Indian Farmer

ISSN 2394-1227

A Monthly Magazine

Volume: 3 | Issue-9 | September- 2016 | Pages - 68

Underutilized Fruit Crops

www.indianfarmer.net

INDIAN FARMER

A Monthly Magazine

Volume: 3, Issue-9 September -2016

Health benefits and Therapeutic uses of Lily Flower

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Major five groups for Lily Flower: Asiatic lily, Oriental Lily, Tiger lily, Trumpet lily, Turk-cap lily.

Botany

Lily is a bulbous, herbaceous plant. Leaves are fleshy, crowded, dark green and glossy, narrowly lanceolate, 0.5 to 1 meter long, 6 to 7 centimeters wide. Scape is erect, solid, somewhat compressed, about 0.5 meter tall, bearing at its apex few to many, sessile, umbellate flowers. The flowers are fragrant with the perianth-tube greenish below and whitish above, about 12 centimeters long, the lobes linear, white, and spreading, 10 centimeters long and 5 to 7 millimeters wide. The membraneous cup connecting the filaments is white, funnel-shaped, 4 to 5 centimeters diameter. The anthers are green and erect.

Useful Parts of the Plant: Leaves, flowers, bulb and even the whole herb.

The lily flower is basically a trumpet shaped flower that is known to be found in various colors such as pink, yellow, red and orange and some varieties of lilies are even known to have a deeper color on their inner petals. These are mostly found in the northern hemisphere, but spread throughout the northern sub tropics too. These are mainly garden plants and culturally very important. The plants easily adapts to various climatic conditions and are easily found in the United States.

Nutritional Information and Properties: Dried lilies are a rich source of fiber and also rich in sodium and carbs. Lily bulbs have proteins and starch and also small quantities of iron, calcium, phosphorous, and vitamins B1 B2 and Vitamin C.

Health Benefits and Therapeutic Uses

- One of the main health benefits of the lily flower is that it helps regulating the heart rate thereby allowing the heart to function more efficiently and regularly. The lily flower has many therapeutic uses as it minimizes the irritability of the myocardium without actually resulting in an increase in the oxygen that is required to function by the heart muscle.
- The health benefits of the lily for the heart are well known on account of the presence of the active cardiac glycosides as well as the flavonoids

which tend to stimulate the arteries and cause them to dilate.

- Another one of the therapeutic uses of the lily flower is in the case of treating burns and preventing the formation of scar tissue. In this herbal remedy, the roots of the lily flower are used to prepare an ointment which is then applied on the burnt area.
- The therapeutic uses of the lily flower also include it being used in case of weak contractions at the time of childbirth. The lily flower is also used for herbal remedies for medical conditions such as leprosy, conjunctivitis, strokes, and angina and so on.
- Another one of the medicinal uses of the lily flower is that the dried flowers are used as a very effective laxative or diuretic. Additionally, the roots and the flowers of the lilies are also used to treat spider bites.
- In some parts of the world , roots of the wood lily variety of the flower are consumed as medicinal teas to treat coughs, fevers, stomach disorders as well as for open sores, wounds and to wash bruises that may have swollen.
- The fresh or dried bulbs of the lily flower are also known to be very effective in treating ulcers and inflammations on account of their astringent and soothing properties. In fact the lily flower is also applied on hard tumors as it is known to soften them immediately.
- Another one of the health benefits and therapeutic uses of the lily flower include the juice of the fresh bulbs of the lily flower being used to cure dropsy naturally.
- The extract of the lily flower is also used in various cosmetics as cure for cuperosis.

Other Uses

Besides the medicinal benefits, the lily flower also has certain other uses wherein the essential oil of the lily flower is used in aromatherapy to treat individuals suffering from depression as it tends to help in creating a feeling of modesty, happiness and a sense of security as well. In fact the essential oil of the lily flower is also an important ingredient in the perfume industry.

Other uses of the lily flower also include the stems of the lily flower being used in Asian cooking as they are sweet, chewy and have a mild vegetable flavor that is similar to that of the lettuce, asparagus or zucchini. In fact the Japanese cuisine is also known to use slices of the sugary sweet and pulpy bulb of the lily flower in many of their dishes.

Chemical Property in Lily Flowers and Bulb

- **Methylflavan / Antioxidant:** Study isolated 7, 4'-dihydroxy-8-methylflavan from the extract of P littorale stem and assessed for its radical scavenging properties.
- **Cytotoxicity:** A 1993 study isolated pancratistatin (PST) from H littoralis which displayed potent cytotoxicity against a human tumor cell line. A recent study showed selectivity of PST to cancer cells and sparing of normal cells. This study investigated the anti-cancer efficacy and specificity of two PST-

related natural compounds, AMD4 and AMD5. Results showed AMD5 had efficacy and selectivity similar to PST and AMD4 lacked apoptotic activity. The phenanthridone skeleton in natural Amaryllidaceae alkaloids may be a common element for selectivity against cancer cells.

- **Anti-tumor:** The biologic activities of isocarbostyril alkaloids showed excellent in vitro and in vivo cytotoxicity against many tumor cell lines and high selectivity for cancer cells versus normal cells.
- **Lycorine Alkaloids / Littoraline / HI Reverse Transcriptase Inhibition / Cytotoxicity:** Study isolated a new alkaloid, littoraline, with 13 other known lycorine alkaloids and one lignan. Littoraline showed inhibitory activity of HIV reverse transcriptase and lycorine and haemanthamine showed potent in vitro cytotoxicity.
- **Pancratistatin / Anticancer:** (1) The species serves as an effective source of pancratistatin, a powerful anticancer agent. Pancratistatin is primarily produced in the bulbs, to a lesser extent, in the roots. The report describes a method for large-scale production. (2) Narciclasine was employed as precursor for synthetic conversion to natural (+) pancratistatin.
- **Alkaloids:** Phytochemical screening of bulbs and flowers yielded four alkaloids: lycorine, hippeastrine, 11-hydroxyvittatine, and (+)-8-O-demethylmaritidine, plus two flavonoids, quercetin 3-O-glucoside and rutin. Study investigated the antimicrobial activity of a petroleum ether extract of the flowers.
- **Narcistatin / Antineoplastic:** Human cancer cell line inhibitory isocarbostyril precursors were isolated from the bulbs of Hymenocallis littoralis from the horticultural production or reduction of narciclasine 1a-4 from the same source.
- **Anti-Candida Activity:** Study evaluated the inhibitory activity of a methanol extract of various plant parts against Candia albicans. The flower and anther were effect at 6.25 mg/ml.
- **Antimicrobial:** Study evaluated an aqueous extract against three organisms: E. coli, S. aureus, and Candida albicans. Varied concentrations showed inhibitory activity against all the tested organisms.
- **Antibacterial:** Ethyl acetate and methanol extracts of leaves, flowers, and stem barks showed antibacterial activity against B. subtilis.

Role of Underutilized Fruit Crops in Nutritional Security and Livelihood Sustenance

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India has a rich biodiversity of fruit crops. Some fruits are cultivated widely and grown commercially while others are cultivated on a smaller scale in few areas. The crops which have limited market and are less known are termed asunderutilized horticultural crops (UUHC). The popularity of these horticultural crops varies with crop species, locality and season of availability. These underutilized fruits areusually cheap and available in abundance in different seasons in the country.Most of them are rich sources of vitamins, minerals, antioxidants and other nutrients such as carbohydrate, protein and fat. Underutilized fruits are known as "fruit crops of future" due to its nutritive value and medicinal properties. The reasons for poor popularity of underutilised fruit crops are: (i)Cultivation in restricted specified areas, (ii) Limited knowledge about its food value, (iii)Non-availability of quality planting materials, (iv)Prolong gestation period and technological gap in enhancing fruit production, (v)Poor marketing network and (vi)Inadequate processing and value addition.

Now days, nutritional security is of prime importance due to lack of balanced diet. India has achieved self-sufficiency in food grain production, but the nutritional security is yet to be achieved. Fruit crops can play an important role in achieving nutritional security. Fruits that are grown commercially are accessible to many but due to higher price, they are still unaffordable by the poor and rural mass, which depend upon the underutilized crops available in their locality. These underutilized fruits that are available abundantly in rural areas are not utilized to their full potential. They are very nutritious and can ensure the nutritional security of the vulnerable communities.Underutilized fruits like aonla, star gooseberry, bael, jamun, karonda, phalsa, tamarind, wood apple, custard apple, kendu, etc. play an important role in overcoming the problem of malnutrition apart from being the source of income. Therefore, there is a scope for popularization of such underutilized fruit crops through developing suitable processing and marketing strategies.

With the increase in health concern, there is a scopefor commercial utilization of underutilized fruitsin many pharmaceutical industries as they are blessed with medicinal and therapeutic values. Therefore there are many

untapped potential in these underutilized fruits for enhancing nutritional security and livelihood sustenance of rural mass through large scale production, value addition, processing along with mining its possibilities for medicinal, pharmaceutical and nutraceutical values.

Properties of underutilized fruits:

1. **Custard apple (*Annonasquamosa*):**

It is an important minor fruit crop of eastern tropical region of India. It is cultivated sporadically under different agro-climatic conditions. In recent years

its market potential has increased considering its food value and utilization in processed products like ice cream. It is a rich source of minerals particularly calcium, potassium, magnesium, iron and copper. It is also rich in vitaminA and C. It has high calorific value and isdelicious in nature.Custard apple may be used as substitute of milk by making the fruit into beverages. It also has medicinal properties and is used in curing diarrhoea and dysentery. The bark of the tree is used inpreparation of herbal medicine because of presence of astringents and tannins.

2. **Jackfruit (*Artocarpus heterophyllus*)**

It is an important minor fruit crop used in both tender and ripe form. It is cultivated in the backyard homestead garden and in small pockets. It also forms an integral part of agroforestry system. The tender

fruits are used as vegetable and have good market potential. It is a rich source of vitamin A, C, riboflavin, niacin, thiamine, and foliate. It also contains important minerals like magnesium, calcium, iron, potassium, phosphorous, copper, zinc, manganese and selenium. Jackfruit is low in sodium, cholesterol, and saturated fats. It is a rich source of dietary fiber and provides almost 11% of the daily fiber requirement. The nutrients found in it have powerful anti-cancer, anti-ageing, anti-ulcerative, and anti-hypersensitivity properties that are valuable in treatment of several diseases.Even the Chinese medicines use jackfruit as a treatment for fighting the effects of alcohol in the body.Consumption of jackfruit leaves helps in improving glucose tolerance in diabetes patients.It has powerful laxative properties. The root extracts of jackfruit are effective in controlling asthma.

3. **Jamun (*Syzygiumcumini*):**

The eastern region of India is blessed with rich biodiversity of Jamun. It is popularly called as black plum and has many vital nutrients. It contains minerals particularly calcium, iron, magnesium, phosphorous and sodium. It also contains vitamin C, thiamine, riboflavin, niacin,

carotene, folic acid, fiber and protein. Jamun fruits and leaves are good for diabetes patient. In a recent study in Central Drug Research Institute, Lucknow, India, it has been found that the dried alcoholic extract of the seeds are good to reduce the level of blood sugar. The decoction of the bark and powdered seed is good in the treatment of diabetes. The fruit and seeds have hypoglycemic effects. It reduces the sugar level in urine (glycouria). Jamun seeds powder contains jamboline, a type of glucose, which helps to control the conversion of starch into sugar. The fruit is also good for digestive system because of its coolant features. The astringent properties in it, helps to prevent acne, blemishes, wrinkles and pimples.

4. **Bael (*Aeglemarmelos*)**:

It is one of the minor fruits of the eastern

region of India. It is popularly referred to as wood apple. It contains minerals, particularly calcium, phosphorous and iron. It also contains vitamin A and C, organic compounds, including tannins, fiber and protein. It is good for digestion. It helps to destroy worms in the intestine. The trunk and branches of bael trees contain a gum-like substance called 'Feronia gum', which is commonly used forcuring diarrhoea, dysentery and counteracts diabetes.The fruits are excellent energy booster. The leaves contain tannin, which is known to reduce inflammation. The fruit has powerful laxative properties. The roots of the tree are integral in management and treatment of ear conditions and pain. It also improves kidney conditions and liver health. In Ayurvedic treatments, all parts of the wood apple plant are used to cure snakebites. In Thai-Myanmar border area, mixture of bael fruit pulp and repellents are applied on the skin of pregnant women for protecting them against malaria.

5. **Aonla (*Phyllanthusemblica*)**

Aonla commonly referred to as Indian Gooseberry is a rich source of vitamin-C (500-700 mg/100g). It is highly

nutritious and regarded as fruit for medicinal value in ayurvedics. Tannin containing gallic acid, ellagic acid and glucose in its molecule which is naturally present in the fruit, prevents or retards the oxidation of vitamin-C. The fresh fruit is light, laxative and diuretic. They are useful in the disorders associated with the digestive system and are also prescribed in the treatment of jaundice and coughs. It is one of the three ingredients of the famous ayurvedic preparation, triphala. The plant is considered to be an effective antiseptic

for cleaning wounds and is also one of the many plant palliatives for snakebite and scorpion-stinging. The curative properties of aonla make it a miracle fruit against respiratory disorders, diabetes, heart disease, diarrhoea, dysentery, eye disorder and rheumatism.

6. **Ber (*Zizyphusmarutiana*)**

Ber commonly referred to as Indian plum is a well-known economical and medicinal tree. The fruit contains Vitamin B, C, carotene, protein, sugar, minerals, mainly calcium, iron and phosphorus. It improves muscular strength and act as an immune stimulant to increase physical stamina. It has antipyretic, diuretic, expectorant and sedative properties. The pulp of dried fruit is recommended in Ayurveda for treating burning sensation, blood impurities, excessive thirst and anorexia. It is also used to cure rheumatism, vomiting and eye diseases.

7. **Tamarind (*Tamarindusindicus*):**

Tamarind is one of the minor fruits of Indiawhich contains several health benefiting essential volatile chemical compounds such as limonene, geraniol, safrole, cinnamic acid, methyl salicylate, pyrazine and alkyl-thiazoles. Together, these compounds account for the medicinal properties of tamarind. In addition, it is also rich in many vital vitamins, including vitamin A, C, thiamine, folic acid, riboflavin and niacin. It is also a good source of minerals like copper, potassium, calcium, iron, selenium, zinc and magnesium. Its sticky pulp is a rich source of non-starch polysaccharides (NSP) or dietary-fiber such as gums, hemicelluloses, mucilage, pectin and tannins, which contribute towards its laxative properties. The fruit is rich in tartaric acid.

8. **Karonda (*Carissa carandas*)**

It is a hardy, evergreen, spiny and indigenous shrub widely grown in India. The fruits are rich source of iron. It has a

lengthy history in Indian folk medicine. Tribes in the Western Ghats use the fruit as a blood sugar stabilizer and as a guard against liver damage.Karonda's extracts show potent antimicrobial activity. The root bark has potent antihelmitic properties comparable to the drug, albendazole and the root extract has potent wound healing abilities.

9. **Star gooseberry (*Phyllanthusacidus*)**

Though star gooseberries do not receive as much attention as aonla but these

fruits may still be considered as super fruits for their incredible health benefits. The antioxidants in star gooseberry fruit

have a hepatoprotective effect on the liver. The plant extracts provide treatment against cystic fibrosis of the lungs. The leaf extracts exhibit strong anti-microbial, anti-inflammatory, analgesic and antioxidant properties, also reduces blood pressure, thereby suggesting potent hypotensive properties.

10. **Kendu (*Diospyrosmelanoxylon*)**

Kendu is commonly referred to as Coromandel ebony or East Indian ebony and is native to India and Sri Lanka. The seeds have intoxicating properties and have been prescribed in India as a cure for mental disorders, nervous breakdowns and palpitations of the heart. The fruits have a cooling and an astringent effect. The dried flowers are reportedly useful in urinary, skin and blood diseases. The bark is astringent and used in the treatment of diarrhoea. Recent researches reported the presence of antiplasmodial properties in *Diospyros.*

SCOPE OF UNDERUTILIZED FRUITS

Majority of these less known fruit trees establish through natural regeneration of seeds, start bearing fruits after a long gestation period and produce fruits of inferior quality, without any nutrition. Hence these species have remained neglected without any commercialimportance. Most of these species can grow under varied agro-climatic conditions and have excellent potential for establishment on marginal and wastelands throughout the tropics. Few research works have been conducted on some of these crops. However, there is further need to develop improved cultivars, develop suitable farmer friendly technologies and set up field demonstrations to provide first hand exposure to the farmers for popularising these species in the field.

These fruit crops have unique features that can make them easily adaptable to our changing environment, for example aonla and ber are tolerant to a wide range of soils and water with high salt concentrations. Early maturity and high profitability are some of the salient features of ber tree. Ber fruits generally come to the market during October – December, when other major fruits are not available. Low cost of production, better quality and high nutritional value are other points in favour of this crop. Custard apple, jackfruit and tamarind are very hardy and require limited care and are tolerant to a wide range of soils and moisture stress. In tamarind apart from the fruits, the wood is considered as a premium quality timber. In spite of heavy bearing and higher income, tamarind has not been considered as a commercial crop because of long gestation period and non-availability of superior quality planting material. It is only during recent years that a few natural selections have been made from the wide range of germplasm available and vegetative propagation techniques standardized. However, field demonstrations and practical training for farmers are necessary to popularise the cultivation of this species.

Post-harvest loss of fruits is a major concern in many developing countries. Since, fruit crops are highly perishable, proper storage techniques, enhancement of shelf life, processing and value addition are some of the ways to popularise the underutilized fruits in distant and international markets. It is

necessary to employ modern methods to extend storage life for better distribution and also processing techniques to preserve them for utilization in the offseason in both large and small scale. These underutilized fruits can be processed into a number of products, for instance aonla can be processed into aonla candy, murrabah and juice etc. Jamun can be processed into squash, jams, jelly, candies and vinegar. Sapota pulp, Jam and powder are some of the processed products of Sapota. Similarly custard apple can be processed into frozen custard apple pulp, bael into several fruit beverages and jackfruit into a number of ready to eat and ready to cook products. Processing and value addition of these crops can be a useful enterprise for the tribal and rural people for their livelihood enhancement.

The underutilized fruit crops are underexploited crops that have a scope for commercially utilization in several aspects. They can be promoted for large scale cultivation by creating suitable market. Market demand for such fruits will increase only after the consumers are aware of their nutritive and medicinal properties, even the rural massthat are no longer practicing their cultivation need to be motivated to take its cultivation on a commercial scale. For this purpose Government interventions are required to preserve as well as expand the rich biodiversity of these underutilized crops that are gradually becoming rare. Many of these fruits are not well known globally. Hence, there is a scope to create a global demand for these fruits by popularising its cultivation and consumption at national level. This can be a useful avenue to earn huge foreign exchange for our country. Besides, these fruits are rich source of several medicinal and therapeutic ingredients and can be exploited on a commercial basis in the pharmaceutical and agrochemical industries. Processing and value addition of these underutilized fruits is another sector that can ensure livelihood security among the tribal and rural masses that depend on these crops.

CONCLUSION

Underutilized fruits are reserve of several nutritious and medicinal components, which are yet to be exploited.There is a need to utilize these crops for diversification of agricultural systems. This may be possible by involving communities and research scientists in conservation and crop improvement of underutilized crops. There is also a needto create awareness about nutritive value of underutilized fruit species.These crops will help in maintaining biodiversity, traditional subsistence farming systems, sustaining the environment and thus will serve as risk buffers in times of climate change.

Table 1: List of Underutilized fruit crops with important features:

Sl. No.	Fruit crop	Nutritive value	Medicinal properties
1.	Aonla	Vit. C (500–700 mg/100g) anti-oxidative property	Constituent of Triphala Laxative properties
2.	Star Gooseberry	Vit. C (150-200 mg/100g), anti-oxidative property	Protects liver
3.	Bael	Rich in Vit B, and minerals	Laxative and diuretic effect due to presence of marmelosin (0.2-0.4 per cent)
4.	Custard apple	Rich in potassium, calcium	Good for hair, eyes and skin.
5.	Jackfruit	Vitamin A 110 IU Potassium	Laxative effect (Dietary fibre content1.5 g)
6.	Karonda	Rich in iron	Antimicrobial properties
7.	Jamun	Rich source of magnesium anti-oxidative property	Reduces blood sugar level
8.	Ber	Rich source of Potassium, calcium, phosphorus	Antipyretic, diuretic and expectorant properties
9.	Tamarind	Rich in potassium, phosphorus, magnesium, calcium	Carminative and laxative Contains health benefiting essential Phytochemicals

Metatranscriptomic:

Towards a system level understanding of microbiome

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Abstract :

Metatranscriptomics is the study of rRNA and mRNA of a (microbial) community in an environment. It allows the simultaneous investigation of the gene expression (mRNA) and abundance (rRNA) of the active microorganisms. Recent advances in meta-omics and particularly metatranscriptomic approaches have enabled detailed studies of the structure and function of microbial communities in many ecosystems. Microbes often occur in complex communities in the environment. These communities are found in microenvironments within the human body, in biofilms on the surface of objects, in soil and water samples, and in extreme environments such as deep mines, glaciers, and the various layers within the ocean. Traditional microbial genetics and microbiology study organisms individually and rely on the culture of these organisms in the lab, but it has been shown that more than 99% of the microbial diversity is unculturable. Metagenomics is the field of biology that endeavors to study microbial communities directly obtained from the environment. In contrast, metatranscriptomics enables researchers to investigate the actively transcribed messenger RNA from a community. It has been applied to environments as diverse as soil and sea water. The primary goals of these approaches are to characterize the organisms present in a sample and identify the activites that are occurring.

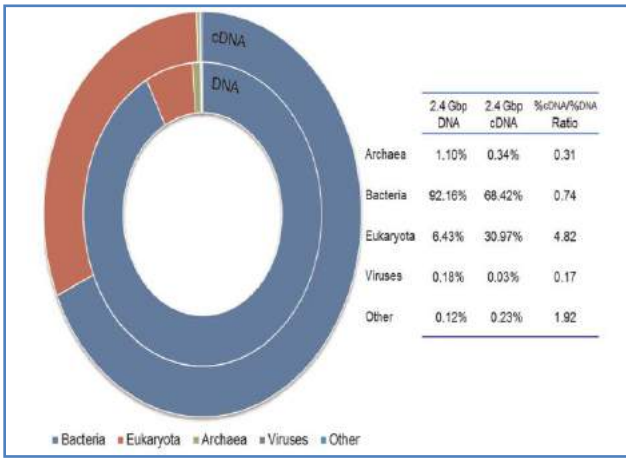
INTRODUCTION

At any moment, an estimated 10^{30} bacterial and archaeal genes are mediating essential ecological processes throughout the world. The new field of metatranscriptomics, using an approach that sequences microbial genes expressed within intact natural communities, allows us to understand microbial gene expression patterns. It is now feasible to deeply sequence the assortment of microbial community transcripts from a particular time and place, whether from bacteria, archaea, or small eukaryotes in the ocean, the soil, or the human gut. Putting aside the challenge of correctly assigning functions to the mRNAs being sequenced, the scientific promise of identifying all the processes

simultaneously mediated by an undisturbed microbial assemblage is apparent. Essentially, we can eavesdrop on microbial ecology.

Beyond Metagenomics :

Metagenomic approaches to inventory microbial genes in the ocean and soils have fueled a revolution in efforts to understand the genetic potential of uncultured bacteria and archaea. Metagenomics allows us to sequence genomes from a complex assemblage of microbes as a single unit in a culture independent manner.



	2.4 Gbp DNA	2.4 Gbp cDNA	%cDNA/%DNA Ratio
Archaea	1.10%	0.34%	0.31
Bacteria	92.16%	68.42%	0.74
Eukaryota	6.43%	30.97%	4.82
Viruses	0.18%	0.03%	0.17
Other	0.12%	0.23%	1.92

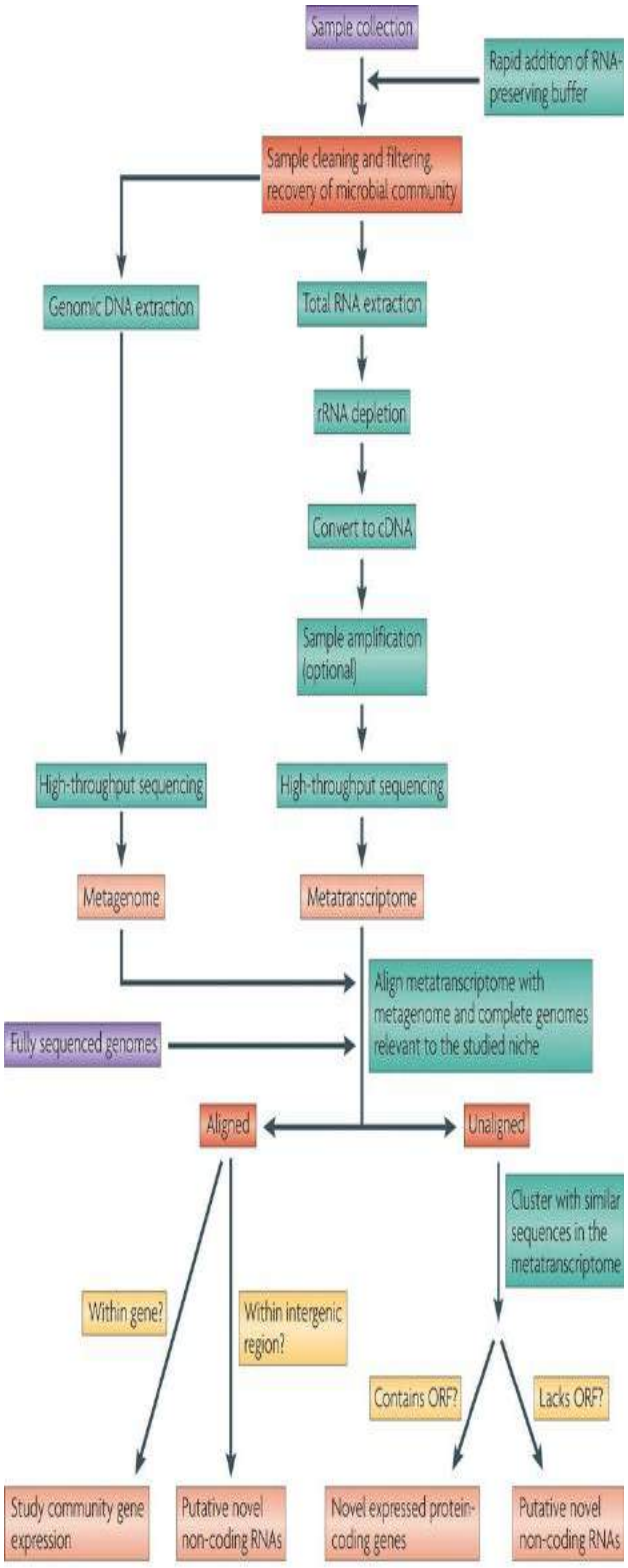
Figure 1. Combined taxonomic domain information of DNA and cDNA datasets. Total DNA sequences and cDNA sequences were assigned to Bacteria, Eukaryota, Archaea, viruses, and other sequences.

Deeper sequencing and better annotation im- proves the quality of knowledge that comes from such analyses. While it provides information on the possible activities of a microbial community, meta-genomics cannot reveal the actual activities at a specific time and place, or how those activities change in response to environmental forces or biotic interactions. The challenge is to narrow down the suite of possible actions the metage nome to those that are ongoing at a particular time the metatranscriptome and ultimately to identify what is responsible for the difference. Interest in describing in situ gene expression patterns for natural microbial communities is not new. Most of what we know comes from reverse transcription PCR (RT- PCR), in which mRNAs extracted from microbial communities are converted to cDNAs and amplified to allow detection with primers targeting conserved regions of genes of interest. This can also be done quantitatively (RT-qPCR)if there is value in estimating the number, not just presence or absence, of transcripts in a community. However, this approach can target only a small number of genes at a time, and the vast nucleotide sequence diversity observed for functional genes in nature makes it difficult to design primers that bind only to orthologs of a given gene. Moreover, since non-PCR-based sequence data are available for only a tiny fraction of natural microbial communities, we do not know how well PCR primers match target genes in particular microbial communities, and assessing the results is not easy. Nonetheless, much has been learned by tracking expression of well-conserved marker genes for critical micro- bial processes, such as those for carbon and nitrogen fixation. Environmental microarrays overcome the gene number constraint by measuring expression levels of hundreds to thousands of genes at a

time. However, designing microarray probes to encompass the full diversity of ortholog sequences encountered in nature is no less of a challenge than doing so for PCR primers. In addition, obtaining sufficient mRNA for replicated microarray studies with environmental samples is difficult. As a result, environmental microarrays have most often been used to survey DNA rather than mRNA, providing little information on community gene expression.

What is the Metatranscriptomics :

Metatranscriptomics is the study of rRNA and mRNA of a (microbial) community in an environment. It allows the simultaneous investigation of the gene expression (mRNA) and abundance (rRNA) of the active microorganisms. In contrast to proteins, which have a longer lifetime in the cell and more stable concentrations in response to external influences, mRNAs provide a more immediate picture of the cells responses to changing environmental conditions. Also, metatranscriptomics avoids the limitations inherent to PCR primer-based methods. The poly(A) tail of eukaryotic mRNAs enables the cDNA synthesis from these mRNA templates in total RNA pools with selective primers.The total microbial RNA is dominated by Rrna transcripts, including prokaryotic 16S and 23S rRNAs and eukaryotic 18S and 28S rRNAs. Only a small fraction, usually 1 to 5%, is mRNA. Several strategies are currently applied to enrich for prokaryotic mRNA molecules. Selective nuclease degradation of rRNA , polyadenylation of mRNA, and rRNA depletion by capture with commercial kits and sample-specific probes have been attempted to reduce the rRNA fraction of metatranscriptomes.



CONCLUDING REMARKS

Metatranscriptomics enables us to identify activities and investigate gene regulation in complex microbial communities, both for descriptive studies of baseline gene expression and for experimental studies of manipulated systems, with no need to presuppose which genes should be targeted. For ecosystems as diverse as the ocean and the human microbiome, understanding and predicting in situ gene expression patterns is a major goal for the coming decade.

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Effect Of Climate Change On Agriculture

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Solar radiation, temperature, and precipitation are the main drivers of crop growth; therefore agriculture has always been highly dependent on climate patterns and variations. Global food security affected by climate change is one of the most important challenges in present time to supply sufficient food for the increasing population while sustaining the already stressed environment (Lal *et. al.,* 2005). Since the industrial revolution, humans have been changing the global climate by emitting high amounts of greenhouse gases into the atmosphere, resulting in higher global temperatures, affecting hydrological regimes and increasing climatic variability. Climate disruptions to agriculture have increased. Many regions will experience declines in crop and livestock production from increased stress due to weeds, diseases, insect pests, changes in atmospheric carbon dioxide and ground-level ozone concentrations; changes in the nutritional quality of some foods; and changes in sea level and other climate change induced stresses. Climate change is projected to have significant impacts on agricultural conditions, food supply, and food security. The agricultural sector continually adapts to climate change through changes in crop rotations, planting times, genetic selection, fertilizer management, pest management, water management, and shifts in areas of crop production.

1. Impacts of Climate Change on Crop

It is likely to be that field crops will be most impacted by the effects of climate change, principally through problems of water availability and the predicted hotter and drier conditions. Plant response to climate change is dictated by complex interactions among carbon dioxide (CO_2), temperature, solar radiation, and precipitation. Each crop species has a temperature range for growth, along with an optimum temperature (Hatfield *et. al.*, 2011)

- The hydrologic cycle now includes more frequent and intense droughts and floods in many agricultural regions. These events can damage and at times even destroy crops.
- Over the next 30-50 years, average temperatures will likely increase by at least 1.0 °C. Anticipated regionally-dependent changes include increase number of heat waves and warm nights, a decreasing number of frost days, and a longer growing season in temperate zones.
- Over the next 30-50 years, CO_2 concentrations will increase to about 450 parts per million by volume (ppmv). While increases in atmospheric CO_2 are projected to

stimulate growth and improve water use efficiency in some crop species, climate impacts, particularly heat waves, droughts and flooding, will likely dampen yield potential. The CO_2 response is expected to be higher on C_3 species (wheat, rice, and soybeans), which account for more than 95% of world's species than on C_4 species (corn and sorghum). C_3 weeds have responded well to elevated CO_2 levels, symbolizing the potential for increase weed pressure and reduced crop yields.

- During grain filling periods if the night temperature become high, it will increases the rate of grain filling and decreases the length of the grain filling period resulting in reduced grain yield.
- Indirect climate impacts include increased competition from weeds, expansion of pathogens and insect pest ranges and seasons, and other alterations in crop agroecosystems. The ranges of weeds and pests are likely to expand northward. This would cause new problems for farmers' crops previously unexposed to these species. Moreover, increased use of pesticides and fungicides may negatively affect human health (USGCRP, 2009).
- Climate change also reduces grain quality or nutrient content.
- Higher temperatures will cause the distribution of existing insect pests to widen, and may allow the establishment of new pests in new cropping areas, resulting in reduced production and increased pest control costs.
- The distribution of wild crop relatives, an increasingly important genetic resource for the breeding of crops, will be severely affected leading to fragmentation of the distribution and even extinction.
- Price will rise for the most important agricultural crops–rice, wheat, maize, and soybeans. This, in turn, leads to higher feed and therefore meat prices. As a result, climate change will reduce the growth in meat consumption slightly and cause a more substantial fall in cereals consumption, leading to greater food insecurity.
- The net effect of climate change on world agriculture is likely to be negative. Although some regions and crops will benefit, most will not.
- Due to climate change, "southern Africa could lose more than 30% of its main crop, maize, by 2030. In South Asia losses of many regional staples, such as rice, millet and maize could top 10%" (Lobell *et. al.*, 2008)
- In vegetables, exposure to temperatures in the range of 1.8°F to 7.2°F above optimal moderately reduces yield, and exposure to temperatures more than 9°F to 12.6°F above optimal often leads to severe if not total production losses.

❖ **Models used to predict climate change impacts on agriculture**

Scientists at IARI used a variety of crop growth models to evaluate potential climate change impacts on wheat and rice (India's primary crops), and other crops such as sorghum and maize. Specific variables used in the models included changes in temperature, CO_2 levels, precipitation, and solar radiation.

The following models were developed to evaluate the impacts of changes in temperature and carbon dioxide on crops:

INFOCROP, a generic growth model for various crops, was developed by IARI for optimal resource and agronomic management options.

INFOCANE, a simple sugarcane growth model, was developed by IARI to measure effects on cane yield.

Simple tea and coconut models were developed for tropical India and Sri Lanka.

Pest damage mechanisms were coupled with INFOCROP for simulating the effect of pests. The use of this model meant that assessments could be made of the impact of climate change and its variability on incidence of pests for various crops.

Interaction effects of climate changes (temperature rise, rainfall and radiation changes), with irrigation and nitrogen amounts, and agronomic management practices were established for various agro-ecologies. These were used to calculate the actual impact of climate change on agricultural production as well for suggesting agro- and resource management options for sustaining production in India.

2. Impacts of Climate Change on Livestock

Changes in climate could affect animals both directly and indirectly.

- Heat waves increases under climate change, which is directly threaten livestock. Over time, heat stress can affect on animal fertility, milk production and increase vulnerability. Optimum animal core body temperature is often maintained within a 4°F to 5°F range, while deviations from this range can cause animals to become stressed. This can disrupt performance, production and fertility, limiting the animals' ability to produce meat, milk, or eggs. In many species, deviations in core body temperature in excess of 4°F to 5°F cause significant reductions in productive performance, while deviations of 9°F to 12.6°F often result in death (Gaughan *et. al.*, 2009)
- Drought may affect on pasture and feed supplies**.** Drought reduces the amount of quality forage available to grazing livestock.
- Climate change may increase the prevalence of parasites and diseases that affect livestock. The earlier onset of spring and warmer winters could allow some parasites and pathogens to survive more easily. In areas with increased rainfall, moisture-reliant pathogens could thrive (CCSP, 2008)
- Increases in carbon dioxide (CO_2) may increase the productivity of pastures, but may also decrease their quality. Increases in atmospheric CO_2 can increase the productivity of plants on which livestock feed. However, studies indicate that the quality of some of the forage found in pasturelands decreases with higher CO_2. As a result, cattle would need to eat more to get the same nutritional benefits.
- It is expected that increased air temperatures will cause more stress on livestock. Both humans and livestock are warm-blooded animals, so both are affected by increased heat and humidity. During stifling heat, livestock reproduction declines as well as their appetite. Decreased

appetite will lengthen the time needed for the livestock to reach their target weight. Stress can also increase the incidence of sickness, decrease rates of reproduction, and increase fighting among animals in confinement. In some areas, night-time temperatures are even more above average than daytime temperatures during heat-waves, which has resulted in increased mortality rates. Despite the warmer winter temperatures, global warming could have a negative overall impact upon livestock.

- As indicated above, increased carbon dioxide may result in feed and forage that is less nutritious even if there is more of it. It is likely that growers would be forced to use feed additives in order to see the expected growth gains in livestock, and to avoid illnesses. This increased cost to the grower would result in increased food costs to the consumer. Availability could also decrease if there is not enough water and nutrients in stressed soils to keep up with plant growth.
- Insect parasites and diseases could also become more prolific as global warming progresses. It is expected that in cases of increased heat stress and humidity, most livestock will not be able to fight these diseases without the use of costly medicines.

3. Impacts of Climate Change on Fisheries

Many fisheries already face multiple stresses, including overfishing and water pollution. Climate change may worsen these stresses. In particular, temperature changes could lead to significant impacts (USDA, 2007).

- Many marine species have certain temperature ranges at which they can survive. For example, cod in the North Atlantic require water temperatures below 54°F. Even sea-bottom temperatures above 47°F can reduce their ability to reproduce and for young cod to survive. In this century, temperatures in the region will likely exceed both thresholds (USDA, 2007).
- Some diseases that affect aquatic life may become more prevalent in warm water. For example, in southern New England, lobster catches have declined dramatically. A temperature-sensitive bacterial shell disease likely caused the large die-off events that led to the decline.
- Changes in temperature and seasons could affect the timing of reproduction and migration. Many steps within an aquatic animal's lifecycle are controlled by temperature and the changing of the seasons. For example, in the Northwest warmer water temperatures may affect the lifecycle of salmon and increase the likelihood of disease. Combined with other climate impacts, these effects are projected to lead to large declines in salmon populations (Field *et. al.*, 2007).
- In addition to warming, the world's oceans are gradually becoming more acidic due to increases in atmospheric carbon dioxide (CO_2). Increasing acidity could harm shellfish by weakening their shells, which are created from calcium and are vulnerable to increasing acidity. Acidification may also threaten the structures of sensitive

ecosystems upon which some fish and shellfish rely.

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Water Requirement of Dairy Cattle

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Water is the most important nutrient for cattle. Providing adequate water to livestock is critical for animal health and production. A 10 % loss of body water is fatal to most species of livestock. Water accounts for more than 98 % of all molecules in the body and between 50 and 81 % of an animal's total body weight at maturity. Water is necessary for maintaining body fluids and proper ion balance; digesting, absorbing, and metabolizing nutrients; eliminating waste material and excess heat from the body and transporting nutrients to and from body tissues. Water loss from the body occurs via urine, feces, and through sweating; and by evaporation from body surfaces and the respiratory tract. Water requirement of dairy cattle fulfills by drinking and consuming feed that contains water, as well as from metabolic water produced by the oxidation of organic nutrients. Water is an especially important nutrient during periods of heat stress. Care should be taken to ensure adequate water supplies during periods of heat stress. The amount of water a cattle drinks depends on her size, water quality, availability of the water, and amount of moisture in their feed. Without water, feed intake greatly decreases, the animal becomes dehydrated and body functions fail. Cattle need less water for washing than buffaloes. Water provided to animal should be fresh, clean and always available. It ensures the welfare of animal.

Purpose of water requirement:

A. voluntary intake of drinking water

B. washing and cleaning of animals

A. voluntary intake of drinking water – this occurs for two purposes:

1. Maintenance purpose
2. Milk production purpose – 3 litre water for every litre of milk

Water should be placed near feed sources and in milking parlor return alleys, because most water is consumed in association with feeding or after milking.

Daily water requirement of animals for drinking purposes depend upon the following factors:

1. Body size - Heavier animals require more water.
2. Physiological condition - Lactating animals require more water than dry

animals or males in direct proportion to their level of production.

3. Season - During hot season animals consume more water (20-25%) than during winter season.
4. Nature of feed - Animals receiving dry feeds requires more water than those getting sacculent fodders.
5. Water quality- Low quality water tends to reduced water intake to animals. Certain salts and gases (Na, K, Ca, Mg, Cl & sulphate) makes water more palatable.

Water requirement of Cattle for drinking purposes:

Dairy cows should be provided with water *ad lib.* through out the day. If this is not possible they should be watered to fill three times during summer and twice during winter in a day. The younger animals should be provided with water more frequently. Fattening cattle water requirement is more than dry cows due to extra demand for both growth and fattening. Dairy cows and buffalo under average feeding conditions require 30-35 liters of water per day for drinking.

Effect of water temperature:

The temperature of drinking water has only a slight effect on animal behavior and performance. Under most circumstances, responses to chilling water would not warrant the additional cost. Given a choice, cows prefer to drink water with moderate temperatures (63-82°F) rather than very cold or hot water. The drinking water temperature between 7.2 – 15.5^{0}c of dairy cattle is preferable (Looper and Waldner, 2007). Water temperature averages between 10 and 20°C, depending on season, animals per waterer, and usage rate. Cattle in a thermoneutral environment drink during daylight hours with peaks of activity at sunrise and sunset but when heat stressed shift drinking frequency to afternoon, evening and some into the night.

Effect of environmental factors:

Environmental factors i.e. mean ambient (Ta), maximum (Tmax), and minimum (Tmin) temperature (°C), precipitation, relative humidity (%), wind speed (m·s−1), solar radiation (SR, W·m−2), and temperature humidity index (THI) all affects daily water intake (DWI) of cattle. Ta, Tmin, and THI are considered to be the primary factors that influence DWI in cattle, whereas SR and DMI have a smaller influence on DWI. During the summer cattle consumed 87.3% more water than during the winter season (Arias and Madar, 2011). Water consumption can increase by 78 % under extreme conditions. In normal conditions with good quality water, consumption in summer will be about 40 % higher than in winter. Generally, animals prefer water at or below body temperature and avoid warmer water. Cool water is preferred in hot conditions. With salty water the summer intake may be 50 to 80 % higher than consumption in the cooler months.

Effect of genetic group:

Tropically adapted cattle breed types (*Bos indicus*) cousume less water than British or Continental influenced cattle (*Bos taurus)*. Average water intake was found within the range of 25 to 35 L/head/day. Gender did

not influence water intake (Beatty *et al*., 2006). European breed of cattle drink more than tropical breeds. European cattle *(Bos taurus*) drink 30 % water per unit dry matter ingested at 28^0 C than zebu cattle (*Bos indicus*) and 100% more at 38^0C.This is because zebu cattle conserve water better (Broom and Fraser 2007). Restriction of water causes a larger reduction in the feed intake of zebu breeds than that of European breeds.

Effect of diet:

Cattle fed on feedstuff with a high level of protein drink much more than those on a lower protein supplement. The quantity of water consumed depends not only on dietary intake, its characteristics (dry food or not) but also on the quality and accessibility of the water. Sodium intake influences less water intake to animals (Meyer, 2004).

Two formulas to estimate water consumption of lactating dairy cows are as follows:

1. FWI = 12.3 + 2.15 x DMI + 0.73 x milk
2. FWI = 15.99 + 1.58 x DMI + 0.9 x milk + 0.05 x Na + 1.2 x minimum temperature

Where FWI is free water intake (water consumed by drinking rather than in feed), DMI – dry matter intake (kg/day), milk is in kg/day, Na is in g/day, and temperature is in °C.

Water consumed as part of the diet contributes to the total water requirements; thus, diets with higher moisture concentrations result in lower FWI.

Effect of water quality:

Water quality is an important issue in dairy cattle production and health. The five properties most often considered in assessing water quality for animal are:

- Organoleptic properties (odor and taste)
- Physiochemical properties (pH, total dissolved solids, total dissolved oxygen and hardness)
- Presence of toxic compounds (heavy metals, toxic minerals, organophosphates and hydrocarbons),
- Excess minerals or compounds (nitrates, sodium sulfates and iron) and

Microbiological properties (bacteria and algae)

Water requirement for washing and cleaning of cattle:

For washing purposes cow require much lesser amounts of water than buffaloes, as cows are not washed daily like buffaloes. Only udders and perhaps soiled hindquarters of cows need to be washed daily in preparation for milking. About 45-70 litres of water per day per animal is necessary for washing and cleaning each cow ((Singh, 2009).

Water requirement for maintenance purpose:

Water is an important element for maintaining the body against environmental stress in cattle. The physical properties of water are important for the transfer of heat from the body to the environment. The increase of DWI during the summer would be mainly attributed to the direct effect of the animal attempting to reduce the thermal load of cattle. This is mediated by evaporative cooling, which is

probably the most practical means for cooling livestock but demands that cattle consume extra water to maintain homeostasis (Beede and Collier, 1986) . During periods of cold stress, the high heat capacity of body water acts as insulation–conserving body heat.

Problems due to less water intake:

- ✓ Reduced water consumption can be a sign of unfamiliarity, sickness or other stressors and may result in dehydration. Common signs of dehydration include lethargy, tightening of the skin, weight loss, and drying of mucous membranes and eyes.
- ❖ Cattle - The eyes will appear sunken and dull.

In lactating dairy cows, dehydration results in a near cessation of milk production.

- ✓ Low water intake increases hematocrit and blood urea, reduces the respiratory rate and rumen contractions reduces body weight and provokes aggressive behaviour around waterers.
- ✓ Reduction in food intake
- ✓ Change in natural consistency and form of dung
- ✓ Change in colour of urine
- ✓ Gradual decrease in excretion and quantity of urine
- ✓ Decrease in growth

CONCLUSION

Water is an important, but often overlooked, nutrient. It is involved in every physiological process of animal's body. Proper water consumption ensures that an animal will maintain its body weight, body temperature and overall health. Limited access or reduced water consumption can result in dehydration, which can be fatal to livestock. Good water quality can fulfill water requirement of the animal for drinking. Adequate water supply for washing animals ensures its cleanliness. Therefore, both purposes of water requirement measures good production and performance of the animal.

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Table 1: Water requirement of cattle depending upon nature of diet

	Conc. Mix. + dry roughage		Conc. Mix.+ green roughage	
	/kg D.M W.I (L)	/100kg b.wt W.I (L)	/kg D.M W.I (L)	/100kg b.wt W.I (L)
Mature cattle	3.7	6.1	1.3	3.1
	Conc. Mix. + dry roughage		Conc. Mix.+ green roughage	
	/kg D.M W.I (L)	/100kg b.wt W.I (L)	/kg D.M W.I (L)	/100kg b.wt W.I (L)
Mature cattle	3.7	6.1	1.3	3.1

Catogeries	Daily Water Requirement (L)		
	Winter		Summer
Calf	11.8		28.4
Heifer	27.5		55.2
Dry cattle	45.1		55.5
Adult (lactating)	58.5		63.9
Other cattle	45		45 – 70*

Water quality	Effect on animal
If TDS <2000 mg/litre	This level will increase thirst and daily water intake
If TDS 2000-2500 mg/L	Specific salts may cause a toxic effect
If TDS 4000-5000 mg/L	Animals may initially be reluctant to drink
If TDS 5000 mg/L to 10,000 mg/L	Potential loss of production, decline in animal health and condition.
pH	5.5 – 8.5 for dairy cattle

Table 2: Effect of water quality {total dissolved solids (TDS) and pH} on cattle

Table 3: Water requirement of cattle

Crop diversification: Need of the Hour

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Abstract

Cultivable area in our country is shrinking due to various factors like soil salinity, alkalinity and acidity but on the other hand human population is increasing which will put more pressure on the land resources in terms of future food demand. Moreover, the choice of food is dependent on several factors like food prices, household income etc. In our country the prevailing cereal dominated mono cropping has several limitations. But our country is having a diverse climate which allows cultivation of diverse line of crops. So going for crop diversification which means shift from less profitable and sustainable crop or cropping system to a more profitable and sustainable cropping system can efficiently address the above problems. Crop diversification is achieved by two means, horizontal diversification (crop substitution and crop intensification) and vertical diversification (value addition to the agricultural produce). It is affected by market availability, profitability, incentives by government, ease of cultivation, available technology etc. and helps in increasing profitability, labour spreading, land utilization efficiency, poverty alleviation, food and nutritional security.

INTRODUCTION

Green revolution technologies, expansion of area under irrigation and government policy for increased food grain production and to eliminate food grain imports have made India self sufficient in case of cereals but it is dependent on imports to meet pulses and edible oils demand. However, the population of our country is increasing at a greater rate and is expected to increase further in near future which will put much pressure on our natural resources to produce sufficient food for ever increasing population, giving emphasis to nutritional security. Mono cropping is having severe limitations like yield stagnation, build up of pathogens, insects and weeds, reduction in soil fertility, thereby reducing its sustainability. Also the area under irrigation is expanding causing the problem of soil salinity, water logging and increase in water table which will also reduce the cultivable area. Soil acidity is also a major problem in some of the states. Climate change is also taking place which further limits the choice of crops for a particular area. So, there is a need to intensify our cropping system taking into account the crops suitable for a particular area based on the drivers of crop diversification.

Increased urbanization coupled with changing life style of people has led to shift in demand of food grains to non-food grains. Moreover, the pattern of food consumption is also influenced by the food prices and household income. As the country is bestowed with diverse climate hence has the ability to produce diverse type of crops. Therefore, it is the urgent need to diversify the cereal dominating cropping systems of our country to cope with changing demand.

Government of India has taken initiatives to diversify crops in original green revolution states to divert area of water intensive rice crop to others from *Kharif* 2013-14. Diversification is also necessary for rice-wheat cropping system which is facing yield stagnation and over exploitation of ground water in Punjab, Haryana and Western Uttar Pradesh. Other problems related to rice-wheat cropping system are increased incidence of weeds, diseases and insects, deterioration of soil health and pollution of ground water with nitrate. Diversification in dry lands is also necessary to bring sustenance in crop production and for risk mitigation due to scanty rainfall during the crop season.

Concept of crop diversification

Crop diversification is a shift from less profitable and sustainable crop or cropping system to a more profitable and sustainable crop or cropping system and is reflected as a shift from regional mono cropping to production of a number of crops in the region. Substituting crops may be cereals, pulses, oilseeds, fibre, fodder, fruit, vegetable or spice crop to meet the ever increasing demand of agricultural commodities of the regional interest or of the global perspective. Due to high profitability, crop diversification with fruits, vegetables and spices is seen during recent times.

Approaches for crop diversification

Crop diversification can be achieved by two means, first through horizontal diversification which include crop substitution *i.e*. replacing the crop in the cropping system and crop intensification *i.e.* addition of new crop to the existing system (intercropping and sequence cropping). Second, though vertical diversification which is done by value addition of the produce and is related to industrialization of the produce for example, making tomato sauce, fruit juices, syrup and canning of vegetable crops.

Need of crop diversification

- Enhancement of farm income
- Sustainability in crop production
- Food and nutritional security
- Employment generation
- Poverty alleviation
- Abatement of environmental pollution
- Judicious use of land and water resources

Determinants of crop diversification

In general, it is considered that higher the level of technology available in a particular area more will be the degree of diversification. It is also influenced by the economic condition of farmer. Rich farmers prefer to go for specialized crop cultivation where as the poor farmers go for subsistence type of farming focusing on family needs and choose the appropriate crop combinations which increase the level

of diversification. Other factors determining crop diversification are:

- Market availability for produce
- Higher profitability
- Incentives
- Ease of cultivation/operation
- Available technology for risk mitigation (for drought areas)
- Stability and resilience in production

Benefits of crop diversification

- Alternative crop will increase profitability.
- Labour will be spread out for a longer period of time.
- Diversified rotation will help break the pest cycle and thereby reduce their incidence.
- Higher net return form unit of labour will be achieved.
- Sufficient but optimum utilization of natural resources.
- Higher land utilization efficiency.
- Higher employment generation.
- Poverty alleviation.
- Substituting or intensifying crop can be a renewable resource for high value products.

CONCLUSION

In the era of commercial agriculture, agriculture produce has to meet the demand of domestic as well as global market. The demand is driven by consumers' preference which is diverse and depends on many factors. So, to fulfil the demand keeping an eye on the food and nutritional security is the prime concern now-a-days which can be addressed efficiently by diversifying the existing crops or cropping systems with climate smart and more remunerative crops or cropping system as per the location. As like the success of other technology, success of crop diversification is also dependent on sound government policy for identification of site specific crop diversification options and creation of institutional and physical infrastructure facilities.

Goat pneumonia: Cause and Management

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Goat is known as the "poor man's cow" in India and as "wet nurse of infants" in Europe. Goats are multi-purpose animals, producing meat, milk, skin and hair. In India, 95% of goat meat produced is consumed locally and the per capita availability is far below the requirement. Thus, there is a considerable potential for developing goat production not only for meat for internal consumption but also for export, for quality leather production in which India ranks high among the goat skin exporting countries.

The major impediment to goat production in most developing countries is the high incidence of infectious diseases with pneumonia being an important respiratory disorder. Pneumonia is the inflammation or infection of lung. Rhinitis, laryngitis, tracheitis and bronchitis describe infections of the upper portion of the respiratory tract.Goats are especially sensitive to respiratory infections caused by virus, bacteria and fungi, mostly as a result of deficient management practices that make these animals more susceptible to infectious agents. The tendency of these animals to huddle and group rearing practices further predispose to infectious and contagious diseases. Younger animals are more prone to respiratory disease infections. Due to lack of immunity they may get infection from the contaminated milk, carrier animals and pasture. Other predisposing factors are deleterious changes in environment, rain and windchill, severe parasitism, poor ventilation and overcrowding.

Multifold etiological factors are responsible for pneumonia. Virus and mycoplasma are considered to be the initiating factors and subsequently complicated by secondary bacterial involvement such as *Pasteurella multocida*.

A. Viral cause of pneumonia

1. Peste des petits ruminants (PPR)-PPR is a highly contagious economically important viral disease caused by a Morbillivirus of family Paramyxoviridae (Abubakar *et al*., 2008). It is characterized by pyrexia, mucopurulent nasal and ocular discharge, conjunctivitis, necrotizing and erosive stomatitis (Fig. 1), pneumonia, gastroenteritis and ultimately death (Couacy-Hymann *et al*., 2007; Diallo *et al*., 2007).

Discharge from eyes, nose, mouth and the loose faeces contain large amounts of the virus.

Fig 1*. Nasal dishcharge and oral lesion – in PPR*

Fig 2*. Dull animal with nasal dishcharge*

Fine infected droplets are released into the air from these secretions and excretions, particularly when affected animals cough and sneeze. Animals in close contact inhale the droplets and are likely to become infected (Bundza *et al*., 1988).

Treatment : There is no specific treatment against this viral disease. Symptomatic treatment for diarrhoea and respiratory problems should be done. Fluid and antimicrobial therapy is indicated.

Control: Strict sanitation and hygienic measures should be adopted in farm. Newly purchased animals and animal returned from market should not be introduced without observation for a definite period of time.

Vaccination- live attenuated vaccines developed in India- Sungri96: IVRI, Mukteshwar (isolate of goat origin), Arasur 87: TNUVAS (isolate of sheep origin), Coimbtore97: TNUVAS (isolate of goat origin). Presently a commercial vaccine Raksha PPR (Indian Immunologicals) is available which should be given at 3-4 months of age when the maternal antibodies are diminished. Revaccination is done after three years.

B. Bacterial cause

1. Pasteurellosis or Haemorrhagic septicaemia (HS)- caused by bacteria *Pasteurella multocida* (type B). Outbreaks are common in late spring and early summer. Poorly ventilated barns, exposure to bad weather, transportation stress and malnutrition are associated with severe outbreak of the disease.

Clinical and necropsy findings: Sudden death without clinical signs seen in kids but in older goats, respiratory distress can be seen. Most common clinical signs are fever with temperature of 104° -106° F, moist painful cough, dyspnoea (difficulty in breathing). Examination of the lungs may reveal crackle like sounds, along with nasal and ocular mucopurulent discharge, anorexia (loss of appetite) and depression. Greenish gelatinous exudate over the pericardium and large quantity of straw coloured pleural exudate are characteristic findings in post-mortem examination.

Treatment: Ceftiofur @ 1.1-2.2 mg/kg body wt. is the only antibiotic approved by the Food and Drug Administration (FDA) to treat caprine pneumonia. Vaccinate kids at the age of 6 months with commercially available Raksha HS vaccine. Animal should be vaccinated annually before onset of monsson.

2. **Contagious caprine pleuropneumonia (CCPP)-** caused by *Mycoplasma capricolum*

subsp. *capripneumoniae* (*Mccp*). *Mycoplasma mycoides* cluster cause a variety of clinical syndromes like mastitis, arthritis, kerato-conjunctivitis, pneumonia and septicaemia (MAKePS syndrome) in small ruminants resulting in serious economic loss to the small and marginal farmers. Outbreak of the disease often occur after heavy rains (e.g. after the monsoons in India), after cold spells or after transportation over long distance. This may be because, recovered carrier animals shed the infectious agent after the stress of sudden climatic or environmental changes. Disease is transmitted during close contact by the inhalation of infected respiratory droplets.

Clinical and necropsy findings: The most consistent observations throughout the outbreak in infected goats are mild to severe cough, purulent nasal secretion, emaciation, dyspnoea, increased respiration rate, pyrexia, keeping head downward and reluctance to move. Characteristic post-mortem findings are lung enlargement, hepatization along with thick, abraded and whitish pleura (Hussain *et al*., 2012).

Treatment: Tylosine @ 10 mg/kg body wt. I/M for 5 days, is drug of choice for mycoplasmosis. Oxytetracycline can be given @ 15 mg/kg body wt. I/M daily for 6-8 days.

Prevention and control: Strict hygienic environment, isolation of affected animals and vaccination.Vaccination with single dose (0.15 mg) of lyophilized, saponin killed mycoplasma strain F-38 is effective.

C. Parasitic or verminous pneumonia: Most commonly caused by infection with lung worms including *Dictyocaulus filaria*, *Muellerius capillaris* or *Protostrongylus rufescens.* Lungworm infestation is more common in temperate region in India. In contrast to the acute viral and bacterial pneumonias, which result in a bronchopneumonia affecting the anterior ventral portion of the lungs, verminous pneumonia affects the margins of the diaphragmatic lung lobe. *Dictyocaulus* has a direct life cycle, whereas *Protostrongylus* and *Muellerius* have indirect life cycles and rely on a variety of snails and slugs to serve as intermediate hosts. Adult forms of *Dictyocaulus* and *Protostrongylus* live in bronchi but rarely cause clinical signs. Adult *Muellerius* live in alveoli and lung parenchymal tissue and are considered the least pathogenic of the three lungworms.

Clinical findings: The acutely infected goat shows, diarrhoea preceding respiratory signs which include sudden onset of rapid shallow breathing of abdominal type. There is frequent bronchial cough, slight nasal discharge (Fig. 2), dyspnoea and high body temperature of 104°-105°F which is greatly influenced by exercise and excitement.

Necropsy findings: Adult lung worms of *D. filaria* and *P. rufescens* found in lumen of bronchi, results into bronchopneumonia mainly in the diaphragmatic lobe. The worms of *M. capillaris* are found in small fibrous nodules upto 5 mm in diameter in lung.

Diagnosis of lungworm infection requires Baermann examination of fecal material.

Treatment: The animals suffering from verminous bronchitis can be successfully treated by administering imidathiazoles (tetramisole hydrochloride @ 15 mg/kg

body wt. orally or levamisole hydrochloride @ 7.5 mg/kg body wt. orally) or benzimidazole (fenbendazole @ 7.5 mg/kg body wt. orally) or avermectin (ivermectin @ 200 µg/kg body wt. S/C).

Prevention and control: Animals must be removed from infected ground. Young animal should not be grazed with old animals. Proper deworming of animals should be done. Vaccination containing gamma attenuated *D. filaria* infective larva (ovine strain) has been developed in India but presently not being produced.

CONCLUSION

Goat is an important livestock for livelihood source of small and marginal farmers in India. Pneumonia is one of the most common respiratory problems in goats throughout the world. Although, pneumonia often occurs in kids, illness and deaths also occur in adult animals. Pneumonia in herd can be prevented by maintaining strict hygienic measure, stress free environment, balanced nutrition, proper deworming and scheduled vaccination.

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DNA Fingerprinting Methods and its Importance in Dairy Animals

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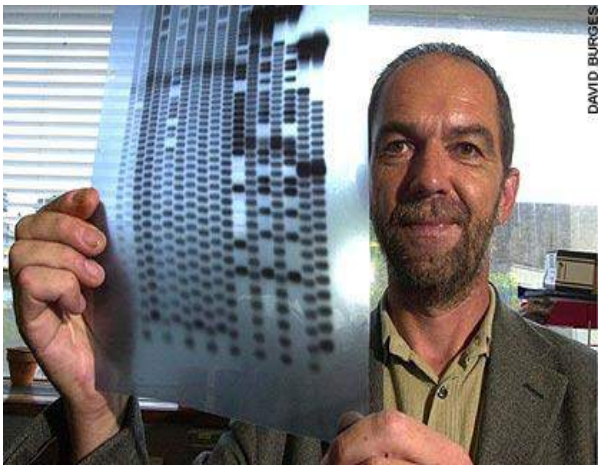
DNA profiling (also called DNA fingerprinting, DNA testing, or DNA typing) is a forensic technique used to identify individuals by characteristics of their DNA. A DNA profile is a small set of DNA variations that is very likely to be different in all unrelated individuals, thereby being as unique to individuals as are fingerprints (hence the alternate name for the technique). DNA profiling should not be confused with full genome sequencing. DNA Fingerprinting was Developed by Professor Alec Jeffreys at Leicester University in 1984 as a form of genetic. First used in the law courts of England in 1987 to convict a man in a rape case. Colin Pitchfork was the first criminal caught based on DNA fingerprinting evidence. Lalji singh is known as Father of DNA fingerprinting in India. He studied evolution of karotypes in snakes. Also founded Centre for DNA fingerprinting and diagnostics in 1995. Established Bkm-derived probes for forensic investigation. In 1991 first DNA fingerprinting based evidence to settle a disputed paternity. There are various synonyms of DNA Fingerprinting i.e DNA profiling, DNA typing, DNA testing, Genetics fingerprinting.

Biological materials used for DNA profiling



A common method of collecting a reference sample is the use of a buccal swab, which is easy, non-invasive and cheap. When this is not available (e.g. because a court order is needed but not obtainable) other methods may need to be used to collect a sample of blood, saliva, semen, or other appropriate fluid or tissue from personal items (e.g. a toothbrush, razor) or from stored samples (e.g. banked sperm or biopsy tissue). Samples

obtained from blood relatives (related by birth, not marriage) can provide an indication of an individual's profile, as could human remains that had been previously profiled.

Why It Is Done

DNA fingerprinting is done to:

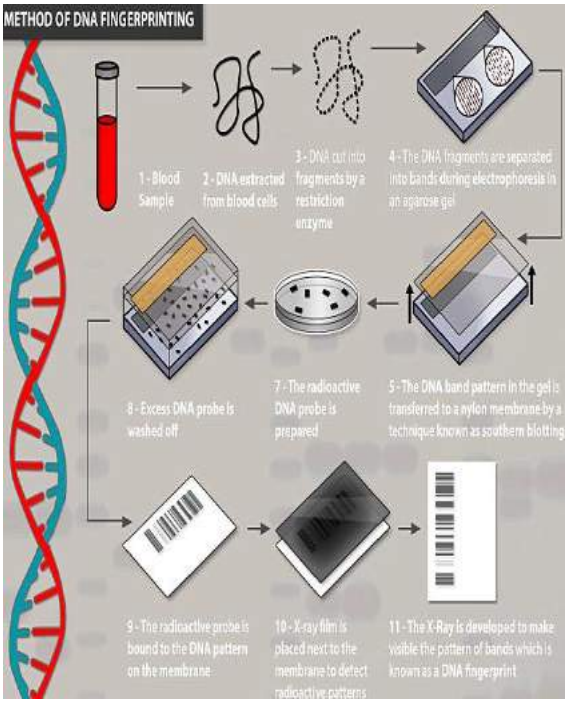
- Find out who a person's parents or siblings are. This test also may be used to identify the parents of babies who were switched at birth.
- Solve crimes (forensic science). Blood, semen, skin, or other tissue left at the scene of a crime can be analyzed to help prove whether the suspect was or was not present at the crime scene.
- Identify a body. This is useful if the body is badly decomposed or if only body parts are available, such as following a natural disaster or a battle.

Procedure used for DNA Fingerprinting

DNA profiling uses repetitive ("repeat") sequences that are highly variable called variable number tandem repeats (VNTRs), in particular short tandem repeats (STRs). VNTR loci are very similar between closely related humans, but are so variable that unrelated individuals are extremely unlikely to have the same VNTRs.

RFLP analysis

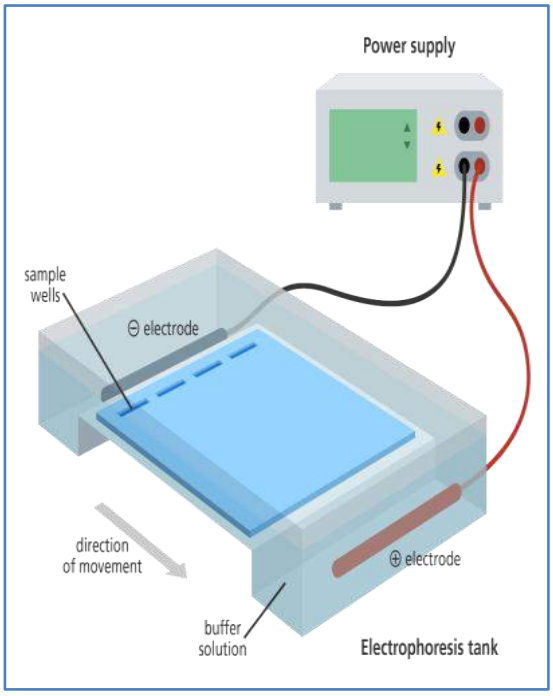
The first methods for finding out genetics used for DNA profiling involved **RFLP analysis**. DNA is collected from cells, such as a blood sample, and cut into small pieces using a restriction enzyme (a restriction digest). This generates thousands of DNA fragments of differing sizes as a consequence of variations between DNA sequences of different individuals. The fragments are then separated on the basis



of size using gel electrophoresis.

The separated fragments are then transferred to a nitrocellulose or nylon filter; this procedure is called a Southern blot. The DNA fragments within the blot are permanently fixed to the filter, and the DNA strands are denatured. Radiolabeled probe molecules are then added that are complementary to sequences in the genome that contain repeat sequences. These repeat sequences tend to vary in length among different individuals and are called variable number tandem repeat sequences or VNTRs. The probe molecules hybridize to DNA fragments containing the repeat sequences and excess probe molecules are washed away. The blot is then exposed to an X-ray film. Fragments of DNA that have bound to the probe molecules appear as dark bands on the film.

The Southern blot technique is laborious, and requires large amounts of undegraded sample DNA. Also, Karl Brown's original technique looked at many minisatellite loci at the same time, increasing the observed variability, but making it hard to discern individual alleles (and thereby precluding paternity testing). These early techniques have been supplanted by PCR-based assays.



PCR analysis

Developed by Kary Mullis in 1983, a process was reported by which specific portions of the sample DNA can be amplified almost indefinitely (Saiki et al. 1985, 1988). This has revolutionized the whole field of DNA study. The process, the polymerase chain reaction (PCR), mimics the biological process of DNA replication, but confines it to specific DNA sequences of interest. With the invention of the PCR technique, DNA profiling took huge strides forward in both discriminating power and the ability to recover information from very small (or degraded) starting samples.PCR greatly amplifies the amounts of a specific region of DNA. In the PCR process, the DNA sample is denatured into the separate individual polynucleotide strands through heating.

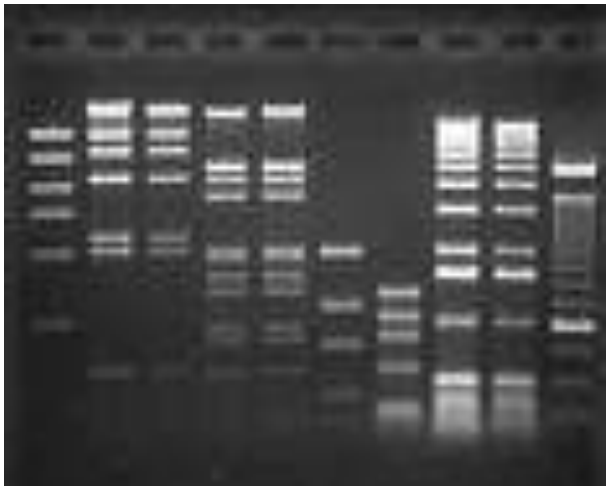
Two oligonucleotide DNA primers are used to hybridize to two corresponding nearby sites on opposite DNA strands in such a fashion that the normal enzymatic extension of the active terminal of each primer (that is, the 3' end) leads toward the other primer. PCR uses replication enzymes that are tolerant of high temperatures, such as the thermostable Taq polymerase. In this fashion, two new copies of the sequence of interest are generated. Repeated denaturation, hybridization, and extension in this fashion produce an exponentially growing number of copies of the DNA of interest. Instruments that perform thermal cycling are now readily available from commercial sources. This process can produce a million-fold or greater amplification of the desired region in 2 hours or less.

However, the PCR method was readily adaptable for analyzing VNTR, in particular STR loci. In recent years, research in human DNA quantitation has focused on new "real-time" quantitative PCR (qPCR) techniques. Quantitative PCR methods enable automated, precise, and high-throughput measurements. Interlaboratory studies have demonstrated the importance of human DNA quantitation on achieving reliable interpretation of STR

typing and obtaining consistent results across laboratories.

STR analysis

The system of DNA profiling used today is



based on PCR and uses simple sequences[7] or short tandem repeats (STR). This method uses highly polymorphic regions that have short repeated sequences of DNA (the most common is 4 bases repeated, but there are other lengths in use, including 3 and 5 bases). Because unrelated people almost certainly have different numbers of repeat units, STRs can be used to discriminate between unrelated individuals. These STR loci (locations on a chromosome) are targeted with sequence-specific primers and amplified using PCR. The DNA fragments that result are then separated and detected using electrophoresis. There are two common methods of separation and detection, capillary electrophoresis (CE) and gel electrophoresis.

Each STR is polymorphic, but the number of alleles is very small. Typically each STR allele will be shared by around 5 - 20% of individuals. The power of STR analysis comes from looking at multiple STR loci simultaneously. The pattern of alleles can identify an individual quite accurately. Thus STR analysis provides an excellent identification tool. The more STR regions that are tested in an individual the more discriminating the test becomes.

Applications in livestock

- Holstein Friesian, 47 genotypes,16 AFLP *EcoRI/Taq1* primer generate 1100 amplified bands and to identify 248 polymorphism in CpG islands
- Enzymes *Taq1* provides superior polymorphism targeting of CpG dinucleotides
- Bhuyan et al. 2010 used microsatellite markers for studying DNA fingerprinting in Murrah buffalo

Parentage verification in field progeny testing program

- 212 Mehsana buffaloes (100 dams, 100 daughters, 12 sires)
- 10 microsatellite markers
- Mutiplex microsatellite parentage testing
- 7/10 microsatellite loci high polymorphic information
- Fast, robust, economic tool to verify parentage with high accuracy

Detection of DNA fragments to differentiate cattle breeds

- Identification of Hanwoo (Korean cattle) from others breeds
- DNA markers of 519 bp was identified using RAPD –PCR for 6 cattle breeds
- Shows different DNA polymorphism than others breeds
- Kemp and Teale, 1994 identified population specific DNA Polymorphism

to differentiate *Bos indicus* and *Bos taurus* in West Africa

Fetal sex determination

- Prenatal sex determination by using PCR method, after 45days fertilization
- Amplification of Y specific sequences
- Routinely used to farm condition
- Other applications: Discrimination amongst pork, beef, lamb, chicken, turkey meat, Wild life investigation.

Crop Residue Management -Need of the Hour for Sustainable Agriculture

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In India more than 500 million tons of crop residues produced annually. These residues are used as animal feed, for thatching of homes, and as a source of domestic and industrial fuel. A large portion of unused crop residues are burnt in the fields primarily to clear the left-over straw and stubbles after the harvest. Burning of crop residues causes environmental pollution, emission of greenhouse gases and results in loss of plant nutrients. Therefore, appropriate management of crop residues assumes a great significance. Crop residue are a tremendous natural resource, not waste materials, is a good source of organic matter. This practice is designed to leave 30% residue *in the field after the crops have been harvested and thrashed* to reduce wind and/or water erosion. In areas where mechanical harvesting is practiced, a large quantity of crop residues are left in the field, which can be recycled for nutrient supply.

Need of Residue management?

- Loss of organic source
- Loss of plant nutrients
- Environmental pollution
- Health problem
- Reduced soil microbial activity
- Depletion of soil organic carbon

Crops used as residues

Wheat occupies the highest acreage in the world followed by rice, maize, barley, sorghum and millets (includes pearl millet and several minor millets). Rice predominates in India. In India, crop dry matter production was mostly contributed by rice, sorghum, ranked second with only one-third of rice's total followed by wheat, millets, maize and pulses. Among different crops, cereals generate maximum residues (352 Mt), followed by fibers (66 Mt), oilseeds (29 Mt), pulses (13 Mt) and sugarcane (12 Mt). The cereal crops (rice, wheat, maize, millets) contribute 70% while rice crop alone contributes 34% to the crop residues. Wheat ranks second with 22% of the crop residues whereas fibre crops contribute 13% to the crop residues

generated from all crops. Among fibers, cotton generates maximum (53 Mt) with 11% of crop residues.

Benefits of crop residues

- Protect soil from the direct impacts of rain, wind and sunlight leading to improved soil structure, reduced soil temperature and evaporation, increased infiltration, and reduced runoff and erosion
  - Crop residue contributes to soil organic matter and nutrient increases, water retention, and microbial and macro-invertebrate activity
  - saves irrigation water
  - less weed infestation
  - Increased fertility.

Potential uses of crop residues

- Livestock feed
- Compost making
- Energy sources
- Biogas generation
- Raw material for industry
- Mushroom cultivation

Crop residue management in rice-wheat cropping system

In NW India, RW cropping system generates huge quantities of CRs. Management of rice straw, rather than wheat straw is a serious problem, because there is very little turn-around time between rice harvest and wheat sowing and due to the lack of proper technology for recycling. Many farmers in NW states of the IGP after harvesting wheat grains, collect wheat straw with specially designed machine for using it as fodder leaving behind about 20 to 25% (1.5-2.0 t/ha) wheat straw in the field. The wheat straw left on the field is also burned before preparing for rice transplanting. Farmers have the apprehension that wheat stubbles will adversely affect the rice yield. Adverse effects of wheat stubbles incorporation can be averted by incorporating both green manure (having narrow C:N ratio) and cereal straw (having wide C:N ratio) into the soil before rice transplanting.

Legume Crop Residues and Green Manures

In northwestern India, short-duration legumes (e.g., mungbean and cowpea) can be grown in the fallow period after wheat harvest. In the rice-wheat system, incorporation of mungbean residue after picking pods, significantly increases rice yield and saves 60 kg N/ha. The advantages of incorporation of legume crop residues and green manuring to rice are similar.

Managing crop residue with conservation agriculture

Permanent crop cover with recycling of crop residues is a pre-requisite and Integral part of conservation agriculture. Agronomic productivity and profitability are high with use of crops residue in conjunction with no tillage in conservation agriculture. To harness the full potential of CA, not only residue will have to be used as soil surface mulch but also rice will have to be brought under zero tillage. The RCTs with innovations in residue management avoid straw burning, improve soil organic C, and enhance input efficiency.

Impact of crop residues on soil health and crop yield

Incorporation of crop residues into soil or retention on the surface increase hydraulic conductivity and reduce bulk density of soil. The crop residues act as a reservoir for

plant nutrients, prevent leaching of nutrients, increase cation exchange capacity (CEC), provide congenial environment for biological N_2 fixation, increase microbial biomass. Higher yields with crop residues application result from increased infiltration and improved soil properties, increased soil organic matter and earthworm activity and improved soil structure after a period of 4-7 years.

Fig 1: A 'Happy Seeder' for direct drilling of

seeds in the presence of surface residues

Fig 2: Crop residue retention between the crop rows

Fig 3: Leaving of crop stubbles in the field

CONCLUSION

The use of as Crop residues as a mulching material has been found beneficial as it reduces maximum soil temperature and conserves water. Crop residues offer sustainable and ecologically sound alternatives for meeting the nutrient requirements of crops, and improving soil and environmental quality. Crop residues management option can be achieved only if the management option is feasible under a given set of soil, climate, and crop management conditions; is compatible with available machinery; and is socially and economically acceptable.

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Organic Animal Husbandry

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Animal welfare including stress-free life to animals prevention of cruelty against them, food hygiene and food safety, sanitary and phytosanitary requirements, HACCP, ISO certification, OIE guidelines on animal welfare, Codex standards are some of the issues which have become important in modern conventional system of animal production. These food safety and quality enhancing mechanism are further emphasized under the organic production management of livestock towards development of human society that is not only more humane but also aware, educated and concerned about health hygiene and welfare of the animal. The organic animal husbandry system has emerged only recently, which is still evolving. It is very sophisticated and knowledge intensive system of animal production requiring high level of knowledge and skills, directed to safeguard not only the human health but also the welfare of animals and the environment on the whole. Organic agriculture including organic livestock production is gaining increasing attention globally, so it is important to develop better understanding of this emerging system of food production. Organic animal husbandry or organic livestock farming may be defined as a system of livestock production that promotes the use of organic and biodegradable inputs from the ecosystem in terms of animal nutrition, animal's health, animal housing and breeding. It deliberately avoids use of synthetic inputs such as drugs, feed additives and genetically engineered breeding inputs, while ensuring the welfare of animals.

Principal of Organic Livestock Production

- Organic livestock farming is a land based activity. In order to avoid environmental pollution, particularly natural sources such as the soil and water, organic production of livestock must in principle provide for a close relationship between such production and the land.
- Livestock must have access to free range exercise area and / or grazing apart from specified exemptions. Biological diversity should be encouraged and preference should be given to breeds adaptable to local conditions.
- Genetically modified organisms and products derived are not compatible with organic production.
- Organic livestock should be fed on organically produced grass, fodder and

other feed stuffs, apart from some specifications (for ruminants 10% of DM of specified components may come from conventional origin).

- Animal health management should be mainly based on prevention (appropriate breeds, a balanced high-quality diet and a favorable environment in terms of stocking density and husbandry practices).
- The preventive use of chemically synthesized medication (allopathic medicines) is not permitted, but sick and injured animals must be treated immediately as well being of the animal is more important (although this may affect their status with regards to organic certification).
- Housing should satisfy the needs of the animals concerned. Adequate ventilation, light, space and comfort should be provided to permit ample freedom of movement to develop the animal's natural social behaviour.

BREED AND BREEDING

Organic farming prefers to the use of local, native and pure breeds. A choice of breeds account must be taken care of the their capacity to adapt to local condition in terms of it's disease resistance, maintenance and adaptability. An organic farm in case of cattle, can maintain with local desi cattle who's genetic and production potential can be up-graded with bulls of good producing records if necessary. Organic farmers should pay attention to fitness characteristics, persistence and forage intake potential when breeding or making genetic choices. In addition, measures that encourage high feed intake should be implemented as soon as possible when raising heifers. Since profitability increases with high lifetime performance, longevity is an important characteristic, and should have first priority when making genetic choices. In this manner, it is possible to attain a sufficient farm income even at relatively low performance levels. Organic farmers may judge the productivity of an animal by different criteria than the conventional farmer. The animal's production record is important, but there are other characteristics which are equally important for adaptation to an organic environment such as mothering ability, hardiness and thriftiness, resistance to disease and parasites, and ability to forage. Organic farmers are more likely to breed for lifetime yield and longevity. Studies show that heifers, selected for high first lactation yields and bred early, often have inferior production after the second lactation when compared to later maturing cows. Culling rates are also higher. Longevity within the herd also promotes a more stable social order and more a stable state of health since more animals are adapted to the conditions. Older cows can also help increase the vigor of the herd because the quality and quantity of colostrum increases with age, which gives added protection to their calves. Selection by the farmers for useful traits is also a viable option for some genetically determined characteristics. Resistance to parasites is one example. Studies from New Zealand show that the use of resistant rams with non-resistant ewes increased growth rates in the lambs compared with lambs from non-resistant

rams. India is enriched with an enormous bovine population (273.3 million) having 26 native cattle breeds (10% of world) and all the breeds of reverine buffaloes (8 breeds). The indigenous cattle and buffaloes in India deserve attention in a sense that these are ideal for organic system. The health care requirement of Indian cattle and buffaloes is one of the lowest in the world, owing to high disease resistance. Health signifies the most important sign of successful organic animal husbandry and all other aspects such as profit, fertility, growth rate, milk yield and feed conversion are related to the animal's health. Moreover, the indigenous technical knowledge and practices followed by Indian farmers makes them more suitable to organic livestock farming. The indigenous technical knowledge can be properly tested and documented so as technical knowledge can be properly tested and documented so as to apply in organic livestock production. Organic farmers should pay attention to fitness characteristics,persistence and forage intake potential when breeding or making genetic choices. In addition, measures that encourage high feed intake should be implemented as soon as possible when raising heifers. Since profitability increases with high lifetime performance, longevity is an important characteristic, and should have first priority when making genetic choices. In this manner, it is possible to attain a sufficient farm income even at relatively low performance levels.

ORIGIN OF STOCK

Animals must be born to organically managed dams if they are to be slaughtered for organic meat production. In organic farming preference should be given to local breeds. Stock on organic farms should be purchased from organic holdings. Whilst a closed herd/flock policy is a basic principle of organic livestock production, up to 10% of the herd/flock can be replaced annually, with a requirement that "special attention must be paid to animal health measures" (such as screening tests or quarantine periods, depending on the circumstances). The process of conversion to organic seems apparently less complicated in terms of management procedures than in other livestock species and livestock production systems. The transition period from conventional to full organic certification is extremely variable depending on national regulation, type of production and the certification agency (from a minimum of 12 months to a maximum of 48 months). During transition, producers experience many changes in management practices, with impacts on the entire production system (soil, crops and livestock management). During transition, animal health can be negatively affected with a higher incidence of disease and decline in productive efficiency. And moreover a decrease in profitability can be expected in the transition period because the reduction in productivity is usually accompanied by an increase in labor, infrastructure and machinery cost.

Conversion to livestock farming

The establishment of organic animal husbandry requires an interim period, termed as the conversion period. The time between the start of organic management and certification of animal husbandry is

known as the conversion period. Organic farming system, which is a process of developing viable and sustainable agro-ecosystem with a holistic approach, cannot be introduced in one way. Complete organic farming is easy compared to partial organic farming, which doesn't work so well. Changing to an organic management system for livestock enterprise requires a careful and gradual approach.

Three steps to be followed:

1st - Introducing more natural varying systems and modifying housing to reduce animal stress

2nd - Eliminating practices such as routine veterinary inputs gradually to gain confidence

3rd - Integrating livestock into the whole farming system for the ultimate success of an organic farm

A farm holding will need to undergo a conversion period during which necessary changes are implemented, conversion of land and livestock takes place, but no produce are marketed as organic. Livestock may be marketed as Organic, provided the land has completed conversion and retrospectively from that date, provided that the stock have undergone minimum conversion periods. Land should be converted first, according to organic norms, which act as a source of feed for cattle. The whole farm, including livestock should be converted according to the standards set down. Animal products may be sold as "products of organic agriculture" only after the farm or relevant part of it has been under conversion for at least 12 months and provided the organic animal production standards have been met for the appropriate time.

Is organic livestock farming maintains sustainability ?

Sustainable agriculture is a way of raising food that is healthy for consumers and animals, does not harm the environment, is humane for workers and animals, and provides a fair wage to the farmer. The characteristics of this type agriculture include:

Conservation and Preservation: what is taken out of the environment is put back in, so land and resources such as water, soil and air can be replenished and are available to future generations. The waste from sustainable farming stays within the farm's ecosystem and cannot cause or buildup pollution. In addition sustainable agriculture seeks to minimize transportation costs and fossil fuel use, and is as

locally- based as possible.

Biodiversity: farms raise different types of plants andanimals, which are rotated around the fields to enrich the soil and help prevent disease and pest out-breaks. Chemical pesticides are used minimally and only when necessary; most sustainable forms don't use any form of chemicals.

Animal welfare: animals treated humanly and with respect, and are well cared for. They are permitted to carry out their natural behaviors, such as grazing, rooting or pecking and are fed a natural diet appropriate for their species.

Economically viable: farmers are paid a fair wage and are not dependant on subsidies from the government.

Sustainable farmers help strengthen the rural communities.

Socially just: workers are treated fairly and paid competitive wages and benefits. They work in a safe environment and are offered proper living conditions and food.

The concept of organic livestock farming can only fulfill the criteria for sustainability if all requirements on animal health and welfare, together with product quality and ecological soundness, are strongly considered and controlled. Sustainability lies at the heart of organic farming and is one of the major factors determining the acceptability or otherwise specific production practices". It is even suggested that sustainable is a polite word for organic farming.

LIMITATION

(a) Space Requirement: It is practically difficult to provide a large locomotion area as prescribed, e.g. 6.0m^2 indoors + 4.5m^2 outdoors for dairy cows.

(b) Withdrawal Period: Prolonged withdrawal period required after any veterinary treatment with drugs, make farmer reluctant to call veterinary doctor thus deterioration of animal welfare.

(c) Preservatives: Blanket rejection of preservatives may have serious effect on food supply and safety of foods.

(d) Cost of production: As it is very high in comparison with conventional production system for example cost of production of organic pig is 85.2% higher than conventional system.

(e) Decreases availability : Organic milk and meat production may further decreases the availability of milk and meat.

CONCLUSION

Since India is endowed with many features which can be taken as way forward to organic animal husbandry. India's traditional farming system was somehow similar to organic farming such as crop-livestock integrated farming system. India being endowed with vast number of native breeds which are well adapted to local situations, being hardy, resistance to diseases, health and maintenance cost is very low. Remote areas like hilly terrains, tribal areas and certain north eastern states have favourable conditions for the development of organic livestock farming. Also farms in India are mostly diversified in terms of crops grown, species and breeds of livestock maintained. Although India is in infancy in terms organic animal husbandry it can go long way forward in the coming years due to increase in demands world over. There is wide scope of research activities in all the dimension of organic livestock production, viz. breeding, feeding, disease control, management, processing, marketing, socioeconomic and ethical aspects to make organic animal husbandry viable and sustainable.

Wound Management by Maggot Debridement Therapy (MDT)

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Wounds in animals and humans are encountered very commonly in our day to day life. Wound can be defined as a separation or discontinuity of the skin, mucous membrane or tissue surface caused by physical, chemical or biological demage and restoration of the tissue continuity is termed as wound healing. The healing of wound is a natural process of the body guided by various complex tissue mechanisms dependent on various factors and by knowledge of these factors we can direct body in order to achieve the early healing with minimal dressings and nearly no scar tissue formation.

Types of wounds commonly seen are:-

1. **Bite wound: -** Results from dog, monkey or any other wild animal bites.
2. **Lacerated wound:** - Caused by the tearing of tissues mostly by the barbed wires or during the motor accidents.
3. **Erosive wound** :- Usually there is superficial loss of the upper layer of the skin
4. **Ulcerative wound**: - Caused by mechanical compression of skin underlying the bony prominences and recumbent animals have these type of wounds.
5. **Poisoned wound:** - Caused by various type of poison and toxins.
6. **Maggoted wound: -** Results from the laying of eggs by flies on wound. Almost any part of the body with wound having access to flies produces these types of wounds. Amongst these, it is often observed that maggoted wound shows faster healing, thus, studied in detail by various pioneer researchers. Before getting into deeper understanding of mechanisms and application, a closer look on various factors affecting wound healing is required.

Broadly, 2 types of factors are involved:-

(A) Local factors:

1. **Tissue vascularity: -** Highly vascular tissues like muscles heal faster.
2. **Movement: -** Continuous movement at the site of wound prolongs the tissue healing. In equines, it may lead to proud flesh formation.

3. **Extent of wound: -** Smaller the wound, minimal will be the chances of infection so early healing is expected.
4. **Foreign body**: - The presence of foreign body inside the wound may lead to abscess formation thus delaying the wound healing.
5. **Wound infection**: - The secondary infection by pathogens (bacteria, virus, fungus, parasites) delays the wound healing. Bandaging prevents the wound to become more infected. Some of the wounds exposed with soil get infested with free living nematode larvae, thus do not responds to the antibiotic therapy but responds to commercial preparation like negashunt which contains a mild insecticide.

(B) Systemic factors

1. **Age: -** Young animal wounds heal faster than the aged animals.
2. **Nutrition: -** The nutrition has wide role like vitamins (C and E), minerals and trace elements (zinc) are required for the normal wound healing. Deficiency of these may delay the wound healing.
3. **Drugs: -** The various type of drugs have differential role on wound healing like anti-inflammatory drugs, antibiotics, antihistaminics etc.

Wound Management: - In brief, the term can be defined as conditioning the body for the the early healing of the wound or injured body tissue. It includes several approaches like application of disinfectants, antiseptics, tourniquet, irritant (phenol, turpentine oil) etc. These drugs or methods suffers from deep set back in case of chronically ill or severely wounded immune-deficient patients, which includes both human and animals suffering from diabetes mellitus or other immune related disorders. With the advancement in science and technologies, therapist comes up with several alternative approaches for such cases but reality lies in very meager recovery rates and increase reports of drug resistance with development of multi drug resistant microbes. One such alternative is the application of sterile maggots and the technique known as maggot therapy or larval therapy of maggot debridement therapy (MDT) or simply bio-debridement.

The annual cost of management of non-healing wound exceeds $20 billion globally, excluding the losses due to manpower days, which, according to an estimate lies around 2 million workdays. In such case, use of sterile maggots proved as most promisable alternative. Maggot debridement therapy is the intentional application of live, “medical-grade” fly larvae to wounds in order to effect debridement, disinfection and ultimately wound healing. The idea generates from the battlefield of World War I where an orthopedic surgeon, William Baer, observed faster healing of soldiers wound infested by maggots. Later, he systemically applied maggots for healing wounds of its patients and published World’s first literature on maggot therapy in 1931. After that breakthrough finding, many European, Canadian and American hospitals opened their own insectaries and start rearing and disinfecting the larvae.

Clinicians interest in maggot therapy increased to the extent that hospital lacking insectaries could

commercially order maggots from reputed laboratories, for instances, Surgical Maggots™ from Lederle Laboratories (Pearl River, New York). The viable germ free maggots cost around US$5 in 1931. Now with the availabilities of adhesives, synthetic fabrics, improved antiseptics, disinfectants, the production of germ-free maggots becomes simplified and can be transported using overnight courier services. With the advent of era of antibiotics, a sharp decline in the use of maggots in larger set up was noticed and the technique gets confined to local clinicians. Several classes of antibiotics were launched in the market but with the emergence of multiple drug resistance in microbes, rapidly withdrawn and the now the situation get worsen to the extent that cost of drug development exceeds the benefit ratio forcing the pharmaceuticals to withdraw themselves from R&D and search for some alternatives. Osteomyelitis and soft tissue abscesses are one of the hardiest wounds infected with drug resistant bacteria so attracted the attention of clinicians towards wound therapy.

Mode of action: Clinical and laboratory research have understood 4 major actions of maggots on wound, these are, (a) debridement, (b) disinfection, (c) stimulation of healing, and (d) biofilm inhibition and eradication. Maggot therapy is a controlled deliberate therapeutic myiasis. Maggots are the apodous larvae of dipteran flies and blowflies which includes *Lucilia cuprina*, *Callipora* sp., *Callitroga* sp. and *Chrysomya bezziana* that most commonly infest any wound and cause myiasis. At first, the suitable fly species and strain is selected and chemically disinfected to make it germ free and then special dressing containing maggots are prepared which prevent them from leaving the wound unescorted. Tough quality control measures are to be followed throughout the breeding and production processes. In USA, maggots allowed to be used for therapeutic purpose belongs to LB-01 strain of *Phaenicia (Lucilia) serricata*.

Sterile maggots are applied on the wound at a dose of 5-10 larvae per square centimeter of wound surface area and are left within their dressing for 48-72 hrs and afterwards they are removed and wound are left free for healing. Most common limitations associated with MDT are patient pain or discomfort, delivery problem and chances of escape of maggots. Pain or discomfort can be tackled using analgesics. Maggots confinement dressing in various size and style are available to prevent escape of maggots. If delivered more than 24 hrs late and passed through temperature extremes, survivability of maggots decline. Indian climatic conditions make it a good supplier candidate but a poor end user. Moreover, used maggots if not disposed properly, can aggravate fly problem in that area. At present, more than 24 laboratories across the world are supplying medical grade maggots in over 30 countries and maggot therapy is approved by FDA for single use only on registered therapist prescription.

Conclusion can be drawn from the fact that in last few years, there are many success reports are available in literature

pertaining to adoption of maggot therapy. But more or less, it is confined to developed countries leaving myriads of poor developed countries citizens deprived of this therapy. The therapy need to be popularized to bring them in the reach of a needful patient to relieve their toughest wound at the earliest possible. With the continuous research in this particular area, the day is not far ahead when researchers will come up with lead molecules and their characterization will revolutionize the wound therapy.

An overview on Computer Assisted Sperm Analyzer (CASA) for evaluation of sperm in Domestic Animals

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In India, control of semen quality was mainly based on the microscopical control of mass movement or single cell motility by the use of light microscopy and the human eye. Microscopic assessment has the disadvantage that sperm motility estimates can vary among the examiners and experiences. Amann (1994) was the first to discover the benefit of CASA-systems to detect environmental influences on the quality of semen production and sperm function. CASA does not only measure the proportion of motile spermatozoa but also measures other sperm motion parameters derived from individual sperm cells and it has more predictive power on fertility potential of semen ejaculates (Mortimer, 1994). In addition to the use of computerized techniques to predict semen fertility, CASA also provides a useful tool to study the effects of various *in vitro* procedures on sperm motility as well as the means to study the phenomenon of sperm hyperactivation. Spermatozoa FPM along with certain velocity parameters are essential for the spermatozoa to achieve fertilization. Spermatozoa kinematic parameters such as PFM, VSL, VCL, ALH, and LIN were positively correlated with bull fertility (Perumal *et al*. 2011). Study of CASA parameters was reported in domestic animal species such as cattle (Perumal *et al.* 2011), buffalo (Anil Kumar *et al.* 2011) and dog (Domosławska *et al.* 2013). Computer-assisted sperm analyzers (CASA) have become the standard tool for evaluating sperm motility and kinetic patterns because they provide objective data for thousands of sperm tracks (Contri *et al*. 2010). Thus, Computer-assisted sperm analyzers (CASA) has brought new dimension to semen evaluation and represent third generation devices for visualization and analysis of sperm motion (Kumar *et al*., 2013).

Computer assisted sperm analysis (CASA) is a powerful tool for the objective assessment of sperm motility and is hence now frequently used for evaluating semen quality. The basic components of this technology consist of a microscope to visualize the sample, a digital camera to capture images and a computer with specialized software to analyze the movement of the spermatozoa. The

essential principle behind most microscopy-based CASA systems is that a series of successive images of motile spermatozoa within a static field of view are acquired by computer software algorithms, which then scan these image sequences to identify individual spermatozoa and trace their progression across the field of view. This involves recognising the same cell in each image by its position, and inferring its next position by estimating the likelihood that it will only have moved a certain maximum distance between frames. Computer assisted sperm analysis can also provide information about sperm concentration, morphology, viability and index of DNA fragmentation of frozen-thawed sperm (Vincent *et al.* 2012). Several models of CASA instruments like CEROS (Hamilton-Thorne, USA) and the Sperm Class Analyzer (SCA; Microptics, Spain) are now available to evaluate the quality and the motility of spermatozoa. Each system operates on similar principles but they differ in their parameter settings and use different algorithms to determine speed and trajectories.

Processing of semen in CASA

After semen collection, the sperm concentration was first estimated using a phase-contrast microscope (Nikon, Eclipse 80i; 400xmagnification). 25 μL of semen was diluted into 50–100 μL of Tris (formulated for bull semen) and 5 μL of this diluted semen was loaded into a prewarmed dual chamber disposable Leja slide and was allowed to settle on the minitherm heating stage (38◦C) before the analysis. The following parameters such as percentage of FPM, TM, SM, VAP, VSL, VCL, ALH, BCF, and LIN were measured. A minimum of 200 spermatozoa from at least two different drops of each sample were analyzed from each specimen. The number of objects incorrectly identified as spermatozoa was manually removed and final analysis was done for each sample. (Perumal *et al.*, 2014).

Use of CASA

These computerized measurements can be useful to assess various sperm characteristics simultaneously and objectively, and are valuable for the detection of subtle changes in sperm motion that cannot be identified by conventional subjective semen analysis as reviewed elsewhere (Kathiravan *et al*., 2011). Parameter like Sperm motility, progressive motility Curvilinear Velocity (VCL), straight line velocity (VSL) of sperm, average path velocity (VAP) of sperm, Linearity (LIN), straightness (STR), amplitude of lateral head displacement (ALH) and Beat cross frequency can be determined by CASA. Computer assisted sperm analysis instruments collect a wide range of sperm motility parameters, allowing a more detailed and accurate analysis of sperm movements and track speed.

Constraints of CASA/Limitation

Many factors are known to affect CASA results.

1. The type of specimen chamber used for analysis can affect the movement of sperm, the accuracy of the cell count number, and therefore the percentage of motile spermatozoa (Massányi *et al*., 2008).
2. The temperature at which semen is analyzed is also an important factor that may affect CASA results.

3. The type of extender in which semen is diluted is another aspect that should be taken in consideration when evaluating spermatozoa with CASA. Some extenders contain debris of size similar to a sperm head, causing CASA software to include them in the analysis. Egg-yolk and milk based diluents are examples of extenders containing such particles.

Table 1: Spermatozoa parameters measured by Hamilton-Thorne Sperm Analyzer- CASA (Version 12 IVOS,Hamilton-Thorne Biosciences, Beverly, MA). Harris (2011)

Variable	Description
Motile	% of total spermatozoa moving at path velocity > 30 µm/sec and progressive velocity > 15 µm/sec
Progressive	% of total spermatozoa moving at path velocity > 50 µm/sec and straightness > 70%
Rapid	Progressive % with path velocity > 50 µm/sec
Medium	Progressive % with path velocity < 50 µm/sec but > 30 µm/sec
Slow	Progressive % with path velocity < 30 µm/sec and progressive velocity < 15 µm/sec
Static	Immobile sperm
Path velocity (VAP)	Mean velocity of the smoothed cell path (µm/sec)
Progressive velocity (VSL)	Mean velocity measured in a straight line from the beginning to end of the track
Track speed (VCL)	Mean velocity measured over the actual point-to-point track
Lateral amplitude (ALH)	Average width of the head oscillation as the sperm swims
Beat frequency	Frequency of spermatozoa head intersecting the sperm average path in either direction
Straightness	Measures departure of mean sperm path from straight line (ratio of VSL/VAP)
Linearity	Measures departure of actual sperm track from straight line (ratio of VSL/VCL
Elongation	Ratio (%) of head width to head length
Aera	Ratio (%) of head width to head length

CONCLUSION

These specialized techniques should routinely apply for regular analysis of fresh and frozen-thawed semen in domestic animals because they offer new possibilities, to achieve more and more objective information about the functionality of fresh and frozen/thawed sperm.

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Preventing Browning in Tender Jackfruit during Minimal Processing For Ready to Cook Product

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In India, Jackfruit (*Artocarpus heterophyllus* Lam.) is used for culinary purpose at its tender stage and relished as a dessert fruit when ripe. Tender fruits are low in calories and good source of minerals (206mg potassium, 97mg phosphorus and 50.1mg calcium/100g of edible portion), fibre (4.4g/100g of edible portion), protein (2.6g /100g of edible portion) and vitamin C (11mg/100g of edible portion). Unlike other vegetables, it is considered relatively safe, as pesticides are rarely used for its cultivation. The curry prepared from the tender jackfruit tastes as good as meat based curry and is liked by all sections of the society. However, consumers hesitate to purchase it due to cumbersome process of peeling and cutting, as the peel is very hard and full of latex. Thus, there is an ample scope for minimal processing in tender jackfruit so that this vegetable could be made available to the consumers in ready to cook (RTC) form. One of the most important challenges during peeling and cutting is the preservation of normal tissue colour or control of cut-surface browning/discoloration, as it affects external appearance of the product. Consumer's choice and preferences for minimally processed products are greatly influenced by its colour. Loss of natural colour is considered as deterioration of quality, which in turn lowers the consumer's acceptance for the product. Hence, there is a need to device methodology for preventing/ containing browning in cut tender jackfruit, during its minimal processing.

Browning: The exposed cut-surface of jackfruit flesh becomes brown due to hydroxylation of monophenols to colourless diphenols and oxidation of diphenols to dark coloured quinones by the enzyme polyphenol oxidase (PPO). This process of enzymatic browning does not occur in intact plant cells because PPO (enzyme) and phenolic compounds (substrate) are located separately in the cytoplasm and vacuoles, respectively. This compartmentalization of substrate and enzyme is lost due to physical injury to the cell during minimal processing which in turn allows them to come into contact of each other and initiate the reaction of browning in the presence of

oxygen. The cut-surface of jackfruit becomes very dark within 5-10 minutes as shown in Fig 1.

Prevention of browning: Various physical and chemical agents are known to control the PPO-mediated cut-surface discoloration/ browning in fresh-cut fruits and vegetables. Some of them are listed in Table 1.

Table 1. Antibrowning treatments for fresh-cut/ minimally processed products

Sl. No	Antibrowning Agents	Fresh-cut /minimally processed products
Physical		
1.	Blanching in water	Aonla, Plum, Beet, Brussels sprout, Carrot, Cauliflower, Peas, Potato, Spinach
2.	Blanching in steam	Mango, Pineapple, Carrot, Cauliflower, Peas, Potato, Spinach,
Chemical		
1.	Sodium chloride (common salt)	Apple, Mango, Watermelon, Potato
2.	Ascorbic acid	Apple, Banana (cooking),Carambola, Kiwi, Loquat, Pear, Artichoke
3.	Citric acid	Apple, Banana (cooking), Carambola, Chestnut, Artichoke, Cabbage, Sweet potato
4.	Oxalic acid	Apple, Banana (cooking), Mangosteen
5..	Sodium metabisulphite	Apple, Sweet potato

Considering the tremendous scope of minimally processed tender jackfruit and role of antibrowning agents in maintaining the visual quality of RTC product, an attempt was made at ICAR-IIHR-Central Horticultural Experiment Station, Bhubaneswar to develop suitable antibrowning treatment for fresh-cut tender jackfruit. Chemicals and physical treatments used for the purpose are given in Table 2.

Table 2. Antibrowning treatments used in the study

Sl. no.	Treatments	Concentration	Method of application
1.	Citric acid	0.5, 1.0 and 1.5%	Solution was poured to the cut-surface during peeling and dicing thereafter, the diced jackfruit pieces were immersed in the solution for 15 minutes.
2.	Ascorbic acid	0.5, 1.0 and 1.5%	
3.	Sodium chloride (common salt)	2, 5, 10, 15 and 20%	
4.	Blanching	-	Water was poured to the cut-surface during peeling and dicing thereafter, the diced jackfruit pieces were immersed in the boiling water for 3-5 minutes.

Blanching and salt treatments were not found effective in preventing the browning. Ascorbic acid at higher concentration, i.e., 1 and 1.5% conferred temporary protection from enzymatic browning that lasted for 15-20 minutes.

Thereafter, discolouration of the product started (Fig 2). As far as citric acid is concerned, 1% concentration was found to be optimum, because below this concentration the control for browning was not effective and at higher concentration, i.e., 1.5% the product became sour. Chelating and acidifying properties of citric acid makes it an excellent antibrowning agent. It reduces the activity of PPO by capturing/chelating copper in the active site of enzyme and reducing the pH of medium. PPO catalyzes enzymatic browning at neutral pH (6-7). Thus, acidification by citric acid leads to reduction in activity of enzyme and containment of cut-surface browning.

The minimally processed tender jackfruit treated with 1% citric acid, retained the visual appeal (off white colour) even after 20-24 hrs at room temperature storage and up to 5-7 days under refrigerated storage (Fig 4). Moreover, as citric acid is a major constituent of several fruit crops, it is recognized as safe for human consumption. Hence, to preserve the normal tissue colour of the RTC tender jackfruit, 1% citric acid solution could be used as an antibrowning agent during minimal processing.

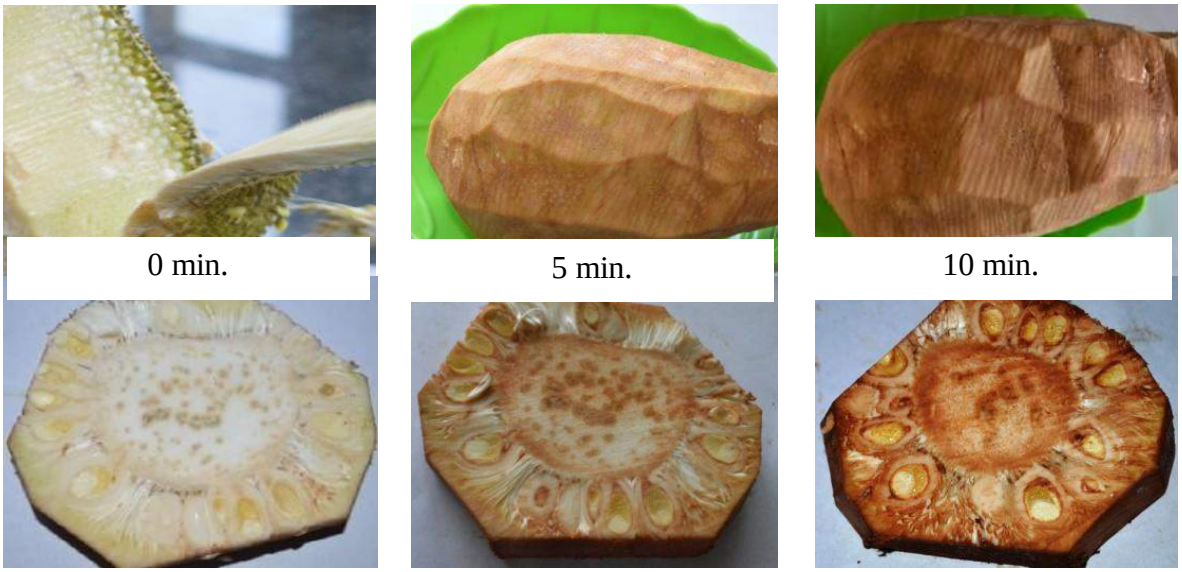

Fig 1. Gradual change in the colour of exposed cut-surface of tender jackfruit

Fig 2. Effect of Ascorbic acid and citric acid on preventing the browning in tender jackfruit

Acute Phase Proteins and Its Role In Domestic Animals

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Acute phase proteins (APPs) are blood proteins primarily synthesised by hepatocytes. The plasma concentration of APPs may be increased or decreased as a part of Acute Phase Response (APR). This response is called as acute-phase reaction. The acute phase response is a non-specific and complex reaction, triggered by different stimuli including injury, trauma, infection, stress, inflammation as well as neoplasia. It comprises a wide variety of behavioural, physiological, biochemical and nutritional changes. The most important metabolic changes include the increased or decreased production of various proteins from the liver, which are known as acute phase proteins. Acute phase proteins have been well recognised for their application in the diagnosis and prognosis of various inflammatory and organ diseases, organ transplant and cancer treatment. Due to their altered levels in affected animals, APPs may provide an alternative means for monitoring animal health and herd health.

Acute phase proteins (APPs)

Acute-phase proteins (APPs) are large and varied group of plasma proteins which are synthesized by many cells, especially by hepatocytes released into the blood stream in response to a variety of stressors. Usually, the structure of APPs and acute-phase responses are similar in all species, having universal character in animal kingdom. Many of the APPs are glycoproteins. Glycosylation are higher in the molecules synthesized during the acute-phase responses. Exceptions are C-reactive protein (CRP) and serum amyloid A (SAA), which are not glycosylate.

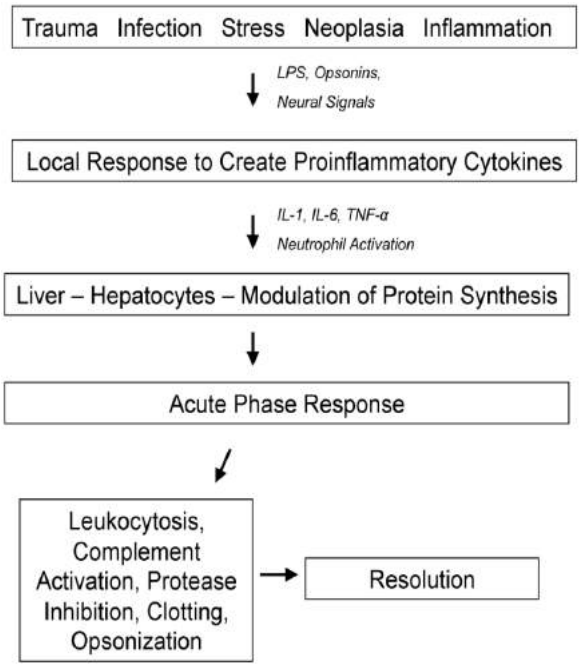
Acute phase proteins play important roles in various stages of the inflammatory reaction. In general, the main function of APPs is to protect the host against pathological damage, assist in the restoration of homeostasis and in the regulation of different stages of inflammation. Some of the acute phase proteins (α1-anti-trypsin, α2-macroglobulin) have anti-protease activity designed to inhibit proteases released by phagocytes or pathogens to minimise damage to normal tissues. Other APPs (haptoglobin, serum amyloid A, C-reactive protein) have scavenging activities and the bind metabolites are released from cellular degradation. Others (α1-acid glycoprotein) are characterised by anti-bacterial activity

and have the ability to influence the course of the immune response.

APPs have major functions in opsonisation, trapping of microorganisms and their products, in activating complement system, in binding cellular remnants, in neutralizing enzymes, scavenging free hemoglobin and radicals and in modulating the host immune response. APPs have been well recognized for their application in the diagnosis and prognosis of cardiovascular disease, autoimmunity, organ transplant and cancer treatment.

Acute phase response (APR)

The acute phase response consists of large number of behavioural, physiological, biochemical and nutritional changes involving many organs distant from the site of inflammation. The APR results in a complex systemic reaction to re-establish homeostasis and promote the healing. The APR is referred to as the 'molecular thermometer' whereby quantisation of individual acute phase protein can provide an assessment of the response to the triggering event.



The APR is core part of the innate immune response and is observed across all animal species. The acute phase response begins within inflammatory sites, where cells involved in the innate immune response (i.e. macrophages, monocytes) produce and release vast number of inflammatory mediators like cytokines. Innate immunity fulfills an important role in the body's early defence mechanism and serves to initiate the acquired immune response. The innate immune system is very diverse and includes physical barriers, phagocytes, complement and toll-like receptors which serve to prevent infection, eliminate potential pathogens and initiate the inflammatory process. Later aspects of induced innate responses are dependent on cytokines and chemokines, which are generated by activated cells including monocytes, macrophages, fibroblasts, endothelium, platelets, keratinocytes, and T cells. These proinflammatory signals, including IL1, TNFα and IL6 have numerous effects throughout the body including inducing the acute phase response.

Classification of acute phase proteins

All the up-regulated proteins have been called *positive* APP, in order to differentiate them from *negative* APP, which is down-regulated. Positive APP is represented by large number of proteins which may be further classified as major, moderate and minor depending on their concentration. Major proteins increase 10- to 100-fold, within the first 24–48 h after the triggering event and often exhibit a rapid decline due to their very short half-life. Concentration of some proteins like C reactive protein (CRP), Serum amyloid A (SAA) rise as early as 4

hours after inflammatory stimulus and attain their maximum levels within 24 to 72 hours and also decline very rapidly.

Moderate proteins increase 2- to 10-fold, and minor proteins are characterised by only a slight increase. Moderate and minor proteins begin to increase 24 to 48 hours and reach to their maximum level in about 7 to 10 days; about two weeks are required to return to their normal levels. These may be observed more often during chronic inflammatory processes.

I. Plasma proteins with increased concentration during the acute phase response (positive acute-phase proteins):

- Protease inhibitors: α1-antitrypsin, α1-antichemotrypsin;
- Coagulation proteins: fibrinogen, prothrombin, factor VIII, plasminogen;
- Complement proteins: C1s, C2, B, C3, C4, C5, C6, C9, C1, and INH;
- Transport proteins: haptoglobin, hemopexin;
- Other proteins: C reactive proteins (CRP), Serum Amyloid A (SAA), α1-acid glycoprotein, Gc-globulin, ceruloplasmin.

a. Based on synthesis intensification and other parameters:

- Approximately half-fold increase: ceruloplasmin, complement component C3;
- Increase from a two-fold to three-fold: haptoglobulins, fibrinogen, α-globulins with protease activity; these are detected in 8 hours after stimulation of generative cells;
- Rapidly increase to a thousand-fold: CRP, SAA; these are detected 4 hours after the stimuli and attain a maximum level at least 24 hours.

II. Plasma proteins with decreased concentration during the acute phase response (negative acute-phase proteins):

- Protease inhibitors: inter α1-antitrypsin;
- Complement proteins: properdin;
- Lipoproteins: lipoproteins with high density, lipoproteins with low density;
- Other proteins: albumin, prealbumin, transferrin.

According to importance of their participation in innate immunological mechanisms:

- Major APPs: CRP and SAA;
- Other APPs: α1-acid glycoprotein, haptoglobin, β2-macroglobulin, ceruloplasmin, fibrinogen, hemopexin, α1-proteinase inhibitor, α1-antitrypsin, α1- antichemotrypsin, cystein protease inhibitor, fetuin and serum mucoid.

All mentioned classifications include plasma proteins with important physiological activities. Their changes, registered in various diseases, furnish significant clues about ethiopathogenesis and elements for establishing diagnosis and prognosis.

Main acute-phase proteins

1. C-reactive protein (CRP)

CRP is the most important APP. CRP is a α-globulin characteristic to vertebrates, including fishes, that was discovered by *Tillet* and *Francis* in 1930 in serum of the patients with acute pneumonia produced by *Streptococcus pneumoniae*.. The term "C-reactive protein" derived from capacity to react with pneumococcal protein C (polyoside somatic antigen) through phosphorylcholine.

Binding of CRP to the bacteria, fungi and parasites membranes are dependent to

Ca2+, being associated with the classical activation pathway of the complement, resulting C3b formation. CRP reacts also like opsonin. It amplified chemotaxis mechanisms and macrophages and neutrophils phagocytosis. CRP binds damaged cells nuclear chromatin, participating in degradation of their nuclear components. CRP also binds some endogenous compounds, like membrane phospholipids.

Similar to other APPs, CRP is synthesized by hepatocytes, synthesis amplified in acute infections, inflammations, neoplastic and autoimmune diseases, and diseases with immune complexes. In these pathological conditions, CRP serum concentration increases rapidly, being obvious in a few hours after infection. Conclusively, CRP has nonspecific functions, independent to immune system, in early response and defense mechanisms against infectious diseases and other pathological conditions.

2. Coglutinin (CGT)

It is an ample plasma molecule which binds C3b of the complement in multiple combination sites; thereafter, CGT contributes in agglomeration (coagglutination) of C3B covered particles, followed by their phagocytosis and elimination.

3. Serum amyloid A (SAA)

It has various functions, including decrease of IL-1 and TNF-α induced fewer, inhibition of thrombocytes aggregation, and inhibition of oxidative reaction in neutrophils. Higher plasma concentration of SAA determined amyloidosis, disease characterized by deposition of this APP in various tissues, in fibrils that interfere with normal functions of the organs (e.g. myocardial contraction and glomerular filtration).

4. α1-acid glycoprotein (α1-AGP) suppresses lymphocytes blastogenesis response and antibodies synthesis.

5. β2-macroglobulin (β2-M) is a proteases inhibitor, neutralizing neutrophils and macrophages lysosomal hydrolases, similar to other anti-proteases.

6. Ceruloplasmin (CPL) eliminates neutrophils superoxides. **Fibrinogen** (FNG) is implicated in coagulation and wounds healing. Higher concentration of FNG determined erythrocytes agglomeration, fast deposition and increase of their sedimentation velocity.

7. Haptoglobin (HGB) inhibits bacterial development by binding iron, depriving bacteria of this element. In some species, authors describe other acute-phase proteins.

Role of acute-phase proteins in various species

Principal actions of positive APPs are hemoglobin, free radicals and aggregate cells elimination, binding of some bacterial components and amplification of immunoglobulins synthesis. APPs detection and measuring techniques are applied also in domestic animals for diagnosis neoplastic diseases, immunopathies and glomerulonephritis especially in dogs and horses. Measuring of haptoglobin and SAA in cattle serves in diagnosis of hepatic lipidosis, inflammation processes and reproduction-related diseases.

a. Cattle

APPs synthesis is initiated and regulated by IL-1, IL-6 and TNF. CRP does not have increases of serum concentration during the acute phase responses; therefore CRP

is not an APP. CGT is the main APPs in ruminant. The main plasma proteins whose concentrations increase during acute phase responses and their functions are:

- **Haptoglobin** – this APP binds free hemoglobin and composes polymers in association with albumin; it is an paraclinical marker for inflammatory processes severity; increases of haptoglobin concentration could be seen in hepatic lipidosis, defective nutrition, mastitis, experimental inflammation and in Dexamethasone treatment; presence of haptoglobin in serum is useful paraclinical sign in acute inflammations, acute infections, traumatic reticulitis;
- **Fibrinogen** - the fibrin precursor in coagulation process;
- **Serum amyloid A** - the fibrillar amyloid proteins precursor; it is associated with serum high density lipoproteins; concentration is increased in cows fed with endotoxin, during the pneumonia and also in association with parturition.
- **Ceruloplasmin** - binds copper ions, participates in oxygen radicals elimination;
- **α1-antitrypsin, α1-antichemotrypsin and β2-macroglobulin** - all with proteases inhibitor functions;
- **α1-acid glycoprotein** - with proteins transport function.

b. Sheep

There was described multiple APPs whose concentration are increased during endotoxin shock and various pulmonary diseases: HGB, CPL, and FNB. Synthesis of these APPs and their actions appertain to systemic and tardy period of acute phase response. Haptoglobin is a significant paraclinical parameter in prognosis of dystocia. Measuring of HGB, like auxiliary diagnosis element, is useful in infections. Changes in HGB, CPL and FNB concentration are correlated with decreases in production during diseases accompanied by inflammatory phenomena.

c. Goat

Significant increases of serum HGB in goat with dystocia unlike those with normal births and in the non pregnant. No changes in APP concentration associated with helminthiasis.

d. Swine

There are some studies about response through multiple APPs in swine: α1-AGP, soluble acid glycoprotein (AGPs), CLP, HGB, and CRP. Authors induced sterile inflammations and these were associated with increases in APP concentrations, especially in CRP, AGPs, and HGB. CRP and HGB is the most useful marker for inflammatory damages diagnosis in swine. Increase in CRP concentration after ACTH or corticosteroids administration, the level of this protein achieving normal value after treatment interruption. HGB level is increase in animal with atrophic rhinitis and with *Actinobacillus pleuropneumoniae* infection.

e. Horses

Increased plasma FNG synthesis and decreased CPL level in inflammation. The serum levels of some APPs increases in laminitis. In severe colic high concentrations of serum lipids, lipoproteins and TNF can be observed.

f. Dogs

Measure of CRP, together with α1-AGP and HGB was used in trypanosomiasis

and ehrlichiosis monitoring. CRP concentration increases after the middle of gestation and after parturition. Structural changes of HGB in dogs with hepatic diseases, especially chronic hepatitis and in various types of anaemia were observed.

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Foal Care and Management Of Colic In Horses

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Horse is considered as the lately domesticated animals and well adapted to temperate zone and sub tropics. Foal is a young horse of either sex less than one year old.Male and female foal foal is called colt and filly. Care and management starts 6 week before foaling. Neo-natal feeding depends up on feeding of mare during gestation. The dam should receive booster vaccinations to provide high levels of immunoglobulin in her colostrums. Colic is a major problem related to horse health management. Proper treatment and care can eliminate the colic problems in horse.

CARE OF THE FOAL AT BIRTH

Just after birth remove the mucus from nasal passage and mouth. We should remove the fluid from lung by flow of air or by lifting the foal by hind leg. We can also apply pressure on rib cage and forward motion from abdomen to neck. Umbilical cord cut 2cm from the foal's abdomen. Just after birth breaking of umbilical cord within few minute and apply 2 % iodine solution or 0.5 % chlorhexidine. This can be replies twice daily for three day. The normal physiological and respiratory parameters should be checked just after birth of foal.

COLOSTRUM FEEDING

Colostrum feeding is essential just after birth of foal. It is a necessary step to provide a passive immunity to new born foal. A 250-300 ml colostrum is essential just every 1 to 2 hrs for first 6 hrs. A 5% of B. wt. just after foaling, 10% 0f B.wt. from 1 to 5 day and 20% of B.wt. milk- from 5 day onward is sufficient amount. A normal IgG level: 800mg/ (dl) is adequate for foal. But when the IgG level <400 mg/dl the chances of failure of passive transfer is more. In case of orphan foal colostrum Should be frozen. We can feed through bottle or buckets. In the absence of colostrums milk from other livestock spp. like goat or cows milk can be preferred.

MANAGEMENT OF COLIC IN HORSES

The term "colic" literally means abdominal pain, or "a pain in the belly", for which there are many causes. Usually horse owners typically refer to colic as problems with the gastro-intestinal tract. Important cause of colic is -

- Mouldy feed and Improperly chewed food due to bolting or poor teeth

- Overeating grain when hungry from being off feed
- A diet of extremely coarse roughage or very fine roughage such as coastal Bermuda hay
- Consuming foreign objects and Parasites
- Feeding excessive salt to salt deprived horses when water is not readily available
- Long term use of NSAIDS and Stress
- Irregular feeding times and Lack of water
- Giving excess water to hot horses or horses deprived of water and Excess grain.
- Faecoliths or enteroliths (large accumulations formed in the intestine around foreign material)
- Feeding on the ground where sand can be ingested

TYPES OF COLIC

There are five types of digestive colic: spasmodic, impaction, incarceration, displacement, and excessive fermentation.

- *Incarceration colic:* A loop of the intestine may become trapped within a normal or abnormal structure in the abdominal cavity. A common example is a strangulating hernia. This situation may require surgery if the blood supply is cut off.
- *Displacement colic:* A portion of the intestine becomes twisted or caught in an abnormal position. The displacement may or may not be strangulating, but surgery usually is required to save the horse's life.
- *Excessive fermentation*: It occurs when the stomach's contents ferment more rapidly than they can be eliminated. This usually is caused by eating too much grain. Surgery rarely helps, and medical treatment is difficult. This situation also can cause rapid chemical changes in the blood that lead to abnormal blood flow to the hooves. This usually cripples the horse.
- *Spasmodic colic*: mildest and most common, associated with over-excitement or sudden feed changes, generally responds well to modest medical treatment.
- *Impaction colic:* caused by normal ingesta or foreign material blocking the intestine, by increased coarseness of forage, decreased intestinal fluid, or interference with normal intestinal movement. If the blockage prevents passage of gas as well as ingesta, surgical intervention may be necessary.

SIGNS OF COLIC

- Playing in water with its mouth and Curling the upper lip
- Refusing to eat, Biting its flanks and Looking at its abdomen
- An expression of anxiety on its face
- Kicking at its belly, rolling, pawing, getting up and down frequently and overall restlessness
- Assuming a saw horse posture (legs stretched out as if to urinate)
- Increased pulse rate and normal or raised temperature
- Sweating, abdominal distension and ddepression
- Lack of defecation, small volumes of firm, mucus covered faeces and anorexia

DIAGNOSIS OF COLIC

The horse's normal temperature, pulse, and respiration should be evaluated.The initial exam should be done from a distance to better observe the horse's behaviour. If the horse is in extreme pain, the vet can insert a nasogastric tube to relieve gas before the exam. The veterinarian will check the heart rate and capillary refill time (checked on the gums) to aid in determining cardiovascular status. He or she also will listen to abdominal noises and perform rectal palpitation to check for irregularities. Further diagnostic procedures performed in the laboratory may be required, including blood evaluation, abdomniocentesis, abdominal radiography, endoscopy, ultrasonography, and diagnosis of faecal material.

TREATMENT OF COLIC

At first do not allow the horse to drink or eat. Nasogastric tube can be use for to relieve gas. We can use water lavage (enema) at the site of an impaction. Faecal-softening agents such as psyllium hydrophilic mucilloid (Metamucil TM) (1–2 cups for 30 days), mineral oil, or warm-water enemas with lubricants 10–12 litres of warm water via a nasogastric tube every 2 hours. Surgery may involve resection of the damaged intestine. When deciding about surgery, consider economic factors. The post surgery survival rate is 50 percent, with 20 percent of those survivors dying within 1 year.We should allow the horse to maintain a regular schedule of exercise. We should feed small amounts frequently.Allow foreign materials that could be ingested, such as rubber feeders or fencing material, away from horses.Provide high-quality feed— high forage, low concentrate. Provide regular dental care to allow for proper chewing. Do not feed on the ground where sand may be ingested. Maintain a regular deworming schedule.