of vitamins and minerals. They also contain a lot of water and fiber. Moreover, they contain natural insulin and enzymes which help the breaking down of sugar or starch in food.

Improve Bone Health

Mushrooms are a rich source of calcium, which is an essential nutrient in the formation and strengthening of bones.

Help in Nutrient Absorption

Mushrooms contain vitamin D and this essential vitamin can facilitate the absorption and metabolism of calcium and phosphorous. Calcium and phosphorus are also present in good amounts in mushroom, so the combined effects of having all of these nutrients make them a good idea to eat whenever possible.

Boost Immune System

Mushrooms contain natural antibiotics (similar to penicillin), which inhibit microbial growth and other fungal infections. Those same polysaccharides, beta-glucans, can stimulate and regulate the body's immune system. They can also help heal ulcers and ulcerous wounds and protect them from developing infections. The good combination of vitamin A, B-Complex, and C that is found in them also strengthens the immune system.

Lower Blood Pressure

Studies on various types of mushrooms, including shiitake and maitake mushrooms, have shown them to be high in potassium content. Potassium acts as a vasodilator, relaxing tension in blood vessels and therefore reducing blood pressure.

Weight management and satiety

Dietary fiber plays an important role in weight management by functioning as a "bulking agent" in the digestive system. Mushrooms contain two types of dietary fibers in their cell walls, beta-glucans and chitin. These increase satiety and reduce appetite. By making you feel fuller longer, they can reduce overall calorie intake.

VALUE ADDITION OF MUSHROOMS (Wakchaure, 2011)

Mushroom soup powder

Soups are commonly used as appetizers but also as main course by the diet-conscious. Mushroom soup powder can be prepared using quality mushroom powder produced from the button mushroom and oyster mushroom. Dried button mushroom slices or whole oyster mushrooms can be finely ground in a pulveriser and passed through 0.5 mm sieve. Mushroom soup powder is prepared by mixing this powder with milk power, corn flour and other ingredients.

Mushroom Biscuit

Delicious and crunchy mushroom biscuits were prepared by using the button/oyster mushroom powder and various ingredients viz., maida, sugar, ghee (bakery fats), mushroom powder, coconut powder, backing soda, ammonium bicarbonate and milk powder. For making biscuits entire ingredients were finely ground and cleaned with the help of fine sieve separately. The ingredients viz., ghee and sugar were well mixed for 5-7 minutes using Dough kneader to make the mixture homogenous. These

ingredients were added to dough kneader for dry mixing of 20-25 minutes. Thereafter, 500 ml water was added to kneader to make dough cohesive and homogenous and continued for next 10-15 minutes. After that dough was kept for 10 minutes under the wet cloths to make it cool. Thereafter, thin sheets of dough (1.25 cm thick) were made and cut into different shapes of biscuits using different steel dies. These raw cut biscuits were kept in the steel trays in systematic manner and then these trays were shifted to hot oven (180C) for baking purpose. After 20 minutes, baking trays were removed from the hot oven and after cooling the biscuits were ready to packaging and serve. The ingredient like sugar gives desired sweetness, ghee gives smoothness and ammonium bichromate gives the crunchiness to the biscuits.

Mushroom nuggets

The nuggets add taste as well as nutrients to the meal, since it is prepared from pulse powder. For preparation of mushroom nuggets, mushroom powder (dried and coarsely ground mushrooms) is mixed with the Urad dhal powder and a paste is prepared by adding required quantity of water. Ingredients and spices are added to the prepared paste and round balls of 2-4 cm diameters are made out of the paste. The prepared balls are spread over a steel tray and are dried by sun-drying method and thus the mushroom nuggets are prepared.

These nuggets can be relished in two ways: straightaway this can be deep-fried and used as snacks or can be used in vegetable curry preparation along with suitable vegetables or alone.

Mushroom ketch-up

Ketch-up is a common and popular product relished for its typical taste and texture as accompaniment with snacks. It is made by concentrating the juice/ pulp of the fruits/ vegetables without seeds and pieces of skin, as the skin and seed spoil the appearance of the ketch-up. It does not flow freely and is highly viscous in nature. They also contain more of sugar and less of acid. Freshly harvested button mushrooms are washed, sliced and cooked in 50% of water for 20 minutes. Mushroom paste is prepared using a mixer grinder. Arrarote (0.2%), acetic acid (1.5%) and other ingredients (as given below) are mixed in the paste and cooked to bring its TSS to 35Brix. Then the ketch-up is filled in the sterilized bottles or jars.

Mushroom candy

A fruit or vegetable impregnated and coated with sugar, subsequently taken out and dried is called a candied fruit or vegetable. The process for making candy is practically the same as that employed in the case of mushroom preserve described elsewhere, with the difference that the produce is impregnated with a higher concentration of sugar. The total sugar content of the impregnated produce is kept at about 75% to prevent fermentation.

Fresh mushrooms after harvesting are washed and halved longitudinally into two pieces. Halves are blanched for 5 min in 0.05% of KMS solution. After draining for half an hour these are treated with sugar. Sugar treatment is given at the rate of 1.5 kg sugar

per kg of blanched mushroom. Initially sugar has to be divided into three equal parts. On the first day, blanched mushrooms are covered with one part of sugar and kept for 24 h. Next day, the same mushrooms are covered with second part of sugar and are kept overnight and on the third day mushrooms are removed from the sugar syrup. The sugar syrup is boiled with 3rd part of sugar and 0.1% of citric acid to bring its concentration up to 70°Brix. Mushrooms are mixed with this syrup and again the contents are boiled for 5 min to bring its concentration upto 72°Brix. After cooling, the mushrooms are removed from the syrup and drained for half an hour. The drained mushrooms are placed on the sorting tables to separate, to reject defective and unwanted pieces. Finally mushroom pieces are subjected to drying in a cabinet dryer at 60°C for about 10 h. As soon as these become crispy, all mushrooms are taken out, packed in polypropylene bags and sealed. The mushroom candy can be stored up to 8 months with excellent acceptability and good chewable taste.

Mushroom preserve (*Murabba*)

Murabba (preserve) is made from matured fruit or vegetable, by cooking it whole or in the form of pieces in heavy sugar syrup, till it becomes tender and transparent. In *murabba* preparation, around 45 kg of fruit or vegetable is used for every 55 kg of sugar and cooking is continued till a concentration of at least 68% of soluble solid is reached. Fresh button mushrooms are graded, washed, pricked and blanched in 0.05% KMS solution for 10 min. It is treated with 40% of its weight of sugar daily for 3 days. Then, mushrooms are taken out from the syrup and 0.1% citric acid and remaining 40% of sugar is mixed in the syrup. After bringing its concentration to 65Brix, mushrooms are added in the syrup and good quality *murabba* is prepared

Pickle

Mushrooms for pickling are either blanched or fried in oil till brown depending upon taste; various condiments are also ground or fried in oil separately and added to the mushroom. The contents are mixed thoroughly and cooked slightly for few minutes. It is allowed to cool and then filled in the jars (lugs) of desired size. Vinegar may be added for taste and longer storage and the contents in the bottle or the container should be topped up with oil.

Mushroom chips

The freshly harvested button mushrooms are washed, sliced (2 mm) and blanched in 2% brine solution. The mushrooms are dipped overnight in a solution of 0.1% of citric acid + 1.5% of NaCl + 0.3% of red chilly powder. After draining off the solution, the mushrooms are subjected to drying in cabinet dryer at 60oC for 8 h. Then it is fried in the refined oil and good quality chips are prepared. Garam masala and other spices can be spread over the chips to enhance the taste. After spices mixing, the chips are packed in polypropylene packets and sealed after proper labelling.

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