Indian Farmer

ISSN 2394-1227

A Monthly Magazine

Volume: 3 | Issue-12 | December- 2016 | Pages - 70

Common Plant Toxicity In livestock

www.indianfarmer.net

INDIAN FARMER

A Monthly Magazine

Volume: 3, Issue-12 December -2016

Economic impact of subclinical ketosis and clinical management of the affected dairy herd

A. Gopalakrishnan[1*], B. Balamurugan[2], M.I.Yatoo[1], M. Saminathan[3], Vivek joshi[1], Y. Ajith[1] and Umesh Dimri[1]

[1]Division of Medicine, [2]Division of Animal Reproduction, [3]Division of Pathology, ICAR-IVRI, Izatnagar, Bareilly-243122, Uttar Pradesh, India.
*Corresponding author: gopalvet88@gmail.com

Subclinical ketosis (SCK) is defined as increased levels of serum ketone bodies concentrations which are betahydroxybutyrate (BHBA) greater than 1.4 mmol/l during early lactation without the presence of clinical signs of ketosis (Duffield et al., 2009). It is a most important metabolic disorder and occurring due to negative energy balance around calving. This disorder have been associated with decreased milk production, impaired reproductive performance, displaced abomasums, metritis, mastitis, and clinical ketosis.

INCIDENCE AND RISK FACTORS

The incidence of ketosis is higher in third lactation or following that. The peak prevalence of subclinical ketosis occurs during the fourth week of lactation averages 30% in most herds. Subclinical ketosis (SCK) incidence is far more common than clinical disease and frequently goes unnoticed. There are indications that cows with the highest milk yield directly after calving are at greatest risk for developing ketosis. High yielding cattle generally suffer either within a month after calving or any time during lactation period. This is because all high yielding cows in the early lactation remain in negative energy balance. Infrequently it can be observed in dry cows which are in late pregnancy. A significant relation between animal age, number of parturition, mastitis and subclinical ketosis has been reported by Dohoo et al. (1984). Subclinical ketosis was more likely to be found in cows experiencing metritis than in unaffected cows.

DIETARY ENERGY IMBALANCE

The ketone body level in circulation is influenced by both the energy balance and plasma glucose. The high-producing dairy cows are more susceptible due to energy intake may not keep up with demand. Feeding silage with high butyric acid content and less dry matter intake are leading to increases the risk of subclinical ketosis. After post calving, the low blood glucose and negative energy balance which

can stimulate the body starts to mobilize the body's fat stores. Fat mobilization releases NEFA into the blood, where they can be used as a fuel source for several tissues, including muscle and can also be used by the mammary gland for fat synthesis.

A portion of the NEFA released from lipolysis will be removed from the blood by the liver. The liver can completely oxidize these fatty acids for energy, it can partially oxidize them to produce ketones, or the fatty acids can be packaged back as triglycerides and then incorporated into lipoproteins to go back to the tissues, or stored in the liver (Allen et al., 2013). The three most common ketones produced by the partial oxidation of fatty acids in the liver include acetone (AC), acetoacetate (ACAC), and BHBA and these three can be used for energy by some tissues, such as the brain, skeletal muscle, and cardiac muscles. Out of this three ketone bodies, the BHBA is an important for diagnosis, because of this more stable than other two ketone bodies.

ECONOMIC SIGNIFICANCE

Metabolic disorders of cattle affect dairy cows immediately after parturition. Among metabolic diseases, ketosis is a common disease in lactating dairy animals (Thirunavukkarasu et al. 2010). Clinical and subclinical ketosis is one of the major causes of loss to the dairy farmer. Sub-clinical ketosis is however far more costly than clinical ketosis which is visible and treated; as will bring on immune deficiency symptoms mostly commonly verified in elevated cell count and clinical mastitis. Ketosis causes economic losses to the dairy industry because of decreased milk yields and lower milk protein and milk lactose, decreased reproductive efficiency (delayed estrus and lower first service conception rates, increased intercalving intervals and increased risk of cystic ovarian disease and mastitis), increased involuntary culling, and increased treatment costs (Ardvan Nowroozi et al., 2011).

The economic loss of one cow with subclinical ketosis is estimated to be $78 U.S (Geishauser et al., 2001). Averages of 100 dairy cows were suffered with subclinical ketosis and the incidence rate of 41 percent with an annual cost of $3198 (Todd Duffield, 2003). The loss due to ketosis was estimated by (Thirunavukkarasu et al., 2010) and reported that Rs. 577.09 per affected cow, which included the cost of medicines (Rs. 262.99, 45.57 percent), veterinarian's fee including additional labour cost (Rs. 224.98, 38.99 percent) and expenses on feed supplements (Rs. 89.12, 15.44 percent).

CLINICAL SIGNS

In subclinical ketosis, urine and blood contain ketone bodies in excess amounts without showing obvious symptoms of ketosis. But, SCK will have diminished productivity including depression of milk yield and a reduction in fertility. Potential milk production is reduced by 1 – 9 %. Also, it causes increased clinical disease risk, impaired immune function, and increased risk of culling.

DIAGNOSIS

Hypoglycaemia (<30mg/100 ml), ketonaemia (40mg/100ml milk) and ketonuria (500-1000mg ketone bodies /100ml of urine) are characteristics of the disease. There is an increase in plasma free fatty acids in some cases. The gold standard test for SCK is blood β-hydroxy butyrate (BHB) which is more stable ketone body than acetone or acetoacetate. SCK may start at serum concentrations above 1,000 µmol/L. A threshold value of 1,400 µmol/L BHB of blood has been described to distinguish between cows with and without SCK (Oetzel 2004). Subclinical ketosis can be revealed by determining levels of plasma glucose, plasma NEFA and blood, and milk or urine ketone body concentration**.**

TREATMENT AND PREVENTION

- The three common treatments used to elevate blood glucose and control ketogenesis are; intravenous infusions of glucose, intramuscular injections of hormones (glucocorticoid, adrenocorticotrophic, cortisone) to stimulate gluconeogenesis and oral glucogenic materials (Radostits et al., 1994).
- Propylene glycol has been used successfully for the prevention of subclinical ketosis (Sauer et al., 1973). Treatment of cows for eight weeks starting at calving with either 3 or 6% propylene glycol in a concentrate mixture significantly reduced the incidence of positive milk ketone tests. Precalving oral treatment with 300 g/day of propylene glycol for 10 days lowered serum non-esterified fatty acids (NEFA) concentrations and improved some measures of reproductive performance in one study (Formigoni et al., 1996).
- The recommendations for prevention have focused on the nutritional management of the dry and transition cow.
- It is a common recommendation to divide the dry period into two feeding groups: far-off and close-up (Radostits et al, 1994). Typically, far-off diets follow NRC (2001) guidelines for dry cows. The close-up diet is usually balanced according to recommendations that are halfway between those for the dry cow and those for the early lactation cow and should be fed starting at least three weeks before expected calving.
- The goals of the transition diet (specifically designed to prevent subclinical ketosis) are to maximize dry matter intake (DMI) to provide adequate energy density (Oetzel, 1998)
- We should maintain cows in good body condition and avoid excessive fattening prior to parturition, improve and maintain feed intake to avoid severe energy deficit, avoid abrupt changes in ration composition, feed good quality and abundant roughages, have multiple feedings, reduce feeding ingredients high in butyric acid, have a properly balanced ration for protein, minerals and vitamins, provide proper housing and exercise, monitor herds for ketones

and lastly, problem herds should use prophylactic feeding of propylene glycol.

- Maximizing DMI and maintenance of a consistent intake through the last three weeks prior to calving is likely the hallmark of a successful transition cow program.
- Niacin fed prior to calving at the rate of 3 to 6 g/day may be helpful in reducing blood levels of BHBA (Dufva et al., 1983).
- Monensin, an ionophore that included at 30 g/ton of total ration (high group) decreased the incidence of subclinical ketosis and significantly reduced blood BHBA concentrations in the first three weeks postpartum (Sauer et al., 1989).

Monitoring Subclinical Ketosis in herd

- The routine determination of milk acetone levels in control programs can be used to evaluate the status of individual cows, to indicate the energy feeding in early lactation at a herd level, and to evaluate sires for breeding.
- The heritability and the tendency toward a positive genetic correlation between milk acetone and milk yield have also been discussed, as have aspects of nutritional prevention.
- Factors such as energy- and protein-rich roughage, tasty high-energy concentrates, suitable feeding during the dry period and division of the concentrates into at least four meals are considered to be important.

CONCLUSIONS

Subclinical ketosis is an important and common disease in lactating dairy cows. Prevention depends largely on effective dry cow nutrition and management. However, certain feed additives, such as ionophores and rumen-protected choline, may be beneficial. Given the cost of subclinical ketosis, the fact that it is a common problem in early lactation, and the strong association with clinical disease, monitoring programs for subclinical ketosis during the first few weeks of lactation may be warranted.

REFERENCES

Allen, M. S. and Piantoni, P. (2013). Metabolic control of feed intake: Implications for metabolic disease of fresh cows. Veterinary Clinics of North America: Food Animal Practice **29**(2): 279-297.

Ardavan Nowroozi, A., Saeed, N., Abbas Rowshan, G. and Ahad, O. (2011). Prevalence of subclinical ketosis in dairy cattle in the South Western Iran and detection of cut off point for NEFA and glucose concentrations for diagnosis of subclinical ketosis. Preventive Veterinary Medicine, **100**: 38-43.

Dohoo, I.R., Martin, S.W., McMillian, I. and Kennedy, B.W. (1984). Disease production and culling in Holstein - Friesian cow. II age, season and sire effect. *Preventive Veterinary Medicine.* **2**: 665-671.

Duffield, T.F., Lissemore, K.D., McBride, B.W. and Leslie, K.E. (2009). Impact of hyperketonemia in early lactation

dairy cows on health and production. *J. Dairy Sci.* **92**: 571–580.

Dufva, G.S., Bartley, E.E., Dayton, A.D. and Riddell. D.O. (1983). Effect of niacin supplementation on milk production and ketosis of dairy cattle. *J. Dairy Sci.* **66**:2329-2336.

Formigoni, A., Cornil, M.C., Prandi, A., Mordenti, A., Rossi, A., Portetelles, D. and Renaville. R. (1996). Effect of propylene glycol supplementation around parturition on milk yield, reproductive performance and some hormonal and metabolic characteristics in dairy cows. *J. Dairy Res.* **63**:11-24.

Geishauser T., Leslie, K. and Kelton, K. (2001). Monitoring subclinical ketosis in dairy herds. Comp. Cont. Ed., **23**: 65-71.

National Research Council (NRC). (2001). Nutrient requirements of dairy cattle. 7th rev. ed. Natl. Acad. Sci., Washington, DC.

Oetzel, G.R. (1998). Dairy: Nutrition Management. Nutritional management of dry dairy cows. Comp. Cont. Ed., March, Food Animal. Pp: 391-396.

Oetzel, G.R. (2004). Monitoring and testing dairy herds for metabolic disease. Vet.Clin. North Am. Food Anim. Pract. **20**: 651–674.

Radostits, O.M., Blood, D.C. and Gay, C.C. (1994). Veterinary Medicine: A textbook of the diseases of cattle, sheep, pigs, goats and horses. 8th ed. Bailliere Tindall Publishing, Toronto, Canada. Pp:1343.

Sauer, F.D., Erfle, J.D. and Fisher. L.J. (1973). Propylene glycol and glycerol as a feed additive for lactating dairy cows: an evaluation of blood metabolite parameters. *Can. J. Anim. Sci.* **53**:265-271.

Sauer, F.D., Kramer, J.K.G. and Cantwell, W.J. (1989). Antiketogenic effects of monensin in early lactation. *J. Dairy Sci.* **72**:436-442.

Thirunavukkarasu, M., Kathiravan, G., Kalaikannan, A. and Jebarani, W. (2010). Prevalence of ketosis in dairy farms–a survey in Tamil Nadu. Tamil Nadu Journal of Veterinary and Animal Sciences, **6**: 193-195.

Obstructive Urolithiasis in ruminants: an overview

Deepesh Gautam[1*], Deepa Singh[2], Ravi Shankar Kumar Mandal[3] and Balamurugan B[4]

Ph.D Scholars at Division of Surgery1, Extension2, Medicine3, Animal Reproduction4, IVRI, Izatnagar
Corresponding author- email- gautamdeepesh87@gmail.com*

Calculi, popularly called stones can develop in many cavities in the body, e.g. gall bladder, kidney, etc. They are commonest in the urinary tract where they are termed uroliths. Obstructive urolithiasis is the inability to void urine normally because of calculi obstruction in any part of the urinary outflow tract, with the most common site of obstruction being the sigmoid flexure (in large ruminants) and urethral process (in small ruminants) of the urethra. Calculus formations are due to multiple nutritional, physiologic, management and disease causes. Urolithiasis is a common clinical condition of almost all domestic animals (Radostitis *et al.*,1994), but higher incidence has been recorded in bovine and caprine. Urolithiasis becomes an important clinical disease of castrated male ruminants.

Obstruction induced by urethroliths causes urine retention and leads to bladder distention, abdominal pain and eventual urethral perforation or bladder rupture with death from uraemia or septicaemia. Urolithiasis is seen most often during winter in steers and wethers on full feed, or on range during severe weather conditions with limited water intake, especially when the water has a high mineral content (Radostits *et al.*, 1994). Urinary calculi are believed to be formed as a result of abnormally high concentration of insoluble complexes in the urine or mineralization of a nidus (Smith, 1989). Uroliths occur in either sex, but obstructive urolithiasis develops primarily in males because of anatomic differences (Fraser, 1993).

Common problems associated with urinary tract stones-

Blood stained urine (haematuria)

Straining to urinate (dysuria)

Haematuria - irritation caused by the stones on the delicate lining of the urinary tract mucosa. This causes inflammation and then bleeding from the surface. Bacterial infection also exacerbates the problem.

Dysuria- can occur due to inflammation and irritation of the urinary tract, creating an urge to pass urine. When urine flows from the bladder is obstructed the bladder continues to fill with urine and this is an acutely painful condition.

WHY DO THEY OCCUR?

Precipitation-crystallisation theory is the

most commonly accepted theory for bladder stone formation. One or more of the stone forming compounds are present in urine in excessive amount. This may be due to abnormalities in diet or most commonly, bladder infection with certain bacteria. Once the urine can dissolve no more of the compound, it is said to be supersaturated and the compound precipitates and forms minute crystals. These then clump and stick together due to the mucus-like material that is found within the bladder. As these crystals grow other minerals in the urine become involved and so the stones enlarge.

How the cystic calculi diagnosed?

1. Clinical signs (stranguria, haematuria, urine dribbling).
2. Urine analysis and examination of a sample for stones.
3. Bladder and urethral stones can be visualised with radiographs.
4. Serum electrolyte changes.
5. Ultrasound scans.
6. Urethroscopy.

TYPES OF UROLITHS IN RUMINANTS

The stones can be composed of phosphate and calcium salts: calcium phosphate (apatite), magnesium ammonium phosphate (struvite), calcium carbonate, calcium oxalate or silicate. Ruminants fed on high-grain diets with low Calcium : Phosphorus ratio (Ca: P ratio less than 1.5:1), are at increased risk of developing struvite uroliths ($MgNH_4PO_4 \cdot 6H_20$). Calcium phosphate or hydroxyapatite ($Ca_{10}(PO4)_6(OH)_2$) stones form in neutral to alkaline urine pH, usually smooth and round. Diets high in magnesium with a normal Ca: P ratio(2:1) promoted calcium phosphate (apatite) calculogenesis. Ruminants grazing on silica-rich soil are predisposed to form silica uroliths. Diets high in calcium (e.g., subterranean clover) may result in calcium carbonate uroliths. Plants such as Halogeton or tops from the common sugar beet may be a factor in calcium oxalate formation. In the gut, oxalate binds calcium avidly and makes it unavailable for absorption. Struvite stones are also known as magnesium ammonium phosphate stones due to their chemical composition. They form at a neutral to alkaline pH of the urine.

PREVENTION

1. **Water supply and intake**: Provide *ad lib* clean fresh water and add NaCl up to 4% in ration (to induce diuresis), it also replaces Magnesium & phosphate from magnesium ammonium phosphate or phosphate calculi.
2. **Roughage**: Stimulate salivary flow and excretion of P by GI tract.
3. **Urine acidifiers**: Ammonium chloride (NH_4Cl) can be fed at a level of 0.5-1% of dry matter in the diet, it increases solubility of calculi.
4. Add limestone in ration to balance Ca:P ratio (normal- 2:1).
5. Appropriate antibiotic- to prevent urinary tract infections (Enrofloxacin is preferred).
6. Avoid castration at an early age because it causes improper development of urethral tract.

Ethnoveterinary practices used as a Galactogogues in Dairy Animals

Subhash Chandra, Amit Kumar, Archana Yadav, Mukesh bhakat and Pooja Tamboli

LPM, ICAR-NDRI, Karnal, Haryana
**Corresponding author: subhashchndra20july@gmail.com*

The glorious history of Indian dairy industry with over whelming improvement in milk production through crossbreeding to improve genetic potential of indigenous Cattle has brought many challenges, which leads to production loss. To overcome from such problems use synthetic hormone to augment milk production further leads to serious disease condition like hypothyroidism, cystic ovary, reproductive failure and repeat breeding due to altered tissue function and destabilization of the basal metabolic rate of tissue. Therefore, researchers are trying to find out suitable galactogogues of herbal origin to improve the herd health without causing adverse effect. Galactogogues are the chemotherapeutic agent used for the milk production improvement. Several indigenous herbs have galactogenic properties have been experimented in human to improve milk production and having proven ayurvedic strategies (Pattnaik, 2003). Indigenous herbs can be used safely to improve milk production. The mechanism of action of these herbs needs to be established to understand the pharmacodynamics of mammogenic effect of these herbal plants, but these are believes that they work through adreno-hypothalamo-hypophyseal gonodal axis.

The interesting fact is that the ethnoveterinary practices using herbal plants restore tissue function in natural way with microenvironment of body physiology. It is well known that Bovine somatotropin (BST), thyrotropic releasing hormone and oxytocin has galactogenic activity and commonly used to enhance milk production, but they have adverse effect on neuro-endocrine axis of lactation physiology and changes in biochemical reaction of animal tissues. Therefore, uses of herbal plants having galactogenic properties are useful to potentiate ok maintain milk production. Most of them exert their positive effect through interactions with Dopamine receptor, resulting in increased prolactin levels, which leads to improvement in milk production.

Some of these herbal agent names have been recommended as galactogogues in veterinary medicine (Pattnaik, 2003). Yet the full potentials of such herbal galactogogues in terms of their role in

lactation physiology have not been exploited fully.

A number of herbal plants, which contain large number of chemical active compounds including alkaloids, having galactogenic properties, can be used as herbal therapy for the purpose of milk let-down in milking animals.

A number of herbal galactogenic products manufactured by various Indian and foreign pharmaceutical companies are available commercially in market. At present, they are used to increase milk production in various commercial and small holder dairy farms in our country.

CONCLUSION

The boom towards adaptation of traditional medicine giving a window to think towards ethnoveterinary practices. The ingredients used in the ethnoveterinary practices were generally the one that are easily available in the household or nearby surroundings. Therefore, it becomes necessary to conserve these plants both culturally as well as genetically. The government and non-governmental organizations must work in this direction and provide necessary facilities to the farmers to cultivate these species. There is urgent need to create a database of the ethnoveterinary practices of different parts of the country to promote the cultivation of herbal plants and use it for improvement of milk yield. There is need research studies to understand the beneficial role of herbal plants to give a better confirmation of milk yield improvement in dairy animals.

REFERENCES

Bingel AS and Farmsworth MR. (1991). Higher plants as potential sources of galactagogues. *Econ. Med. Plant Res.,* 6: 1-54.

Brinker F. (1998). Herb Contradictions and Drug Interactions. *Sandy and Eclectic Medical Publication,* pp. 70-71.

Chopra RN, Nayar SL and Chopra IC. (1956). Effect of some herbal preparations as galactogogue in milch animals. *Glossary of Indian Medicinal Plants*, CSIR Publication, New Delhi.

Das, S.K., Tripathi, H., 2009. Ethnoveterinary practices and socio-cultural values associated with animal husbandry in rural Sunderbans, West Bengal. *Indian Journal of Traditional Knowledge* 8, 201–205.

Kirtikar KP and Basu BD. (1975). Effect of herbal preparation on hypogalactic cross breed cows. In: Indian Medicinal Plants, 2nd Edn., Periodical Express, New Delhi.

Rashid, A., Anand, V.K., Shah, A.H., 2007. Plant resources utilization in the ethnoveterinary practices by the Gujjar and Bakarwal tribes of Jammu and Kashmir State. *Journal of Phytological Res.* 20, 293–298.

Swafford S and Berens B. (2000). Effect of fenugreek on breast milk production. Annual meeting abstracts, 1113th September. ABM News and Views, 6(3): 10-12.

Tiwari, L., Pande, P.C., (2010). Ethnoveterinary medicines in Indian perspective: Reference to Uttarakhand, Himalaya. *Indian Journal of Traditional Knowledge* 9, 611–617.

Table No. 1: Plant species used for improvement of milk yield of animals

Plants	Parts of the plant	Observations/ Uses/ Findings
Shatavari (*Asparagus racemoscis*)	Root	19.82 % increase in milk yield
Channa (*Cicer arietinum*)	Seeds (seed coat)	Increases the milk yield capacity of the animals.
Ashwagandha/winter cherry (*Eutharia somnifera*)	Root, stem and fruits	
Lana (*Ficus hispida*)	Fruits (alone or in combination with ajwain)	Increases the milk yield capacity of the animals especially in cows.
Peepa (*Ficus religiosa*)	Leaves	Improvement of milk yield capacity of goat.
Kapas (*Gossypium hirsutum*)	Seeds	Increase the milk yield capacity and removes general weakness
Jau (*Hordeum vulgare*)	Seeds	Fed with other constituents to the animals in order to remove general weakness and to increase milk yield.
Til (*Lens culinaris*)	Seeds	Fed to the animal to increase the milk yield
Raspberry (*Rubus idaeus)*	Leaves	Fed to the animal to bring enriched milk. It is not a galactogogue, rather it provides high level of vitamin-A, B, C, E, K, as well as minerals like Ca, Fe for milk production (Brinker, 1998)
Milk thistle (*Silbanum marianum*)	Leaves	Fed to the animal for improvement of milk yield and moderate level of estrogen.
Fenugreek (*Trigonella foenum graecum*) Cumin (*Cuminum cyminum*) Anise (*Pimpinella anisum*)	Seed Seed Fruit	Galactogogue stimulant
Garoh (*Tinospora cordifolia*)	Whole plant	Extensively used for increasing the milk yield capacity of the animals of cows and buffaloes.
Ajwain (*Trachyspermum ammi)*	Seeds	Fed with other ingredient to the animals in order to remove general weakness and increasing milk yielding capacity
Gehun/ Wheat (*Triticum aestivum*)	Grains	Grains soaked overnight are grinded and then fed to the animal in order to remove general weakness and increase the quantity of milk especially in young buffaloes.
Mung (*Vigna mungo*)	Seeds	Fed with other ingredients increase the milk yield in animals.
Makki (*Zea mays*)	Seeds	Fed with other ingredients increase the milk yielding potential of the animal.

Common plant toxicity and their treatments in livestock sector

P. Samal[1*], D. Jena[2], S. Dwivedy[3], S. Behera[4] and A. Mahapatra[5]

[1]ICAR- Central Institute for Women in Agriculture, Bhubaneswar
[2]Division of Animal Reproduction, IVRI, Izatnagar, Bareilly
[3]College of Veterinary Science and A.H., OUAT, Bhubaneswar
[4]Division of Bacteriology and Mycology, IVRI, Izatnagar, Bareilly
[5]Section of veterinary Anatomy, IVRI, Izatnagar, Bareilly
*Corresponding Author: masterpinaki@gmail.com

Abstract:
India has been best owed with a wide range of flora and fauna which signifies its vast geographical variations throughout the country.The inter relationship between the plants and animals is time immemorial. Albeit the plants are sole source of food for herbivores, there are some plants or herbs which are potentially dangerous for their health and life. The toxic compounds in plants are usually a defence mechanism against predation and have a distinct unpleasant odor or a bitter taste and are not preferentially grazed, but scarcity of grasses in adverse environmental condition propels the animals to consume these noxious weed. Consumption of these toxic weeds results appearance of toxic symptoms like alopecia, itching, dermatitis, photosensitisation, nausea, volition, in-appetence, tympani, abdominal pain, diarrhoea and in certain cases death depending upon the type of toxic principle present and the amount of toxic substance consumed. So this condition results huge economic losses in terms of both animal death and production loss. Understanding the dangers and various management strategies to control toxic plants will reduce the risk to your livestock. Recognition of poisonous plants and the proper management of animals and pastures will help to minimize the potential for poisoning animals from poisonous plants.

INTRODUCTION

Many of the plants are main source of feedstufffor the herbivorous animals like ruminants. Though they derive major chunk of nutrients from the forages, many a times someof themturn out to be poisonousfor the animals. Their action come into play while grazing animals like cattle mistakenly consume some poisonous plants as feed and fall as victims to poisoning. If the cases are not treated swiftly and properly then it may aggravate the health of the animal leading to the loss of the life of the animal.They pose a serious threat due to their wide range of distribution from backyard to the forage land. The toxic plants like lantana, datura can be abundantly found in villages areas like near the roadsides, shallow pit of water, uncultivated land etc. So it is very essential from the part of not only veterinarian but also for commoner to know the plants, their effects on livestock and if got affected what to be done at very

first step so as to minimize the poisonous effects.

Lantana camara

This plant is a perennial, summer growing erect scrub. The most distinguishing feature of the plant is its flowers, appearing in dense clusters and vary in colour from red, yellow, orange, pink and white, depending upon their type, maturity and location. The toxic dose for a 300 kg cow varies from about 5-15 kg of fresh leaf, depending on the toxin content of the lantana eaten.

Lantana poisoning in animals

Generally, the animals avoid lantana eating unless until there is no scarcity of food. The incident varies from sporadic to heavy outbreaks in case of fodder scarcity during droughts or floods. Lantana hepatotoxin-sarepentacyclic-triterpenoids called 'Lantadines'.

Figure 1: Lantana camara plant

Clinical signs

Toxicity occurs after ingestion of different parts of this shrub which include leaves, fruits and flowers. After ingestion, the plant materials are metabolized in rumen and toxins got absorbed from the rumen to the hepato-billiary portal system causing several health issues like photosensitivity, jaundice, conjunctivitis, polyuria, liver damage, photophobia, ulceration of tongue, loss of appetite and in severe cases, death may occur.

Diagnosis

History, Clinical signs should be thoroughly examined. In clinical pathology, there is decrease in cytosol glutathione S-transferase, leakage of lysosomal enzyme from liver; Lantana extract in rumen content etc.In post-mortem lesion, liver is ochre coloured and greatly swollen and there is a distended gall bladder. Presence of dry undigested rumen content is also found.

Treatment

Intravenous fluid therapy with antibiotic treatment for skin lesions will be helpful. Drenching with slurry(2.5 kg activated charcoal in 20 litres of electrolyte replacement solution) for cattle; 500 g in 4 litres for sheep and goats) is important.

Abrus precatorius

This is a perennial vine, climbing on other plants and goes up to 10-20 feet tall. The most toxic part of the plant is its seeds. Toxicosis results from broken or chewed seeds. Humans and horses are more susceptible followed by goats, cattle and dogs. These plants are mostly found in tropical locations such as central and western parts of India.The toxic principles include Abrin, Abrine and Abralin.

Clinical signs

Abrin is a potent cytotoxin which causes agglutination (clumping) of RBCs. The clinical signs of affected animals include

severe gastrointestinal irritation, nausea and vomiting; dehydration, trembling, hemolytic anemia, incoordination to paralysis and death. In horses, there is loss of appetite, violent purgation, elevation followed by depression in temperature, incoordination and sometimes paralysis.

Diagnosis

The diagnosis of this toxicity is done on the basis of identification of the seeds of *Abrus precatorius*, substantial evidence of consumption, appropriate clinical signs and post mortem lesions.

Treatment

No specific antidotes are available for this poison.Emetics which induce emesis unless contraindicated by the condition of the animal should be given. Activated charcoal with a saline cathartic, e.g., magnesium sulfate and fluid therapy should be given.Oral antacids to alleviate local irritation have been very beneficial.

Datura stramonium

The Jimsoo weed is a stout and coarse annual herb. The flowers are large, white or purple and fruits have a spiny capsule. These plants grow in fertile soils where other plants are scarce e.g., barnyards, fertile cultivated fields;etc. The toxic principles include tropane alkaloids like hyoscyomine and scopolamine.

Figure 2: Datura stramoniumplant

Clinical signs

Poisoning occurs when a large amount is being consumed by the animal. Entire plant is toxic, seeds most often implicated. Pigs appear to very sensitive to seeds.The common clinical signs in affected animals includeataxia, inability to stand, hypothermia, anorexia, weightloss, diarrhoea and tremors.

Diagnosis

The diagnosis of datura poisoning is done on the basis of case history, circumstantial evidence by identification of *Atropa bellodona* spp. and evidence of consumption. Placing a drop of urine into a cat's eye causes mydriasis if there is datura poisoning.

Treatment

Symptomatic treatment should be carried out. The animals should be removed from source of poison. If poisoning is due to ingestion of a plant material, gastric lavage should be given or vomition should be induced. Pentobarbitone, tranquilizers, sedatives etc. may be used to control excitement and convulsions.

Ricinus communis

This is a large glabrous annual herb which is 3-10 feet tall. The fruit is capsuled and spiny. This plant is commercially grown in India in all states as the common castor oil plant. It occurs in roadsides, dumping

grounds, barnyards of warmer areas of India. Toxicosis not only associated with plant, but most often with seed and seed products. Ricin is the principal toxin which is inactivated by heating in castor bean cakes and meals.

Figure 3: Ricinus communis plant

Clinical signs

All parts of the plants are toxic, specially the seeds. However castor oil is not poisonous. The clinical signs includegastrointestinal irritation, diarrhoea which is often bloody, tenesmusand cessation of rumination. After convulsions, death may result from paralysis of the respiratory centre. Lesions like generalized congestion are seen. Catarrhal to haemorrhagic gastroenteritis is observed. Fatty and hydropic degenerative changes are observed in liver.

Diagnosis

The diagnosis is based on case history, circumstantial evidence by identification of *Ricinus* or products and evidence of consumption along with clinical signs.

Treatment

A gastrointestinal tract protectant such as kaolin-pectin and fluid therapy alongwith ascorbic acid increases survival rates. Judicious use of anticonvulsants if indicated should be done. Renal and hepatic function should be maintained and electrolyte to maintain fluid balance. Oral antacids should be used to alleviate local irritation.

Nerium oleander* and *Thevetia peruviana

This is an evergreen shrub of about 5-25 feet tall and looks like a small tree. The flowers appear in spring or early summer and are white, pink, yellowish, rose, deep red. They are used as an ornament

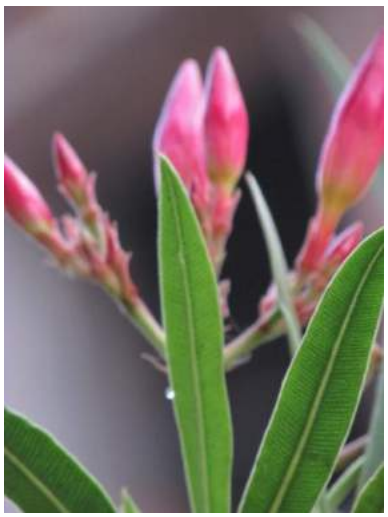


Figure 4: Thevetia peruvianaplnt

Figure 5: Nerium oleanderplant

al shrub in Southern and Southwestern India. The toxic principles include highly toxic cardiac glycoside similar to digitoxin. Stems, flowers, leaves all are toxic. Garden cuttings thrown into feeder troughs are a

major cause of poisoning. Oleandrin is water soluble, so leaves falling in a pond can poison the water, but the water is usually made unpalatable, so animals may avoid it.

Clinical signs

The clinical signs in the affected animals include local irritation of the mucous membranes of the mouth and stomach, anorexia, rapid pulse,cold extremities,pupillary dilation, bloody diarrhoea and nervous disorders like convulsion, ataxia and paralysis occur.

Diagnosis

The diagnosis is based on case history, circumstantial evidence by identification of Nerium species and evidence of consumption. Clinical signs and post mortem lesions are observed.

Treatment

No specific antidotes are available for this poisoning. Emetics (apomorphine) should be used. Osmotic or saline cathartics and gastric demulcents should be used. Atropine along with propranolol should be admistered. Dipotassium edetate may be used as antidote.

Ipomoea carnea

This plant introduced in our country as an ornamental plant. Animals generally do not graze this plant but due to scarcity of the fodder in drought condition and lean periods, they do browse on it and succumb to toxicity. The exact nature of the phytotoxins of this plant is not known. A number of lysergic acid alkaloids, some of which are hallucinogenic have been isolated from Ipomoea species. *I. carnea* leaves are known to contain toxic saponins. This species also accumulate very high concentrations of nitrates from the soil.

Figure 6: carnea plant

Clinical Signs

Acute and sub-acute toxicity following ingestion of *I. carnea* leaves is reported in goats. The important toxic signs observed are salivation, mydriasis, shivering, incoordination, staggering gait, prostration, paralysis of limbs, lateral recumbency, hypotension and death.

Diagnosis

Diagnosis id based on basis of history of grazing near Ipomoea hedges and clinical signs.

Treatment

There is no specific line of treatment. General line of symptomatic and supportive treatment may be given like saline purgatives to remove theunabsorbed ingesta. The affected animals should be administered hepatotonics, nerve tonics to overcome hypophosphataemia.

Parthenium hysterophorus:

Originally native to south and Central America was accidentally introduced into India**.** Its seeds as contaminant of imported

wheat from USA gained access into our country during the early sixties. The weed also poses health hazard in animals, especially the grazing livestock. Cattle, buffaloes and goats graze on the weed where the fodder fields are heavily infested with the weed

Toxicity:

The major sesquiterpene lactone of Parthenium weed i.e. parthenin is a photodynamic substance. Hence, as seen with other photodynamic agents, ingestion of parthenium weed results in primary photosensitization, causing liver pathology and skin reactions. In general, toxicity in cattle and buffaloes develops following ingestion of the weed over a period of seven or more days.Initially the animals show diarrhea followed by cutaneous lesions characterised by itching, erythematous eruptions on tip and base of ears, neck, sides of thorax, abdomen, knee, hock joint and brisket region. Depigmentation in patches may also occur in the above areas. Oedema around eyelids and facial muscles is also observed. The dermal syndrome is commonly seen in buffaloes. Retarded growth is noted in buffalos.

Diagnosis :

History of grazing of animals in parthenium inhabited pastures and signs of dermatitis.

Treatment :

The line of treatment should he aimed at treating the coetaneous lesions by giving anti pruritics and antiseptics and to improve liver function by giving hepatotonics.

Strychnos nuxvomica

This plant used in pesticides to control gophers, moles (subsoil use) and rats.Accidental poisoning due to consumption of seeds, consumption of baits containing strychnine kept for foxes, rats, mice etc. and ingestion of birds or rats died due to strychnine poisoning. All species are sensitive but dogs more prone to this toxicity.

Clinical Signs

Clinical signs include anxiety, stiffness, and violent tetanic seizures spontaneous or initiated by numerous stimuli (which is a diagnostic feature), saw-horse stance/posture of the body opisthotonus and persistent rigid extension of all four limbs.

Diagnosis:

Diagnosis can be done by history of taking this noxious plant, observing clinical signs and laboratory analysis of the ingesta as well as excreta.

Treatment:

There is no specific antidote for this toxicity. Only symptomatic and supportive treat may be provided. Besides that, entero-gastric lavage or stomach wash with dilute hydrochloric acid or 1:1000 potassium permanganate solution or 1:250 dilution of tincture iodine followed by final wash with plain water may be useful.Emetics are generally contraindicated due to the risk of initiation of a seizure and aspiration.

CONCLUSION

In India adverse environmental conditions and frequent occurrence of natural calamities results scarcity of grasses which forces the animals to consume these above

said noxious weed resulting in toxicity. Diagnosis of these poisoning is not an easy task rather it depends upon a good case history and evaluation of clinical signs and pathological lesions, as well as confirmatory laboratory tests. Treatment is not always possible or successful, and prevention remains the most important way to protect animals. However knowledge about the toxicity, pasture management and diagnosis of toxicity in early stage may increase the chances of recovery if treated accordingly.

REFERENCES

Adedapo, A.A.,Omoloy, O.A. and Ohore, O.G.(2007). Studies on the toxicity of an aqueous extract of theleaves of *Abrus precatorius* in rats. *Onderstepoort Journal of Veterinary Research*, 74:31–36.

Binev, R., Valchev, I. and Nikolov, J.(2006). Clinical and pathological studies of jimson weed (*Daturastramonium*) poisoning in horses. *Trakia Journal of Sciences*, 4(3): 56-63.

Bothaa, C.J. andPenrithb, M.L. (2016). Poisonous plants of veterinary and human importance in southern Africa. *Journal of Ethnopharmacology,* 119 (2008): 549–558.

Garg, S.K. (2010). Veterinary toxicology. CBS publisher and distributers pvt. Ltd. New Delhi.

Haraguchi, M., Gorniak, S.L., Ikeda, K., Minami, Y., Kato, A., Watson, A.A., Nash, R.J., Molyneux, R.J.and Asano, N. (2016). Alkaloidal Components in the Poisonous Plant, *Ipomoea carnea* (Convolvulaceae). *Journal of agriculture and food chemistry*, 51: 4995-5000.

Kushwaha, R.K., Berval, R. and Sharma, A. (2014). The therapeutic and toxicological effect of kupilu (*strychnosnux-vomica l.*)- A review.*Ayushdhara*,1(2):1-4.

Narasimhan, T.R., Ananth, M., NarayanaSwamy, M., RajendraBabu, M., Mangala, A. and SubbaRao, P.V. (1977). Toxicity of *Parthenium hysterophorus* L. to cattle and buffaloes. *Pharmacologica Experientia*, 33(10): 1358-1359.

Ross., I.A. (2016). Ricinus communis. *Medicinal Plants of the World,* 10: 375-395.

Sharma, O.P., Makkar, H.P.S., Dawra, R.K. and Negi, S.S. (1981). A Review of the Toxicity of *Lantana camara* (Linn) in Animals. *Clinical toxicology*, 18(9): 1077-1094.

Soto-Blanco, B., Fontenele-Neto, J. D., Silva, D. M., Reis, P. F. C. C. And N´obrega, J. E.(2006). Acute cattle intoxication from *Nerium oleander* pods. *Tropical animal health and production*, 38:451–454.

Diseases Transmitted through Semen in Bovines

Pankaj Gunwant[1], A.K.Pandey[2], Sunil Kumar[3], Piyush Tomar[4*], Dipin Chander Yadav[5] and Manish Kumar[6]

[1]Department of Veterinary Gynecology and Obstetrics; [2]Teaching Veterinary Clinical Complex; [3]Department of Animal Genetics and Breeding;[4]Department of Veterinary Public Health and Epidemiology; [5]Department of Livestock Production and Technology
[6]Department of Veterinary Medicine
Lala Lajpat Rai University of Veterinary and Animal Sciences, Hisar Haryana, 125 004
Corresponding Author: tomarvety@gmail.com

Bull is known as half the herd and success of bovine reproduction depends directly on the quality of bull. Thus selecting a bull becomes a critical element as it may lead to serious economic consequences, if a particular bull has problems regarding infertility or is a disease transmitter. Just as a cow's fertility may be affected by a large number of infectious agents, the bull is exposed to the very same specific agents and many others directly affecting reproductive activity. Diseases transmitted through semen may directly cause failure of cows to conceive and loss of pregnancies through abortion or resorption of fetuses and indirectly affects the fertility of bull. Various micro-organisms including bacteria, viruses, and protozoa can be transmitted through semen. World Animal Health Organization (International Epizootias Office - IEO) has listed several diseases as having proven importance in transmission through semen, and most important diseases are discussed in this communication.

BRUCELLOSIS: It is one of the most important disease transmitted through semen, leading to heavy economic losses to the farmers. *B. abortus* is the species affecting cattle and it's 7 biovarieties are known. It causes abortion in last trimester of pregnancy (7-9 months), retention of fetal membranes, indurations of mammary glands in cows and orchitis and vesiculitis in males. Serological tests are applied routinely to monitor for Brucellosis. Indirect and competitive ELISA formats have been developed and evaluated in several countries. Laboratory tests include isolation or demonstration of the organism in tissues or fluids, and serological tests and agglutination tests on milk or seminal plasma. At present time brucellosis in cattle is considered an incurable disease, although 15 percent of cattle recover from naturally acquired infection. Vaccination of all animals is a logical control measure. Live strain 19 vaccine and the killed 45/20 vaccine have both played an important role in the control of brucellosis. However, strain 19 may produce permanent infections in bulls similar to those of natural disease. So vaccination of bulls is not recommended. New vaccines such as

RB51, can induce a protective immune response but the value of these vaccines in the field remains to be tested. Females are vaccinated at six month of age.

Campylobacteriosis: Infection with *Campylobacter fetus* in cows is characterized by infertility, embryo death and abortion at about 3-5 month of pregnancy. In bulls, infection is not accompanied by either pathological lesions or modifications in the characteristics of the semen. Bulls marked for AI must be declared free of such diseases even though adding antibiotics to semen leads to this pathogen being easily controlled. Diagnosis can be done with the help of direct culture of prepucial smegma, FAT, vaginal mucus agglutination test. Treatment includes broad spectrum antibiotics parentally.

Leptospirosis: Clinically, bovine leptospirosis can be acute (septicaemia, hepatitis, nephritis), subacute (nephritis, agalactia), chronic (abortion, stillbirth, infertility) or, in its most common form, asymptomatic. *Leptospira* spp. are transmitted by semen, as they survive at freezing and cryoconservation temperatures. The reference laboratory test for serological diagnosis of leptospirosis in cattle is the microscopic agglutination test (MAT). Treatment of bulls with 25 mg of dihydrostreptomycin (DHS) per kg body weight has been approved internationally to stabilize low antibody titres and to prevent shedding of *Leptospira*.

Infectious Bovine Rhinotracheitis (IBR): Causative agent of IBR is Bovine Herpes Virus -1. It causes abortion in late gestation, infectious pustular balanoposthitis in bulls, infectious pustular valvovaginitis in cows, pustules in vulva/vagina, glans penis & prepuce and ulcers in vulva/vagina. This is one of the most important viral diseases as the state of viral latency implies that infected animals become carries for life and frequent viral reactivation is caused by stress factors. Diagnosis includes virus isolation, fluorescent antibody test (FAT) technique and ELISA. IPV is self limiting and treatment with antibiotics may be necessary to reduce the likelihood of it's sequel.

FMD: It is considered as one of the most important disease of the world affecting the export of semen. FMD virus has been found in bull semen up to four days, before and well after (37 days) the appearance of clinical sings of the disease. Affected bulls are reluctant to serve and their semen quality is poor. The virus may also multiply in the skin around the preputial orifice and contaminates semen during ejaculation. FMD virus is preserved by semen freezing and storage and can cause infection in inseminated females.

Mycoplasmosis: *Mycoplasma bovigenitalium* occurs most oftenly in bull's genital tracts. Its presence in the prepuce and preputial orifice does not cause lesions; on the contrary, if it reaches the testicles and nearby glands it may cause lesions leading to low spermatic motility and reduced resistance to freezing and unfreezing. Contamination of semen with *Mycoplasma* also originates from using diluters containing egg yolk or milk. Cows infected with these pathogens present severe salpingo-oophoritis. It is also considered an important pathogen which could affect embryo production in vitro through semen. The antibiotics

generally used in semen (gentamycine, tylosin, lincomycine and spectinomycine) do not control its presence or growth in cultures made from semen samples taken from AI-destined bulls.

CONCLUSION: Bulls responsible for the majority of diseases have few, if any, detectable signs. There are generally no changes in the appearance of the sexual organs, libido, and in routine semen evaluations. Heifers are more likely to be open because they lack the natural immunity as in older cows because they have had less exposure to the disease. Though correctly assumed to be a cause of infertility, it is not uncommon to experience fetal losses. Use of Breeding Soundness Examination is also of limited value as the organisms responsible seldom causes any changes in the physical appearance of the sexual organs. Semen evaluation is also typically normal as the organisms are found on the surface of the penis and prepuce, not in the semen itself. An important aspect of the control of these diseases is vaccination. A vaccination program should be in place for all herds that is comprehensive for all diseases that exist within the herd. These diseases in cattle, lead to severe economic loses to the farmers. Yet, the use of effective control measures including bull management and vaccination offer farmers reliable and cost effective controls.

Food Borne Bacterial Pathogens

- Prevention and Control

Piyush Tomar[1*], Neelam Rani[1], Pankaj Gunwant[2] and Sunil Kumar[3]

[1]Department of Veterinary Public Health and Epidemiology
[2]Department of Veterinary Gynaecology and Obstetrics
[3]Department of Animal Genetics & Breeding
Corresponding Author: tomarvety@gmail.com
College of Veterinary Sciences
Lala Lajpat Rai University of Veterinary and Animal Sciences, Hisar Haryana, 125 004

The term Food-borne diseases cover the illnesses acquired through the consumption of contaminated food. Food-borne diseases are a major health problem worldwide leading to high morbidity and mortality. The presence of potential pathogens in the environment, the ability to survive and/or multiply under refrigeration and reduced oxygen conditions are the real challenges for food industry. It is very difficult to maintain a risk-free food supply. Necessary control measures should be employed by food manufacturers and distributors to ensure the food safety until it reaches the consumer. There is an increasing demand for food safety information at the international, national and local level. The present article is giving information regarding the most common food borne bacterial pathogens and their prevention and control.

There are three categories of microbial food-borne diseases:

1. Invasive infection, in which the organism invades and penetrates intestinal mucosa.
2. Toxico-infection, in which the organism produces toxin while in the intestinal tract.
3. Intoxication, in which the organism produces specific toxins or toxic metabolites in the food that is ingested.

Common food borne bacterial pathogens are -:

Campylobacter

Campylobacter jejuni and *C. coli* causes the invasive infection Campylobacteriosis. The pathogen is found in the GIT of livestock, poultry and other animals including pets so is commonly spread by faeces and faecally contaminated water. Asymptomatic faecal carriage occurs occasionally in humans. *Campylobacter* survive in foods at 4°C, but are sensitive to drying and heating. The incubation period is typically 2 to 5 days. Symptoms include fever, malaise, abdominal pain, diarrhea (which can be bloody) and headache.

Measures to control Campylobacteriosis include:

1. Cook poultry and meats thoroughly.
2. Pasteurize milk and dairy products.
3. Prevent cross-contamination of heat-treated foods.

Salmonella

Salmonella causes two types of food-borne human diseases. First, Salmonellosis which is most commonly caused by *S. enterica* subsp. *typhimurium* or *S. enterica* subsp. *Enteritidis.* Secondly, *S. enterica* subsp. *typhi* and *S. enterica* subsp. *paratyphi* are the causes of typhoid fever or paratyphoid fever, respectively. Faecal–oral is the main route of transmission. The incubation period is typically 6 to 48 hrs. Symptoms include mild fever, nausea, vomiting, headache, aching limbs, abdominal pain and diarrhoea lasting from a few days to one week. The disease can be severe in young, elderly and immunocompromised people. As *Salmonella* are heat sensitive so raw or undercooked foods are more likely to cause infection.

Measures to control Salmonellosis include:

1. Cook foods thoroughly.
2. Pasteurize milk and dairy products.
3. Prevent cross-contamination of heat-treated foods.
4. Avoid undercooked or raw eggs.
5. Store heat-treated foods at <4°C or >60°C to prevent growth.
6. Reduce carriage of livestock by vaccinating or dosing with antibiotics or probiotics.
7. Exclude infected or carrier-status individuals from handling food.
8. Control rodents and insects.
9. Dispose of sewage in a sanitary manner.

Escherichia coli O157

Escherichia coli O157 causes toxico-infections, producing enteric or systemic illnesses. Although this disease is relatively infrequent.it can have severe consequences, including haemorrhagic colitis (HC), haemolytic uraemic syndrome (HUS) and thrombotic thrombocytopaenic purpura. The incubation period is typically 3 to 8 days. Symptoms includes watery diarrhoea and HC with severe abdominal pain, sometimes accompanied by vomiting. HUS can occur, with symptoms of kidney failure, reduced white cell count and anaemia. TTP typically has similar symptoms to HUS, but the CNS is also involved, and bleeding into tissues and organs can develop, with blood clots in the brain. Young children are at greatest risk of HUS. HUS typically lasts days or weeks, and requires hospitalization, blood transfusions and dialysis. Coma and death occur frequently.

Measures to control *E. coli* O157 include:

1. Use GHP and HACCP in meat production.
2. Cook meat thoroughly until >72°C in the centre, instantaneously.
3. Pasteurize juice and dairy products; don't consume unpasteurized products.
4. Prevent cross-contamination of heat-treated foods.
5. Exclude infected individuals from handling foods.
6. Use only potable water in food production; consume only potable water.

7. Prevent young children contacting livestock and farm environments.
8. Avoid eating in areas that could be contaminated with animal faeces.
9. Do not use faecally-contaminated water on ready-to-eatcrops.

Vibrio cholerae

Vibrio cholerae O1 classic biotypes, El Tor biotype and *V. cholerae* O139 are the cause of cholera, a toxico-infection. *V. cholerae* primarily inhabit marine water, estuaries and salt marshes. The most common source of cholera is faecally contaminated water. The incubation period is typically 6 hrs. to 5 days. Symptoms include profuse watery diarrhoea with 'rice water' stools, containing flakes of mucus, epithelial cells and large numbers of *V. cholerae*. Abdominal pain and vomiting occur later. Fluid loss can lead to severe dehydration, acidosis, shock and circulatory collapse.

Measures to control cholera include:

1. Consume only potable water.
2. Dispose of sewage correctly.
3. Use only potable water in seafood harvesting and preparation.
4. Do not harvest seafood from waters containing *V. cholerae*.
5. Avoid raw seafoods.
6. Chill seafood to <4°C at harvest and after.
7. Exclude infected individuals from handling food.

Listeria monocytogenes

Listeria monocytogenes cause the invasive infection listeriosis, a disease of humans and livestock, although non-invasive disease can also occur in humans. *L. monocytogenes* can be carried asymptomatically in the GIT of livestock, other animals and humans, and can be shed in the milk of cows with or without mastitis symptoms.The pathogen is ubiquitous in the environment, including food processing plants, refrigerators, drains, soil, water, sewage, dust and on plant tissues. *L. monocytogenes* has been found in improperly fermented silage, which is suspected as being a source of listeriosis in livestock. Two forms of human listeriosis are recognized, and both are commonly food-borne. Invasive listeriosis symptoms include septicaemia, meningitis, of invasive listeriosis are immunocompromised individuals and those with diabetes, heart or hepatic disease. In pregnant women, spontaneous abortion usually occurs in the third trimester, resulting in death of the infant. Non-invasive listeriosis symptoms are mostly enteric and include diarrhoea, mild fever, headache and myalgia, and the disease has a short incubation period 1 to 3 days. Healthy individuals are at risk for noninvasive listeriosis. However, due to its environmental ubiquity, it follows that *L. monocytogenes* is regularly.

Measures to control listeriosis include:

1. Use GHP and HACCP in food production.
2. Immunocompromised individuals and other target populations should avoid high-risk foods.
3. Pasteurize milk and dairy products; don't consume unpasteurized products.
4. Prevent cross-contamination and recontamination of heat-treated foods.

5. Completely separate raw and cooked products during meat product manufacture.
6. Re-heat ready-to-eat foods adequately.
7. Do not use organic waste or faecally contaminated water on ready-to-eat crops.
8. Use the hurdle concept to limit growth of *L. monocytogenes* in foods.
9. Use correct starter cultures in cheese and meat fermentations.

Staphylococcus aureus

Staphylococcus aureus causes the food-borne intoxication staphylo-enterotoxicosis. *S. aureus* produces a range of enterotoxins in food (A, B, C1, C2, C3, D, E, F). Most human food-borne disease is caused by type A enterotoxin. *S. aureus* is harboured in the anterior nares of up to 50% of people, but is also a common environmental contaminant found in dust, air, water, vegetation and on environmental surfaces. *S. aureus* primarily causes enteric illness, but also causes skin and throat lesions in man and animals. The incubation period is typically 1 to 6 hrs. Symptoms include nausea, vomiting, abdominal cramps, diarrhoea, sweating, headache and possibly a drop in body temperature.

Measures to control Staphylo-Enterotoxicosis include:

1. Use good personal hygiene practices when handling foods.
2. People with skin infections should not handle foods.
3. Use GHP when handling foods.
4. Chill cooked food rapidly in small quantities.
5. Store cooked or heat-treated foods at <4°C or >60°C.
6. Avoid extensive handling of foods.
7. Avoid delays between cooking and eating.

Clostridium perfringens

Clostridium perfringens causes the toxico-infection perfringens food poisoning. Perfringens food poisoning is most commonly caused by organisms producing type A enterotoxin. Other types of enterotoxin (B to G) do not normally cause food-borne disease. The incubation period is typically 8 to 22 hrs. Symptoms include severe abdominal pain with profuse diarrhoea. Vomiting, nausea or fever are rare. The young and elderly are more at risk. Infection with type C can cause necrosis and haemorrhages in the small intestine.

Measures to control perfringens food poisoning include:

1. Cook food thoroughly to kill vegetative cells.
2. Chill cooked food, especially meat dishes, rapidly in small quantities.
3. Store cooked food at <5°C or >60°C to prevent growth.
4. Limit the storage interval for cooked food to reduce growth of survivors.
5. Reheat food to at least 75°C to kill vegetative cells and to inactivate toxin if pre-formed in food.
6. Remove soil and dust from food to reduce spore contamination.

Clostridium botulinum

Clostridium botulinum causes two types of food-borne human disease. Botulism is an intoxication, whereas infant botulism

(floppy baby syndrome) is a toxico-infection. *C. botulinum* is an environmental contaminant and is found typically in damp soils and muddy sediments, marine and fresh waters. Asymptomatic carriage occurs in the GIT of animals and humans. Symptoms include nausea and vomiting followed by dizziness, difficulty swallowing, slurred speech, blurred vision and headache. fatigue, muscle weakness, C.

paralysis and respiratory impairment can occur. Respiratory failure can cause death.

Measures to control botulism include:

1. Avoid home canning of vegetables, fish and meats.
2. Discard cans with faulty seals.
3. Heat any suspect food to 80°C for 15 minutes to destroy toxin.
4. Store home-canned foods at <3°

Seed treatment, Methods and its Impact to produce more food grain

*Sumita Das[1] and Subhashree Dash[2]

[1]Ph.D. Scholar Dept. of Seed Science and Technology, [2].Ph.D. Scholar Dept. of Entomology
College of Agriculture, OUAT,Bhubaneswar-751 003
*Email-sumitadas.sst@gmail.com

Seed treatment refers to exposing the seeds to certain agents, physical or chemical, which are able to protect them from pests and provide good health to seed and the emerging plant. In other words, it is a biological, chemical, mechanical or physical process, which is designed to control seed-borne or soli-born microorganisms resulting in the emergence of healthy seedlings and plants.

Merits-

- It improves germination through control of surface moulds.
- Protects seed and seedling from seed borne and soil borne pathogen/insects.
- Prevent spread of plant diseases in the field.
- Easy to apply and cost effective.
- Improves and maintain seed quality.
- Enhances shelf life of seed
- It improves field emergence by enhancing vigour.

Types of seed treatment

Seed disinfestation- It refers to the destruction of surface-borne organisms that have contaminated the seed surface but not infected the seed surface.

Chemicals dips, soaks, fungicides applied as dust, slurry or liquid have been found successful for disinfestations.

Seed disinfection- It refers to the eradication of fungal spores that have become established within the seed coat or in more deep seated tissues. For effective control, the fungicidal treatment must actually penetrate the seed in order to kill the fungus.

Seed protection- Purpose of this is to protect the seed and young seedling from organisms in the soil which might cause decay of the seed before germination or seedling before or during emergence.

Methods of seed treatment-

1.Physical treatment-

a. **Hot water treatment**-. The seeds are dipped for specific period of time in hot water to a particular temperature safe to the seed embryo and deleterious to the associated pathogen. This method is useful for low volume high value seed. The method is effective for internally associated fungi and bacterial pathogens. Hot water (52^{o}c) treatment for 30 minutes ensure effective control of black leg of cabbage and black rot of Cabbage, Cauliflower and Coniphus. Hot water treatment at 50^{o}c is effective against loose smut of wheat and black rot of coniphus. Because temperature and time varies with pathogen and crop.

b. **Dry heat / Heat air treatment**-The seed material is exposed to hot air stream

for a specific period, which is safe for viability of seed. The method is more effective for the pathogens associated on to the seed surface. Treatment of seed with hot air currents ensures effective control of smut of pathogen associate with sugarcane set. keeping tomato seed in heated air at 70^0c for 3-4 days to prevent mosaic disease. This method is less effective than hot water treatment.

c. **Aerated steam heat**-A mixture of air and steam is passed through the seed. It inactivates the pathogen by denaturation of metabolites and exhaustion of reserve food material.

d. **Solar heat**- Sun drying of seed kill most of the pathogen. The method is used for control of loose smut of wheat. For this, the seeds are soaked in water for 6-8 hours (temperature above 35^0c), thereby activating the dormant mycelium present in the embryo and subsequently exposing the seed lot solar heat. As a result of the solar heat the activated mycelium is destroyed without damaging the wheat seeds. Soaking of wheat seed for 4 hours in cold water on a bright summer day and then spread over a hard cemented floor or on galvanized iron sheet exposing the seeds to direct sun light for 4-6 hours controls the disease.

e. **Anaerobic H_2O**-Deeping seeds in water in anaerobic condition is effective for killing some seed borne pathogen.

2.Chemical treatment-

a.**Dry seed dressing**-It is done in a seed treating drum where the fungicide or chemical/pesticides is mixed with the seed before sowing in order to protect the seeds during germination and seedlings establishment from soil borne pathogens/insect pest. This method is known as Dry seed dressing and mostly used by farmers. It is used for small quantity of seed.

Ex-Thiram and Captan @ 2g/kg of seeds or botanicals eg. leaf powder of *Azadirachta indica* and *Vitex negundo.*

b. **Seed Dipping**-

Dipping seeds or propagating material into a fungicidal or antibiotic solution for specific period of time prior to sowing. It helps in better absorption of chemicals.

Seed soaking with Organo-mercurial (for potato scab), DM 5 or ridomil (for potato late blight), streptomycin sulphate (for cabbage, cauliflower or mustard bacterial and fungal diseases) have been found effective. Soaking of cluster and Indian bean seed in antibiotics like streptocycline and aureofungin which control *Xanthomoans spp*. Seed dip and treatment with 20 % trisolium phosphate solution dilute the tobacco mosaic virus (TMV) concentration. This method is not suitable for seeds which are prone to imbibitional injury.

c. **Seed Pelleting**- pelleting the seeds with fungicide which provides protection against soil and seed borne pathogens. Seed pelleting prevent seed against store grain pest. Incorporation of unpalatable substances provide protection against rodent by this method. It is used in small seeds like onion and sugarbeet. As the chemical release is very slow, this method is considered to be very effective.

d. **Fumigation**- Fumigants like formalin, propylene, ethylene oxide, ethylene bromide, phosphine etc. are used. Time and period of fumigation varies with crop and pathogen/ insects.

e. **Slurry**-Dry powder is mixed with equal volume of water to make a slurry by slurry treater. By this treatment seeds are

coated with fungicide which sticks to its surface.

Principle of slurry treater-

- ❖ The slurry treatment principle is the suspension of wettable powder in water to make a slurry, which is then accurately metered through a simple mechanism composed of a slurry cup and seed dump.
- ❖ The cup introduces a given amount of slurry with each weighed dump of seed into a mixing chamber, where they are blended.
- ❖ Slurry treaters are adaptable to all types of seed.

f. **Mist**- A fungicide suspension is broken into a fine droplets by Mist-o-Matic treater. Most effective method.

Principle of Mist-o-Matic treater-

- ❖ The treater is equipped with a large treatment tank, a pump and a return tube that maintains the level in the small reservoir from which tube treatment cups are fed.
- ❖ After metering the treatment material flows to a rapidly revolving fluted disc mounted under a seed spreading cone.
- ❖ The disc breaks converts the drop of treated material into a fine mist and spray it outward to coat the seed falling over the cone through the treating chamber.
- ❖ Just below the seed dump are 2 adjustable retarders designated to give a continous flow of seed over the cone between seed and dump.

3.Priming treatment-

Solid matrix priming**-**Pre sown hydration in a solid based media is called as solid matrix priming. Seed treatment with standard fungicide (Thiram, Captan, Metalaxyl) with one priming agent effectively control the seed and soil borne pathogens. Whereas, seed treatment only with fungicide is ineffective.

Osmopriming- Soaking the seeds in osmotic solutions is known as osmopriming.

Ex-PEG (Polyethylene glycol), it is chemically inert and does not have adverse effects on the embryo. The large size of PEG molecules prevent its penetration into seed tissues, thus reducing toxic side effects on seeds. Immersing rice seed in 20% PEG containing 0.1% Carboxin reduce seed borne infection of *Dreschlera oryzae*.

4.Biological method-

Application of commercial formulation of biocontrol agents like *Trichoderma viridae*, *Trichoderma harzianum*, *Bacillus subtilis*, *Pseudomonas fluorescence* @ 4/kg of seed controls root rot infection and other seed borne diseases.

Precautions required in seed treatment-

- Use appropriate recommended chemical for crop, pathogen and disease.
- Use precise dose of chemical and formulation for large scale.
- Seed should be properly dried before seed treatment.
- Seed should be properly mixed with chemical without any mechanical damage.
- Never use treated seed as food or feed.

Characteristics of a good seed treating chemical

- It should be effective against all seedling diseases normally attacking that crop.
- It should be cheap and easy to apply.

- Non injurious to seed when applied in excess and in prolonged storage.
- Stable in the package on the seed /on the soil.
- Compatible with inoculants on legumes.
- Non toxic when fed to animals.

CONCLUSION:

Therefore, Seed treatment is essential to improve shelf life of seed, protect the seed during germination, seedling establishment, improve the vigour of seedling.

Table 1: Seed treatment recommended under Indian Seed Certification standard

Crop	Fungicide	Rate g/100kg seed	Quantity water to prepare slurry (1g/100 kg seed)
1. Rice	Thiram 75%WP	100	0.50
	OMSD 1%	250	-------
2.Wheat	Thiram75%WP	100	0.50
	Mancozeb75%WP	100	0.50
	Carbendazim50%WP	250	------
3.Maize	Thiram75%WP	100	0.50
	Vitavax dust	100	0.50
4.Arhar	Acivated clay	1000	------
5.Cotton	Thiram 75%WP	250	0.50
	Captan dust	110	-------
6.Ground nut	Thiram 75%WP	250	0.50
	Captan dust	125	---------
7.Tomato	Thiram 75%WP	335	--------
8.Okra	Thiram 75%WP	100	--------
9.Cow pea	Thiram 75%WP or Mancozeb	70	0.50
10.Chilli	Thiram 75%WP or Captan dust	250	----------
11.Soybean	Thiram 75%WP or Mancozeb	70	0.50

Epigenetics: Regulation of Gene Expression

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

[1]Assistant TAM, Cargill India Pvt. Ltd.
[2]Ph.D. Scholar, Department of Animal Genetics and Breeding LUVAS, Hisar
*Corresponding Author: armaandahiya42@yahoo.com

Epigenetics an outside conventional genetics that describe the stable alterations in gene expression potential arises during cell development and proliferation. Epigenetics is the study of cellular and physiological traits that are not caused by changes in the DNA sequence. Epigenetics describes the study of stable, long-term alterations in the transcriptional potential of a cell. Some of those alterations are heritable. However recent changes in the usage of the term have led to the suggestion that "the structural adaptation of chromosomal regions so as to altered activity states". These processes are necessary for the development and differentiation and can arise either due to random changes or due to the influence of the environment. These processes include post synthetic DNA modification either in the DNA itself or proteins which are associated with DNA. These processes includes DNA methylation, histone modifications, non-histone chromatin proteins, small interfering RNA(siRNA) and micro RNA(miRNA. DNA methylation is a chief contributor to stability of gene expression states. DNA methyl transferase (DNMT) maintain DNA methylation.

MOLECULAR BASIS

DNA is tightly packaged into the nucleus of every cell and carries unique genetic code. Each gene occupies a specific region of DNA so that genes are postioned one after another along the DNA. In the nucleus the genetic code of genes is transcribed into mRNA that leaves the nucleus and enters the cytoplasm of the cell, where each mRNA molecule is translated into a specific protein, these proteins carry out various functions in the cell like cell membrane synthesis, form enzymes, transport glucose, help cell to grow and perform tasks like cell replication. For a cell to survive and proper functioning, individual genes need to be turned on or

"expressed" at specific magnitude. Some genes are expressed always and other genes are expressed only at the times of need. Some are expressed at very high level and other are at low level. Molecular bases of epigenetics is inactivation of certain genes without changing the sequence of DNA. Various associated proteins are also becomes active or silence. If these changes occur before fertilisation in sperm or egg cell they can be transferred to the next generation. These changes are preserved when cell is divided.

DNA methylation

DNA methylation is a post replication modification which is mostly found in cytosines in dinuleotide sequence CpG. Most well-studied epigenetic tag/mark; best understood epigenetic cause of disease, conserved across various kingdoms of life. In mammals, in the context of CpG dinucleotides (plants have other types too). Methylated CpGs are associated with silenced DNA, eg. Transposons, inactive X chromosome, imprinted gene. "CpG islands", associated with promoters of 40% of mammalian genes, are generally free of methylation. Two major classes of enzymes in DNA methylation. Denovo methylases and maintainence methylases. Denovo methylation occurs rarely during postgastrulation development but seen is seen frequently during the establishment of cell lines in vitro and in cancer.

How does DNA methylation affect gene transcription?

There are several ways in which DNA methylation can repress transcription. Firstly unmethylated or hypomethylated promoter allows gene transcription. Secondly Methylated CpGs block binding of TFs; hence, transcription blocked. Thirdly Me-CpG binding proteins also preclude TF binding to the promoter region. A general route is through the exclusion of proteins that affect transcription through their DNA binding sites. An example of such exclusion applies to the chromatin boundary element binding protein, CTCF which can block interactions between an enhancer and its promoter when placed between the two elements. CpG methylation blocks the binding of CTCF to DNA and thus allows an enhancer to stimulate promoter activity across the inert boundary site. DNA methylation occurs in repeated sequences and helps to suppress the expression and mobility of transposable elements.Because 5-methylcytosine can be easily deaminated to thymidine,CpG sites are frequently mutated and become rare in the genome, except at CpG islands where they remain unmethylated. DNA methyl transferases DNMT1, DNMT3A, and DNMT3B three independent enzymes control patteren of DNA methylation

Role of DNA methylation

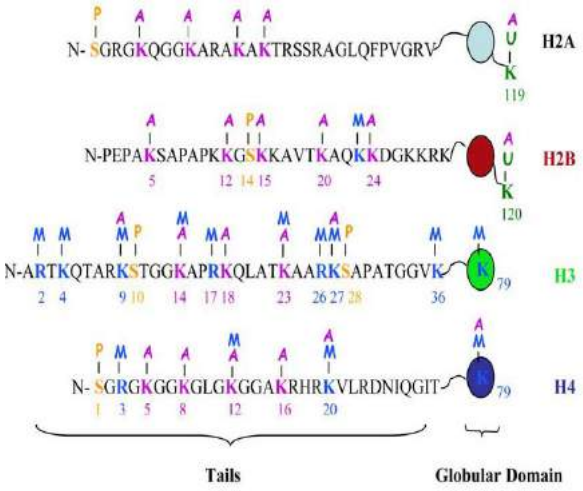
Tight control for maintaining gene silencing, transcriptional silencing of transposons ('genome defense' model) and in genomic imprinting that is one of the alleles of a gene is silenced, depending on the parent of origin.

HISTONE MODIFICATIONS

Unless the genome is accessible by the transcription machinery of the cell, the genome cannot be functional. Hence, the utilization of the biological information in the genome is dependent on the chromatin organization. Histone modifications involves acetylation, methylation, phosporylation.

	Transcriptionally active chromatin/euchromatin	Transcriptionally inactive chromatin/heteochromatin
Chromatin conformation	Open, extended conformation	Highly condensed conformation
DNA CpG methylation	Relatively unmethylated, especially at promoter regions	Methylated, including promoter regions
Histone acetylation	Acetylated histones	Deacetylated histones

Different histone modifications are likely to function in different ways, acetylation at one position is likely to function differently from acetylation at another position.Multiple modifications may work together to change the behavior of the nucleosome. Histone modifications other than deacetylation are also implicated in triggering the denovo methylation of DNA. Mostly methylation of histone H3 at Lys9, which is linked to gene silencing, essential for DNA methylation.



RNA-mediated phenomenon

Sometimes the product of gene transcription maintain the activity of that gene. Epigenetic changes results in production of different splice forms of RNA or by formation of double stranded RNA (RNAi). RNA interference (RNAi) causes gene silencing. RNAi initiates heterochromatin formation in fission yeast and DNA methylation in plants.

EPIGENETICS AND ENVIRONMENT :

Epigenetic modifications of genome provide a mechanism that allows the stable propagation of gene activity states from one generation of cells to the next generation. Because of reversible nature they can be modified by environmental factors, which may contribute to the development of abnormal phenotypes. Epigenetic mechanism also mediates some physiological responses certain environmental stimuli.

GENE ACTIVATION DURING DEVELOPMENT	GENOME IMPRINTING AND X-CHROMOSOME INACTIVATION
Developmental effects of DNA methylation on gene expression involve long-term silencing of gene expression. Genes are transcriptionally activated by removing DNA methylation.	X-chromosome inactivation and genome imprinting both are monoallelic gene expression. X inactivation is random in somatic cells, whereas the expression of imprinted genes and X inactivation is parental origin.

Economicaly Important Traits in Dairy Breeds of Cattle and Buffaloes

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

[1]Assistant TAM, Cargill India Pvt. Ltd.
[2]Ph.D. Scholar, Department of Animal Genetics and Breeding LUVAS, Hisar
Corresponding Author: armaandahiya42@yahoo.com

One of the first steps in developing a breeding programme is to consider which phenotypic traits are of importance. From a practical standpoint, traits with a measurable or at least readily recognizable economic value

are generally to be given the most emphasis, although traits that provide a less tangible utility for cultural or other reasons may also be considered important. The economic traits are typically those that affect either the income obtained or the costs of production. In the India, the sale or home consumption of milk, meat, dung, and skin of the animals and the sale of surplus animals for breeding and meat are the main sources of economic returns of cattle and buffalo farmers. In addition, many farmers use themselves or rent out their animals for draft purposes, either providing an additional source of income or saving the costs of contracting out for these services.

Some of the important traits that need to be included currently for both dairy and beef cattle and buffaloes are listed in Table 1.

Important trait	Dairy cattle/Buffalo	Dairy cattle/Buffalo
Production	Milk yield, Concentration of milk solids	Body size or weight, Growth rate, Carcass quality, Age and weight at slaughter, Leanness, carcass percentage
Reproduction	Age at first calving, Calving interval, Age at first collection of semen	Age at first calving, Calving interval, Mothering ability, Scrotal circumference
Health	Disease resistance	Disease resistance
Management	Longevity , Milk let-down	Calving ease, Temperament
Physical appearance	Body colour, shape and dimensions, udder characteristics, structural traitsand body condition	Body colour, shape, dimensions, structural traits and body condition

PRODUCTION TRAITS

Traits associated with income are typically called production traits. For dairy cattle and buffaloes, these traits are

those that are associated with milk production. In the India, farmers are paid according to the kilograms of milk sold, so milk yield is obviously a trait of high economic importance. When milk is sold in a formal market, the price paid per kilogram may be adjusted based on concentrations of milk solids. Fat content is almost always considered under such a system, but payment for protein or solids-not-fat is becoming increasingly common. The milk of buffaloes is priced 1.5 to 2 times than cow milk due to its greater concentration of milk solids(17 to 19% versus around 13%) and in certain areas it may be mixed with cow milk to increase the thickness of cow milk and, in turn, improve its market acceptability.

For beef cattle, economic value of a cow or buffalo is logically based on the amount of meat expected to be obtained from the animal. In contrast to industrialized countries, the sale price is not always based on formally weighing the animal and paying a certain price per kilogram. Rather, the animal is often priced as a whole. Nevertheless, larger animals fetch a higher price, so some measure of body weight is of particular importance. Reaching a mature weight as quickly as possible is advantageous, so weights at different ages, such as weaning, one year-of-age, and slaughter, can be taken to evaluate growth rate. Age at slaughter can also be used to account for growth rate; younger animals would be favoured. Birth weight is also often considered important for beef cattle, but largely for calving difficulty rather than production, so smaller birth weight may be preferred. Carcass quality traits can be important for some of the regions in India, but in most cases this variable is not considered in the sale price, so a farmer can not economically justify considering it in a selection goal. Traction is also an important output of cattle and buffalo in the country. Animals with long legs, straight barrels and tight skin are generally assumed to be stronger and thus favoured for draft purposes.The *Bos indicus* males with large humps and well-developed dewlaps are preferred because of more dissipation of heat due to a larger surface area and more body reserves for drought periods.

REPRODUCTION TRAITS

Reproduction traits are also important more so in dairy animals. For beef cattle, the number of offspring produced determines the number of animals available for sale. Consistent reproduction is also important for dairy cattle and buffaloes because daily yield is highest in the months immediately following parturition and because longer dry periods (resulting from failure to conceive quickly) result in greater costs for maintenance without any income. Both late age at first calving (AFC) and long intervals between calving, especially in *Bos indicus* cows and riverine buffaloes, have been often cited as constraints to profitability in cattle farming in the country.

ANIMAL HEALTH

Animal health is important for a number of reasons. First, sick animals require costs for treatment. Healthy animals also tend to produce more meat and milk and reproduce more regularly. The climatic conditions can be demanding, with high temperatures, both extremes in precipitation and high risk for disease, so animals that are naturally resistant to problems associated with these adverse conditions are of high value.

MANAGEMENT

Traits associated with management may also be worth considering. Increased longevity is important for a number of reasons. If their animals live longer, farmers can have the opportunity to sell excess animals or expand their herds, both of which would increase the potential for income. Increased longevity also allows for more opportunities for genetic selection. Because disease often leads to death or culling, the animals that live the longest are often those most resistant to health problems. For many indigenous cattle breeds, the presence of or suckling by a calf is necessary to ensure milk let-down. The milk consumed by the calf can obviously not be sold. In truth, this may not result in much waste, inasmuch as the milk consumed can improve both the health and growth rate of the calf, but selecting for milk let-down without this source of stimulation would at least allow farmers to choose between selling the milk and feeding it to the calf. Calving difficulty can cause losses to both the calf and the cow, so this trait may be important, especially when crossing with exotic breeds with larger body sizes than indigenous breeds or with known dystocia problems. Temperament is important in any situation where interaction with humans is critical, especially when animals are used for draft purposes or when animals must be milked regularly.

PHYSICAL APPEARANCE

Finally, different aspects of physical appearance may be important. As already mentioned, body size is important for both beef and draft purposes. Coat colour or traits of the horns may be of importance for traditional or cultural reasons and thus may affect the market value of an animal. Udder traits may be associated with milk production, resistance to mastitis or ease of milking . Although Table 1 divides traits into dairy and beef or draft, some overlap may occur. This is already obvious in the fact that some traits, such as those related to reproduction are listed in both columns. In addition, sale of male dairy animals can be a significant source of income and some animals may be used for draft purposes. The relative importance of these traits will be different in different areas and is important in determining the final breeding objectives.

Homa Organic Farming: Science behind Concepts and Methodologies

[1]Shinogi KC, [1]Sanjay Srivastava, [2]Rashmi I, [3]Radha TK, [4]Rosin KG and [4]Sarvendra Kumar

[1]ICAR- Indian Institute of Soil Science, Bhopal, Madhya Pradesh; [2]ICAR-Indian Institute of Soil and Water Conservation Regional Station, Kota, Rajasthan; [3]ICAR-Indian Institute of Horticultural Research, Bengaluru, Karnataka; [4]ICAR-Indian Agricultural Research Institute, New Delhi
Corresponding Author email:shinojikallely@gmail.com

ABSTRACT

Homa organic farming is becoming popular in India and abroad as a farming method to enhance crop production without any external input use. The farming method that mainly focused on the homa fire technique Agnihotra and use of the Agnihotra ash is also said to have beneficial effects in controlling the pest and disease infestation in the crop fields. There were several scientific efforts for the scientific validation of Homa organic farming methodologies. Some of the studies reported that the Agnihotra fumes are powerful to eradicate harmful microorganisms because of the formation of ethelene oxide and formaldehyde. Further, the Agnihotra ash is reported to have a beneficial effect on the beneficial soil microbial flora.

INTRODUCTION

India has ancient wisdom of farming and *Vedic* literature offers evidences for that. Hymns of *Rigveda* have mentions about ploughing, fallowing, irrigation, cultivation of crops, and celebration of agricultural divinities. In the early period agriculture was purely organic in India. With the boom of green revolution in 1960's, organic agriculture has changed into chemical intensive highly productive systems. In such agricultural practices the quantity as well as frequency of chemical use has been increasing in every cropping season, which leads to deterioration of natural resources and hampering of ecological equilibrium. The call for going 'Back to Nature' has become a universal syndrome in the recent years and a lot of nature friendly farming methods emerged in reaction to this. Homa Organic Farming is just one among those developments that incorporate Homa therapy to organic agriculture.

Homa is a Sanskrit word synonymous to *yajna* is an ancient pyramid fire technique from Vedic period. It is the process of removing the toxic conditions of the atmosphere through the agency of fire. Though we have lost this knowledge in the course of time Param Sadguru Shree Gajanan Maharaj of Akkalkot, Maharashtra renewed the technique in the middle of 20th century and his disciple Vasant Paranjpe popularised it in India and abroad. Homa firing technique

is generally known as *Agnihotra*. It was first publicly demonstrated in Poland by Vasant Paranjpe and Dr. Ulrich Berk, the Founder of German Association of Homa Therapy in the year 1981(www.homatherapy.org). The central idea of Homa therapy is "you heal the atmosphere and the healed atmosphere heals you". Though it is an age old practice that evolved much before scientific era, popularisers of Homa therapy argue that it is a totally revealed science.

HOMA ORGANIC FARMING: MAJOR CONCEPTS

Homa organic farming is believed to be the revised version of *vriksha ayurveda* (ayurveda for the plant kingdom) in the modern context. Experts say that it is a scientific method which emphasise on fumigation of the atmosphere, an important factor to keep the crop healthy from ailments. *Agnihotra* is the basic technique practiced in Homa organic farming where dried cow dung, ghee (clarified unsalted butter) of local cow and unpolished brown rice are burned in an inverted pyramid shaped copper vessel along with singing of special *mantras. Agnihotra* is tuned to the biorhythm of sunrise and sunset and is performed during these periods of a day. It is believed that the *mantras* sung in resonance with a bio-rhythm activate special vibrations which produce a particular healing atmosphere. Ghee is treated as the vehicle Shri. Vasant Paranjpe described the beneficial effects of Agnihotra to the soil and plant systems in his book *HOMA Therapy-Our last Chance*. He claims that Homa atmosphere boost the soil quality through improved water holding capacity, nutrient availability, and soil texture. He also stress that the Homa atmosphere speeds up the plant metabolism by enhancing the chlorophyll production and permeability of the vascular system. Homa ecosystem is said to be balanced in the case of number of pests and beneficial insects. However, Homa preparations like Agnihotra ash powder and Agnihotra ash solution may be used sometimes to control serious pest and disease attack. Another famous Homa organic farming input is *Gloria Biosol*, a liquid bio-fertilizer based on Agnihotra ash prepared under anaerobic conditions in a bio-digester. Biosol was developed by Gloria Guzman Mendez in Peru, South America. It was prepared out of vermicompost, fresh cow dung, cow urine, Agnihotra ash, copper shree yantra disc (a source of energy attractor) and water. This preparation is mainly used to rejuvenate the plants and also to enhance plant growth by controlling pest and diseases.

SCIENTIFIC REASONING OF HOMA ORGANIC FARMING

Research conducted in India showed that fumes emanating from *Agnihotra* eradicate microorganisms that cause illness and diseases (Pachori et al, 2013). Burning of cow dung for disinfection is an age old practice. According to Russian scientist Sirovish, cow's ghee also has immense power to protect human body from the ill effect of radioactive waves. It is also reported that when cow's ghee is burned with rice it produces gases like ethylene oxide, propylene oxide, formaldehyde, and beta-propiolactone which have inhibitory effect on

microorganisms (Mondkar, 1982; Potdar, 1992). Ethylene oxide and formaldehyde are the two gases used to sterilize the medical and pharmaceutical products because of their efficiency in killing viruses, bacteria and fungi etc. Propylene oxide is best known for inducing artificial rain when mixed with silver oxide. Therefore, *yajna* done with cow ghee believed to be a good practice to purify atmosphere and induces rain.

With each *Agnihotra* that is performed highly energised ash is produced and this *Agnihotra* ash is known to be the secret weapon of the homa organic farming. *Agnihotra* ash is beneficial at all stages of farming operations like soil treatment, water treatment, seed treatment. However, the basic intercultural operations and composting are also necessary along with the application of *Agnihotra* ash. There are a number of research reports about the beneficial effect of *Agnihotra* ash. Kratz and Schnug (2007) reported that *Agnihotra* ash improved the solubility of phosphorus in soil. Their experiment showed a 10 times higher water extractable P in soils treated with *Agnihotra* ash than untreated soil. Berde *et al*, (2015) observed that addition of *Agnihotra* ash increased the soil bacterial flora, including nitrogen fixers and phosphate solubilizers and reduced fungal flora. The healthy microflora created in the soil also improves the number of beneficial soil creatures like earthworms. The earthworms eat the dead organic matter in the soil, digest, excrete and again replenish the soil. Study carried out in the University of Agricultural Sciences Dharwad (Namrata *et al.*, 2012) showed that soybean crop was benefited with Homa organic farming practices like application of *Agnihotra* ash and biosol compared to conventional agriculture practices. They have reported that the amount of available nitrogen, phosphorus, potassium, copper, zinc, manganese and iron in the soil of Homa organic farming treatment plots were more than that of conventional plots. Further, the Homa organic farming plots showed a high dehydrogenase activity also compared to conventional. These results indicate the improvement in soil health because of Homa organic farming.

CONCLUSION

Homa organic farming is reported to be cost effective and environment friendly among all other farming approaches. The science behind the Homa organic farming is also based on sound footing. Though there are some research data to show the claimed benefits, it is recommended that this may be tested as multi location trials so that the practice may be recommended as a technology.

REFERENCES

Berde, C., Kulkarni, A., Potphode, A., Gaikwad, A. and Gaikwad, S. 2015. Application of Agnihotra Ash for Enhancing Soil Fertility. *Engineering and Technology Research*, 4(7): 2546- 2551.

Kratz, S. and Schnug, E. 2007. Homa Farming - a vedic fire for agriculture: Influence of Agnihotra ash on water solubility of soil P. *Landbauforschung Völkenrode*. 3(57): 207-211

Monskar A.G. 1982. Effect of Agnihotra on Aerial Microflora. Available: www.homatherapy.org/ content/effect-agnihotra-aerial-microflora

Namrata, K., Babalad, H.B. and Basarkar, P.W. 2012. Effect of Homa organic farming practices on soybean crop. *Organic Farming Newsletter* 8(1):3-10

Potdat, J. 1992. In: Namrata K. 2012. Effect of homa organic farming practices on soybean crop. *Organic farming Newsletter* 8(1): 3-10

Pachori, R.R., Kulkarni, N.S., Sadar, P.S., and Mahajan, N.N. 2013. Effect of agnihotra fumes on aoromicroflora. *The Bioscan* 8(1):127-129.

Paranjpe, V.V.1989. In: Kratz, S. and Schnug, E. 2007. Homa Farming - a vedic fire for agriculture: Influence of Agnihotra ash on water solubility of soil P. *Landbauforschung Völkenrode*. 3(57): 207-211

Fish-Cum-Pig Farming:

An Effective Integration

Sasmita Panda*[1], Kuldeep Kumar Panigrahy[2], Lakshman Kumar Babu[1], Arun Kumar Panda[3], Promila Marndi[4] and Siddhant Sekhar Sahoo[5]

[1]*Department of Livestock Production and Management, College of Veterinary Science and Animal Husbandry, OUAT, Bhubaneswar, 751003, India*
[2]*Division of Livestock Production and Management, National Dairy Research Institute, Karnal*
[3]*ICAR- Central Institute for Women in Agriculture, Bhubaneswar, 751003, India*
[4]*Department of Floriculture and Landscaping, College of Agriculture, OUAT, Bhubaneswar*
[5]*M.V.Sc, Department of Animal Genetics and Breeding, Orissa University of Agriculture and Technology, Bhubaneswar-751003, Orissa, India*
Corresponding Author: smileysas555@gmail.com

ABSTRACT
The thought about integrated farming system has been changed to a great extent in the last two decades when crop and livestock yields increased along with concerns about their socio-economic and biophysical tradeoffs. To overcome the risk of crop failure due to several reasons integration of various agricultural sectors like fishery, piggery etc. has great capabilities for augmenting the farm income. In advanced concentrated animal farms, a lot of manure arises which contains dissolved and undissolved organic material in large quantities which can be used in fish ponds. Fish-cum-pig farming can be an economic and eco friendly integration which not only can provide a supplementary income to the farmers by increasing fish production but also can offer better employment through pig rearing.

Key words: Integrated fish-cum-pig farming, Management, Economics

INTRODUCTION
The key consideration in Integrated farming system is to minimize the use of external inputs by enhancing the recycling of materials within the system through a process of value addition, which is achieved by including intermediate components that make use of the by-products (wastes) from one component as inputs (fertilizers, food) for another.The farmers concentrate mainly on crop production now-a-days which is subjected to a high degree of uncertainty in income and employment to the farmers. There is risk of crop failure due to various reasons like climatic unsuitability, loss to the farmer due to unstable market price and lack of proper storage facilities for such large amount of crop yield. In this situation, it is essential to develop suitable approach for

increasing the income of a farm. Integration of various agricultural enterprises viz., cropping, animal husbandry, fishery, forestry etc. have great potentialities in the agricultural economy. These enterprises not only supplement the income of the farmers but also help in increasing the family labour employment.

1. The integrated farming system approach introduces a change in the farming techniques for optimum production in the cropping pattern and takes care of best possible utilization of resources.
2. The farm wastes are better recycled for productive purposes in the integrated system.
3. A thoughtful mix of agricultural enterprises like dairy, poultry, piggery, fishery, etc. suited to the given agro-climatic conditions and socio-economic status of the farmers would bring prosperity in the farming.

Advantages of Integrated Farming System

- Higher food production to equate the demand of the exploding population of our nation
- Increased farm income through proper residue recycling and allied components
- Sustainable soil fertility and productivity through organic waste recycling
- Integration of allied activities will result in the availability of nutritious food enriched with protein, carbohydrate, fat, minerals and vitamins
- Integrated farming will help in environmental protection through effective recycling of waste from animal activities like piggery, poultry and duck rearing
- Reduced production cost of components through input recycling from the by-products of allied enterprises
- Regular stable income through the products like egg, milk, mushroom, vegetables, honey and silkworm cocoons from the linked activities in integrated farming
- Inclusion of biogas & agro forestry in integrated farming system will solve the prognosticated energy crisis
- Cultivation of fodder crops as intercropping and as border cropping will result in the availability of adequate nutritious fodder for animal components like milch cow, goat /sheep, pig and rabbit
- Firewood and construction wood requirements could be met from the agro-forestry system without affecting the natural forest

Advantages with special reference to crop-fish-livestock farming system

1. As far as fish production is concerned, it serves the major purpose of providing cheap feedstuffs and organic manure for the fish ponds, thereby reducing the cost and need for providing compounded fish feeds and chemical fertilizers. By reducing the cost of fertilizers and feedstuffs the overall cost of fish production is reduced and profits increased.
2. The overall income is increased by adding pig and/or poultry raising, grain and vegetable farming, etc., which supplement the income from fish farming.
3. By producing grain, vegetables, fish and livestock products, the community becomes self-sufficient in regard to food and this contributes to a high degree of self-reliance.

4. The silt from the ponds which is used to fertilize the crops; increases the yield of crops at a lower cost and the need to buy chemical fertilizer is greatly reduced.
5. The crop residues are economically used as feed for livestock.
6. Effective land use by placing the poultry house above the fish pond.
7. Water required for irrigation of crop lands and for routine activities of livestock like washing, cleaning etc. can be obtained from the fish pond.
8. Provides more employment opportunity throughout the year.

CONSTRAINTS OF LIVESTOCK-FISH-CROP INTEGRATION

Despite the technical feasibility and economic viability of the integrated farming approach involving livestock, fish and also crops, the adoption of this technology is not widespread and is confined to the small farmers. There are a number of probable reasons:-

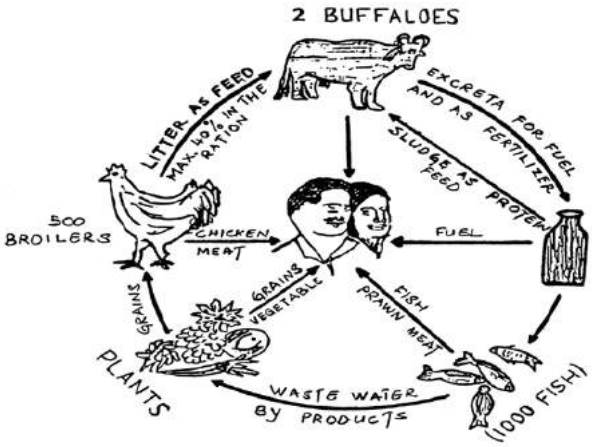


Figure 1 Integrated farming system recycling model

a. The management required for a bi- or tri-commodity enterprise is more complicated as opposed to single commodity enterprise. The bi- or tri-commodity enterprises would definitely require the involvement of farmers with wide experiences of the commodities involved. A farmer owning waste-fed fish ponds has even to acquire the basic knowledge on fish ethology because of the extremely delicate biological and physicochemical dynamics of the pond water.
b. There is unpopularity in terms of consumer's acceptance for the fish cultured from waste-fed ponds. Freshwater fishes have always been associated with muddy off-flavour and integrated approach involving animal waste makes this approach even more unacceptable. The off-flavours can be attributed to the substance geosmin from the pond mud or to some phytoplankton blooms. It is quite common to observe waste-fed ponds with blooms of blue green algae which have been reported to cause off-flavours. Even though there is no direct evidence to indicate that there is any direct effect of eating waste-fed fish on public health, there are definitely some psychological inhibitions such as the possibility of disease/parasite transmissions.
c. This approach is more popular with the small farmers because diversification offers them with greater variety of food. There is also the economic buffering capacity in the event that one enterprise fails or gives poor returns. The larger corporations need not necessarily resort to such buffering needs.

Intensive Integrated Farming System Models (One Hectare)

Benefit : cost analysis of different models				
IIFS	Total input (Rs.)	Total output (Rs.)	B:C ratio (including labour component)	B:C ratio (excluding labour component)
Poultry-crop-fish-duck-horticulture-hedge-row	1,05,722.0	1,67,331.0	1.58	2.24
Crop-fish-poultry-MPTs	60,137.0	90,625.0	1.51	2.12
Crop-fish-goat-bamboo-MPTs	59,442.0	91880.0	1.55	2.40
Crop-fish-pig-hedge-row-MPTs-vermiculture	77,243.0	1,09,887.0	1.42	1.85
Crop-fish-dairy-mushroom-liquid manure -broom-horticulture-vermiculture	1,70,120.0	2,98,735.0	1.76	2.38
Crop and fishery (without integration)	31,773.0	34,894.0	1.09	1.50

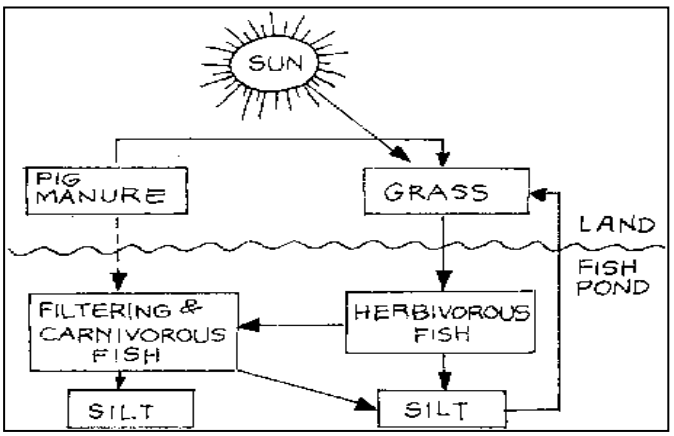
FISH CUM PIG FARMING

In modern concentrated animal farms, a lot of manure arises which contains dissolved and undissolved organic material in large quantities. This secondary product can be used in plant cultures or in fish ponds. This utilization procedure has several steps. The organic material disposed in the pond is transformed by micro-organisms under aerobic conditions. The resulting organic material is nutriment for algae. Algae transform this inorganic material into organic plant material by using solar energy. The algal biomass thus resulting is food for the next consumption level for zooplankton. Phytoplankton and zooplanktons together form plankton biomass which is the natural food for fish.

Only a part of the huge amount of pig manure accumulating in pig farms is utilized in the fields, so the excess, which contains high amounts of direct and indirect proteins (Moav et al., 1977), can be well used in increasing natural nutrient content of fish ponds. Schroeder and Hepher (1975) found that manure load causes a profound change in the natural nutrient cycle of fish ponds, coming about by the organic matter decomposing activity of bacteria and protozoa. Micro-organisms getting into the water with the manure also become fish feed. Water bacteria of 20-30 mm size are also consumed by pelagic fish (Kuznetsov, 1977).

Advantages of pig-cum-fish farming

1. Pig meat and fish can be produced from the same place at the same time.
2. Water needed for pig husbandry practice can get from fish pond.
3. Some part of pig feed can be produced from agricultural crops cultured in the fish pond embankment.
4. Horticultural crops like papaya, banana etc. can be grown on the embankment of fish pond.
5. Fish also feed directly on the pig excreta which contains 70% digestible food for the fish.
6. Pig dung contains: 69- 71% moisture, 1.36- 2.0% nitrogen and 0.36- 0.39% phosphorous when the pigs are fed with pig mesh containing 16- 17% protein, therefore it act as a good fertilizer which helps in producing fish feed i.e. phytoplankton & zooplankton in fish pond. So application of extra fertilizer to fish pond for raising fish and supplementary feeding to the cultured fish is not needed. This cuts the cost of fish production by 60%.



7. The pond muck which gets accumulated in the pond bottom, due to constant application of pig dung, can be used as fertilizer for horticultural crops grown over the pond embankments.

This integrated farming of fish and pig can be divided into 2 groups:

A. Fish culture practice
B. Pig husbandry practice

A. <u>Fish culture practice</u>

"Composite fish culture system" is followed in the integration of pig-cum-fish farming. The detail of the composite fish culture system can be described as below:

Composite fish culture

The principle involved in this type of culture is fuller utilization of fish pond in a body of water. The type of fishes chosen for composite fish culture depends upon their feeding habits such as surface feeder, column feeder, bottom feeder, aquatic vegetation feeder, omnivorous etc.

The whole management practices followed in case of composite fish culture system can be divided into- Pre-stocking management, On-stocking management and Post stocking management.

1. Pre-stocking management

Pond types

Scientifically constructed fish farm has 3 types of ponds and they are-

a. Nursery pond: Area of nursery pond ranges from 100- 500 m^2 and the depth of water should be in between 1- 1.5 m. This pond covers 5% area of total productive area of the fish farm.
b. Rearing pond: Area of rearing pond varies between 500- 1000 m^2 and the depth of water ranges from 1.5- 2.0 m. This type of pond covers 15% area of the total productive area of the fish farm. Sometimes it may be used as stocking pond also.
c. Stocking pond: Area of stocking pond varies between 1000- 20000 m^2 and the depth of water ranges from 2- 2.5 m. This type of pond covers 60- 70% area of the total productive area of the fish farm.
d. Bio pond: Now-a-days apart from the above mentioned fish pond in a fish farm a special type of pond- Bio pond is also seen in some farms. It acts as a large settling tank, where the water used for fish ponds of a farm is purified biologically. On need basis it may be used as stocking pond also. The area covered by this type of pond is 7- 10% of the total productive area of a fish farm.

Pond preparation for stocking with fish

a. Liming and fertilization: The pond is filled with water to a depth of 2- 2.5 meter. Then water P^H is measured and based on the P^H value liming is done. After 7- 10 days of liming fertilization pond water is done. As fertilizer both organic and inorganic fertilizers are used. Then by seeing the pond productivity after 7- 15 days of application of inorganic fertilizer fish seed is released to the pond water.
The pig excreta is rich in nitrogen and phosphorous. Therefore, there is no need of using extra fertilizer as mentioned above in this type of integrated farming. Pig-cum-fish culture is done through the integration of direct or indirect method. In case of direct integration everyday during the cleaning of pig house pig dung are washed directly into the fish pond. In the indirect integration 10- 15 days just before stocking the fish pond with fish seed pig dung is applied at the rate of 1000 kg/ ha water spread area and after stocking the pond with fish seed pig dung is applied at the rate of 50 kg/ ha/ day.
b. Removal of aquatic weed – herbicides like 2,4-D and grmmaxone can be used
c. Removal weed fishes, insects, unwanted organisms, etc. – mahua oilcake is used in clearing pond of unwanted fish. As its toxicity may remain for about 15 days, stocking should be done only after ascertaining complete detoxification of water.
d. Control of algal bloom- Chemicals like- copper sulphate @ 0.1- 0.5 mg/lit of water or diuron @ 0.3- 0.5 mg/lit of water also helps in controlling this bloom.
e. Removal of noxious gases, etc.- Noxious gases and the effect of other substances of pond bottom mud can be reduced by repeated netting or by moving a rope through the pond bottom mud.
f. Pond embankments should be strengthened and raised sufficiently high to prevent possible entry of fishes from adjacent water during the rains.

2. On-stocking management

Selection of fish species

Numbers of fish species are available for culture. But a species selected for composite fish culture should have the following characters-
1. Fast growth rate and Good food conversion efficiency.

3. Acceptability of supplementary and natural food.
4. Adaptability to crowded conditions and resistance to diseases.
5. Ability to withstand changing physicochemical and biological conditions of the pond water.
6. Good market value.

Stocking of fingerlings

Number of fingerlings to be stocked is @ 7000-8000 no.s/hectare. 3,4 or 6 species combination can be introduced into the pond.

Fish species	% of species composition		
	3 species	4 species	6 species
Catla	50	50	30
Rohu	30	25	20
Mrigal	20	20	10
Common carp	-	5	5
Silver carp	-	-	20
Grass carp	-	-	15

3. Post stocking management

Liming: Liming helps in maintaining the PH of fish pond water. This helps in increasing the natural productivity of the pond. Liming also helps in maintaining the cultured fish stock disease free. It is done based on the soil and water PH.

Fertilization: Fertilization increases the natural food availability in the pond. At the same time fertilization creates many environmental problems like- dissolved oxygen concentration depletion, phytoplankton bloom, higher NH3 level, etc. But it is believed that manuring alone can increase the production of the pond by 75%.

Water quality management: In pig-cum-fish farming siltation and thereby cause of turbidity in the fish pond water is a major problem. To check the problem pig dung should be applied to the fish pond at different locations every day. Again at every 1 year interval the pond bottom muck should be removed after partial dewatering. After 3 years complete dewatering and desilting is a must in this integration.

Phytoplankton bloom: The sudden increase of population of certain planktonic algal group as thick mass in water is called phytoplankton bloom. It is identified by the deep green or blue green or reddish green colour of the pond water. The reason for this algal bloom in pond water is the presence of excess nutrients in water. Therefore if this problem encountered in the fish culture pond then supply pig dung to the pond should immediately be cut off and the remedial measures should be taken.

Harvesting management: After 7- 8 months of growing, cultured fishes reach marketable size. The grass carp and silver carp become 1 kg size in 7- 8 months cultured period. To reach 750 gm to 1 kg rohu, catla, mirika, etc needs about 1 year growing period. When the cultured fish reaches 750 gm to 1 kg in weight, then they are harvested from the pond. The harvesting may be done by removing the complete stocks of cultured fishes or by removing the only table size (750 gm to 1 kg) fishes partially based on market

demand. In case of partial harvesting the numbers of fish harvested from a pond is replenished with equal numbers of small fishes from nursery ponds of the farm. This helps in getting more money.

B. Pig husbandry practice

Integration of pig and fish farming is done through 2 ways –

I. Direct- In this direct integration of pig-cum-fish farming pig houses are constructed on the pond embankment and the pig excreta are washed away directly to the fish pond.

II. Indirect- In indirect integration of pig-fish farming pig sties are constructed at any convenient places of the fish farm and pig dung are stored in a storage tank and from there it is applied to the fish pond in required quantity as and when necessary.

In pig farming the following management practices are followed-

1. Construction of pig house
2. Selection of pigs
3. Feeding of pigs
4. Health management of pigs
5. Harvesting

1. Construction of pig house

The pig sty should be well ventilated with feeding and drinking troughs. Adequate spaces with all essential facilities are prime requisite for construction of pig house. Since pig has not the heat regulating mechanism so this point should be taken care of during construction of a pig house.

The floor space requirement of a pig sty is determined @ 1- 1.5 m^2/ pig. The height of the sty should be in between 1.7- 2.0 m. Height of the concrete wall should be in between 1.0- 1.2 m and over this concrete wall iron netting is done to a height of 0.5- 1.0 m. This iron netting helps is ventilation i.e. aeration in the pig sty which keep the pig house in dry condition. An enclosed run is attached to the pig sty towards the pond, so that the pigs get enough air, sunlight, exercise and dunging space. Apart from feeding and drinking troughs (30 cm/ pig) in the pig sty these are also constructed in the run. This helps in keeping the pig house dry and clean.

In case of direct integration system the floor of the sty and the run is cemented with drainage facility to a soak pit which have the built in shutter facility and this soak pit is connected to the fish pond with a drainage pipe. The slope of the floor can be made 1:50 towards the fish pond. This soak pit of pig sty wastes helps in storing the pig sty wastes when the application of pig dung is stopped to the fish pond by closing the shutter. Again when the application of pig dung is started then the shutter of the soak pit is opened.

On the other hand in case of indirect system of integration the floor of the pig sty is connected to a soak pit where the pig sty wastes are stored and from the soak pit they are carried away to the site of application in the fish pond as and when needed in required quantity. The pig sty can be constructed by wide variety of locally available materials like, bamboo, wood etc. but the floor and the wall up to a height of 1.0- 1.2 m must be concrete made.

2. Selection of pigs

Pigs to be raised along with fish are selected with the following criteria-

1. Resistant to disease
2. Good growth
3. Early maturity
4. Prolific breeding

Upgraded exotic (Hampshire, Large White Yorkshire) variety is preferred for pig–cum-fish farming. This is because- it grows up to 60-70kg in 6 months on an average, in one litter it can produce 6-12 piglets and it attains its maturity within 6-8 months growing periods. Thus, 2 crops of exotic variety of pigs can be raised along with one fish crop in 1 year. To fertilize 1 hector water spread area 40-50 pigs are sufficient, therefore, in 6 months fish culture period 40-50 pigs/ ha water spread area are raised. Thus, for 1 year fish culture period, 80- 100 pigs/ ha water spread area are required. 2- 3 months old weaned piglets are brought to the pig sty for rearing in this integration.

3. Feeding of pigs

Pigs are cultured in pig-cum-fish farming in intensive way and are not allowed to go out of the pig sty. They are fed in the house itself with balanced feed- pig mash at the rate of 1.4- 1.5 kg/ pig/ day. The whole amounts are divided into 3 equal instalments and are fed to the pigs in 3 times a day. Along with this balanced feed they are also fed with green grasses, eichornia, etc. To overcome any mineral deficiency they are fed with 'Sod' (30 X 30 cm bed of grass with all its root intact and interlocked soil) is provided once a week. Along with feed, supply of sufficient drinking water is essential.

4. Health management of pigs

It has been found that the pigs are hardy animals, but they are also susceptible to diseases like- swine fever, swine plague, swine pox and may be infested with parasites like- round worm, tape worm, liver fluke, etc. Maintenance of hygienic and healthy condition in the pig sties keeps the pigs away from danger from diseases. The pig sties should be cleaned daily in the morning and evening hours. The pigs should also be given bath during the summer months. The pig sties and the other appliances used in the pig husbandry practices should disinfected at least once in a week using disinfectant like-potash or lime. From time to time the pig should be dewormed. To save the cultured stock of pigs from anaemia, they should be given iron injection like- Imferon. They should be vaccinated for all viral diseases.

5. Harvesting

After attaining slaughter maturity of 6 months growing period, the pig grown up to 65 kg live weight on an average and at that time they are harvested. The whole batch is removed from the culture system and a new batch is brought to grow. From this integration system during a year 6000 kg or more pig meat and about 6000 kg fish can be expected from a ha of water spread area.

Economics of fish cum pig farming

The economy of pig farming for a period of 6 month and pig-cum fish farming for 4 months indicated a net return on per rupee of investment to be Rs. 1.10, 2.26 and 1.13

on pig alone, fish alone and pig-cum fish, respectively under college farm condition, The corresponding values under village conditions were Rs. 167, 1.82 and 1.70 respectively (Singh et al., 2000, Kujur et al., 2005).

CONCLUSION

Considering the above facts, it can be concluded that the fish-cum-pig farming can be an economic and eco friendly integration which not only can provide a supplementary income to the farmers by increasing fish production but also can offer employment through pig rearing.

REFERENCES

Edwards, P., Puilin, R.S.V. and Gartner, J.A., 1988. Research and education for the development of integrated crop-livestock-fish farming systems in the tropics. *International Centre for Living Aquatic Resources Management*

Rangasamy, A. , Annadurai, K., Subbian, P. and Chinnusamy, J. Farming systems in the tropics, Kalyani Publishers.

Kujur, N., Prasad, C.M., Singh, A.K. and Singh, S.K. 2005. Economic Analysis of integrated Pig-cum-Fish farming in Jharkhand. *Indian* J. *Anim Res.,* 39 (1): 73 - 75.

Kuznetsov, Y.A. 1977. Consumption of bacteria by silver carp. *J. Ichthyiol*., 17:398-404.

Moav, R. et al. 1977. Intensive polyculture of fish in freshwater ponds. 1. Substitution of expensive feeds by liquid cow manure. *Aquaculture*, 10:25-43.

Schroeder, G.L. and B. Hepher, 1975, Wastewater utilization in Israel aquaculture. *Ann Arbor, Michigan, Michigan University.*

Singh, A.K.; Ghosh, T.K.; Jha, R.K. and Manna, N.K. 2000. Performance of pig in fish-cum-pig integrated farming in rainfed rice farming areas. *Journal of Research, Birsa Agricultural University, 12(2): 285-288.*

Unrefined Natural Sugars

Gurpreet Kaur and Jagbir Rehal*

Department of Food Science and Technology
Punjab Agricultural University, Ludhiana
*Corresponding Author: *email: jagbir@pau.edu*

Nowadays, people are becoming aware about the ill effects of the consumption of refined sugars in diet. Refined sugar is harmful when ingested by humans because it provides only "empty" or "naked" calories as described by nutritionists. It lacks the natural minerals which are naturally present in its source i.e. sugar beet or cane. So refined sugar has no nutritional value and is extremely processed, in addition to possibly containing harmful chemicals. Completely cutting out refined sugar is not an easy task, and it's not something that we necessarily need to do.We can, however, have unrefined, natural sugar. Unrefined sugars retain much more of sugar's natural nutrients, such as calcium, iron and magnesium. Unlike refined sugar, there's actually a reason for why we're putting it in our body. The various sources of unrefined and natural sugars have been discussed below:

❖ **HONEY**

Honey is made by honey bees by collecting nectar from flowers and converting it into honey by a process of regurgitation and evaporation. This is then stored as a food source in waxy honeycombs inside the beehive. Because honey's flavor and color are derived from the flower nectar collected by bees, it accounts for the wide range of honeys available around the world.

Honey has the same sugar units as the refined cane sugar. The table sugar has glucose and fructose as sucrose whereas in honey fructose and glucose remain in individual units. Honey contains small amounts of vitamins and minerals and is also associated with a lot of proven health benefits due to its antioxidant activity. It also acts as anti-fungal anti-bacterial agent and is used in various skin care formulations as well. Though honey has more calories than sugar, when honey is consumed with warm water, it helps in digesting the fat stored in our body and is

recommended in weight loss plan. Honey is used in a variety of specialty products during baking, in desserts, in spreads, in barbeque sauces, beverages etc.

❖ **PALM SUGAR**

Palm sugar was originally made from the sugary sap of the Palmyra palm, the date palm or sugar date palm, *Phoenix sylvestris*. Now it is also made from the sap of the sago, A*renga pinnata* and coconut palms, and may be sold as "arenga sugar" or "coconut sugar".

The taste of pure coconut palm sugar resembles that of brown sugar, yet with more rounded caramel and butterscotch notes, without the metallic ending flavor that brown sugar has. It has a rich flavor. For cooking purposes, it has a very low melt temperature and an extremely high burn temperature. This makes it a suitable sweetener for confectioners. Coconut palm sugar is a golden brown sugar sold as granule, blocks or liquid. It may be light-colored or dark, soft and gooey or hard. As a product of cottage industry, it varies greatly from batch to batch. The sweetness was perceived even with a small amount of crystals added. It is natural and chemical free and the crystallized sugar produced by this process had good color, unique taste and possibility to be a new form of natural sweetener in the market.

❖ **BIRCH SYRUP**

Birch syrup is a sweetener made from the sap of birch trees, and used in much the same way as maple syrup. It is used for pancake or waffle syrup, to make candies, as an ingredient in sauces, glazes, and dressings, and as a flavoring in ice cream, beer, wine, and soft drinks.

It is condensed from the sap, which has about 0.5-2% percent sugar content, depending on the species of birch, location, weather, and season. The finished syrup is approximately 67% sugar. Birch sap sugar is about 42–54% fructose and 45% glucose, with a small amount of sucrose and trace amounts of galactose. The flavor of birch syrup is distinctive i.e. rich and caramel-like, with a hint of spiciness.

❖ **AGAVE SYRUP**

Agave nectar (also called agave syrup) is a sweetener commercially produced

in Mexico from several species of agave, including the Blue Agave, Salmiana Agave, Green Agave, Grey Agave, Thorny Agave, and Rainbow Agave.

Agave nectar is sweeter than honey, though less viscous.To produce agave nectar from the *Agave tequiliana* plant, juice is expressed from the core of the agave, called the *piña*. The juice is filtered, then heated to hydrolyze polysaccharides into simple sugars. The main polysaccharide is called inulin or fructosan and comprises mostly fructose units. The filtered, hydrolyzed juice is concentrated to a syrupy liquid, slightly thinner than honey, from light- to dark-amber, depending on the degree of processing. Agave nectars are sold in light, amber, dark, and raw varieties. Light agave nectar has a mild, almost neutral flavor, and is therefore sometimes used in delicate-tasting foods and drinks. Amber agave nectar has a medium-intensity caramel flavor, and is therefore used in foods and drinks with stronger flavors. Dark agave nectar has stronger caramel notes, and

imparts a distinct flavor to dishes, such as some desserts, poultry, meat, and seafood dishes. Both amber and dark agave nectar are sometimes used "straight out of the bottle" as a topping for pancakes and waffles. The dark version is unfiltered and therefore contains a higher concentration of the agave plant's minerals. Raw agave nectar also has a mild, neutral taste and is produced at temperatures below 118° F (48° C) to protect the natural enzymes.

❖ **BARLEY MALT SYRUP**

Barley malt syrup is a sweetener produced from sprouted barley, containing approximately 65 % maltose, 30 % complex carbohydrate, 3% protein.

Malt syrup is dark brown, thick and sticky; and possesses a strong distinctive flavor that can only be described as "malty". It is about half as sweet a

s white sugar. Made from soaked and sprouted barley, which is dried and cooked down to make a thick syrup, barley malt is a sweetener that's slowly digested and gentler on blood sugar levels than other sweeteners. This prevents the rapid fluctuations in blood-sugar levels caused by ingestion of simple sugars. Barley malt syrup is best used in combination with other natural sweeteners. Its strong flavor works well in baked goods calling for an earthy, robust sweetener. The powdered form of the syrup is good for sweetening hot cereals and cookies.

❖ **BROWN RICE SYRUP**

Brown rice syrup, also known as rice syrup, is a sweetener derived by culturing cooked rice with enzymes (usually from dried barley sprouts) to break down the starches, then straining off the liquid and reducing it by cooking until the desired consistency is reached.

The final product is 45% maltose, 3% glucose, and 52% maltotriose. Brown rice syrup is the sweetener found in some drinks, such as rice milk. Its mild butterscotch-flavored sweetness doesn't overpower other flavours and it works well for all baked goods. Like barley malt, brown rice syrup has a long shelf life and requires no refrigeration. Unlike honey, it does not crystallize.

❖ **BLACKSTRAP MOLASSES**

Blackstrap molasses is just one type of molasses, the dark liquid byproduct of the process of refining sugar cane into table sugar. It is made from the third boiling of the sugar syrup and is therefore the concentrated byproduct left over after the sugar's sucrose has been crystallized.

Blackstrap molasses is a sweetener that is actually good for consumption. Unlike refined white sugar and corn syrup, which are stripped of virtually all nutrients except simple carbohydrates, or artificial sweeteners like saccharine or aspartame, which not only provide no useful nutrients but have been shown to cause health problems in sensitive individuals, blackstrap molasses is a healthful sweetener that contains significant amounts of a variety of minerals that promote our health. Only 2 tsp of blackstrap molasses contain 2.39 mg of iron and is also a good source of potassium, calcium, magnesium, vitamin B6, and selenium.

❖ **FROM FRUITS**

Many fresh fruits, dried fruits and fruit juices are used as sweeteners. Most commonly used are Dates, date paste, spread, syrup ("dibs"), or powder (date sugar) which are made from the fruit of the date palm (Phoenix dactylifera). Date sugar is made from pitted, dehydrated, crushed dates and is nearly as sweet as white sugar, so it should be used moderately. It contains some minerals, but it doesn't dissolve well, so date sugar may be more useful in cooking than baking. Sugar is also derived from watermelon and pumpkin by boiling the juice in a similar manner as to make beet sugar. dates, grape molasses and rose water are combined to make Jallab, a type of fruit based sugar. Similarly, Pekmez is made of grapes, fig (Ficus carica) and mulberry (Morus spp.) juices, condensed by boiling with coagulant agents. Hence, keeping in mind the ill effects of consuming refined sugar which is chemical laden and devoid of any nutritional benefits, it is high time to switch over to the delicious and nutritious world of unrefined natural sugars.

Traditional and Modern Grain Storage Facilities

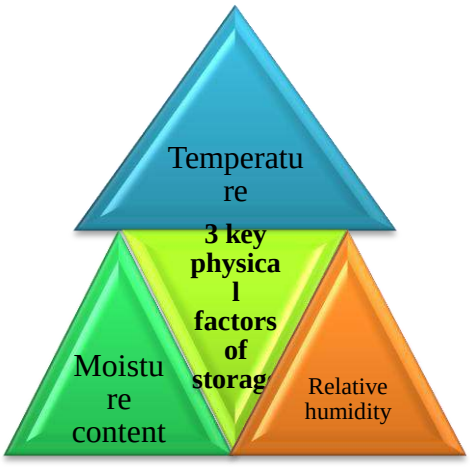
*Mokshata Gupta[1], Tarun Kumar Varun[2], Shilpa Choudhary[3], Nirmala Muwel[4], Kanti Raje[5], Lokesha E[6] and Yengkhom Rojita Devi[7]

[1,3,4,5,6,7] Division of Animal Nutrition, IVRI, Izatnagar, Bareilly, UP – 243122
[2]Division of Dairy Cattle Nutrition, NDRI, Karnal- 132001, Haryana
*Corresponding Author email- mokshtagupta1407@gmail.com

Agriculture is an important sector of the Indian economy, accounting for 14% of the nation's GDP, about 11% of its exports, about half of the population depends on agriculture as its principal source of income and it is a source of raw material for a large number of industries. Food grains undergo various processings like harvesting, threshing, winnowing, bagging, transportation, storage, and processing before they reach to the consumer, and certain losses occurs during these processings. The post-harvest losses of food grains in India is about 12 to 16 million metric tons per year. Quantitative losses occurs when grains are infested by insects, rodents, mites, birds, microorganisms, etc. This causes decrease in seed germination, increase in moisture, free fatty acid levels, and decrease in protein contents, pH, etc. leading to total quality loss. These quality losses affect the economic value of the food grains fetching low prices to farmers. India's grain production is increasing now-a-days due to advances in technology, but post-harvest loss is constant at level of 10%. Losses during storage, accounts for about 6% of the total losses due to lack of proper storage facilities. In India, small farmers uses traditional structures for storage of food grains.

Physical Factors Affecting Storage of Grains

The principal physical factors which interact to create a storage micro environment are the moisture content of stored grain, temperature, relative humidity, oxygen and carbon dioxide in the storage facility. Among these, major factors that can be easily manipulated for proper storage by small farmers are temperature, moisture content and relative humidity.



■ **Temperature:** Optimal temperature range for storage insects is between 25 ºC to 34 ºC and for the mould development is between 15 ºC to 30 ºC. Beyond this range, their development is reduced, and therefore the losses are minimized.

■ **Moisture content**: It is the quantity of water bound in the grain kernels expressed as a percentage by weight of the grain sample. It is a determining factor in the proliferation of mould and storage pests. The moisture content in dry grain is about 6-15% that vary with the type of grain.

■ **Relative humidity:** It is the percentage of water vapour in the air between the grains, and represents the equilibrium between the humidity of the air and the moisture content of the grain. If the relative humidity is above 65%, mould and storage insects will develop and damage the stored grain and seeds.

Lower the temperature, relative humidity and moisture content, the lower the risk of grain damage and seed losing its germination capacity.

STORAGE FACILITIES

A safe storage environment can be developed if proper facilities and good practices are adopted for the storage of grains. This helps to reduce the losses resulting from pests or mould, and ensure that the seed's germination power is maintained during the storage period. Farmers manage to keep small quantities of grains in good conditions of low temperature and low moisture content, without incurring major losses in quality, quantity or germination potential. But, when larger quantities of grains are to be stored, then a larger storage structure has to be built. In such a case, it is critical to be aware of the extra care required in maintaining a specific safe storage environment for grains.

The following storage facilities are mainly oriented towards storage of food grains, and they have been categorized as either traditional or modern storage facilities.

TRADITIONAL STORAGE FACILITIES

On-farm traditional storage facilities can be differentiated as open, semi-open and closed storage.

Open storage

This systems is used in hot and humid climatic conditions or when grain has just been harvested at a higher moisture content. It involves the use of wooden structures that are suitable as temporary drying facilities for cobs or panicles, and sometimes the grain are kept here for longer periods. When grains are kept on these structures it dries quickly, as it is directly exposed to sunlight and natural ventilation. The rapid drying prevents the continue to mature and fully ripen after harvesting. These are elevated from the ground that helps to prevent termite invasion.

These structures are easy to built but they are open to insects, rodents and birds, and over exposure to sun or rain which can damage the grains.

Semi–open storage (cribs)

These structures are made from timber or bamboo and are elevated using stone foundations or wooden frames to prevent

damage from rodents, termites or soil moisture and have a straw roof to protect against the rain or excessive sunlight and allow sufficient ventilation.

These structures are normally used to store cobs or panicles that require further drying before threshing, as the openings or porous walls will allow continuous aeration during storage. This system provide better protection against weather conditions than open ones but do not prevent pests from entering.

Closed storage

They are made from mud (often mixed with chopped straw) or woven with grass, bamboo, etc. and then insulated against pests with mud. They are used for storing grain and seed like sorghum, millet, pulses, paddy rice, peanuts, etc. Wet grain cobs or panicles should not be stored in closed storage, as they will increase the humidity and condensation inside the container, leading to quality changes.

Sometimes, small containers made from clay, straw, wood or leather, are buried or hung from trees or eaves after storing grains in them. Also, seed stores can be constructed underground to protect against rodents and high temperatures.

These structures are suitable for storing seed because of the mud's excellent insulation capacity, which allows the maintenance of a stable temperature and humidity inside the container, preventing seed deterioration.

MODERN STORAGE FACILITIES

The storage grain bag

They are the most common form used by the small-scale farmers for the storage of shelled grain and seeds. They acts as an excellent and affordable storage: enable aeration, avoid spillage and prevent infestation. Plastic bags are not suitable for storing grain or seed because plastic impedes the circulation of air. Tightly woven polypropylene bags are also not suitable because they do not allow sufficient ventilation, but they are often the

easiest to find in the local markets.

The best storage bags are jute bags with a special weave, which is anti-slip and allows

for aeration. Seed should be treated before storing in bags to protect them from insect infestation.

Modern granaries

The construction of modern granaries is often not a cost-effective option for small-scale farmers However, if the farmers come together to pool their production in a single storage facility, then the construction of specific facilities for storage may be justified.

In the construction of community storages in hazard-prone areas, there is a need to have specific technical considerations, mainly regarding the site and orientation of the construction as well as the construction methods .

Modern cribs

It is semi-open and stands on brick supports, more durable when built from hard wood and is more protected with a solid roof, while maintaining good ventilation through a mesh wire surrounding the structure. It is suitable for drying and storing cobs.

Metal silo bins

They has the capacity to hold 100 to 3 000 kg of grains or pulses. They are portable, requires little space, and can be cheaply made from local material and expertise. The silo can last long if well maintained. They are efficient and low-cost storage system suitable for small-

scale farmers. These silos are loaded from the top, and once closed they are inaccessible by rodents or insects, and can be properly sealed against water leaks. They are normally covered, raised from the ground and placed in a well-ventilated place to control both temperature and humidity.

Small metallic silos can be used for seed storage, but they must be kept in a cool place

to reduce germination power. Before placing the grains inside the silos, it must be dried to a safe moisture level.

Hermetic bags

These are hermetically sealed bags of various sizes. They acts as an alternative to traditional storage. The hermetic bags work on the principal that grains release carbon-dioxide which rapidly replaces the oxygen in the sealed container. Once oxygen is exhausted, the pests die and fungi cannot spread. For these sealed units to work effectively, they

need to be completely filled quickly and only opened when the entire contents have to be used.

These are highly suitable for seed storage, since it can be sealed airtight ensuring that a stable condition suitable for seed storage is maintained. To ensure that the seed does not absorb moisture during the long storage period, silica gel is added to absorb excess moisture. An indicator colourant is added to the silica gel so that it changes colour when it needs to be replaced.

Insecticide-treated bags

These are woven polypropylene bags developed to store cereal grains, pulses, oilseeds, seeds, etc. An insecticide is incorporated into the individual fibres, providing a powerful killing action against insects before they can infest the grain or seed in the bag. These are mainly used for storing low volume, high value products like seed.

Small containers

Jars or tins that can be made airtight are commonly used to store well-dried seed. Such containers are feasible for storing small amounts of seed. The bottles or tins of ordinary household products bought from local shops can be used for this purpose and candle wax can be used on the lid to make a good seal, creating a suitable micro-environment for the storage of small quantities of seed. They can easily be placed in a cool place where they are not accessible to rodents.

CONCLUSION

Storage is an important link in the entire procurement and distribution system of food grains that are produced seasonally but consumed throughout the year. Therefore, storage facilities in India need to be strengthened by supplying them with the harvest operations before grain deterioration occurs. Losses due to inadequate post-harvest and storage practices badly affect the economy and the food as well as nutrition security of small-scale farmers.

Isoprene Emission from Bioenergy Plantations- Serious Concern of Global Warming

Vibha Singhal[1], Jyotirmoy Ghosh[2] and Sheeraz Bhat[3]

[1]Corresponding Author, Sr Scientist, ICAR-IISWC, Dehradun (Uttarakhand)
[2]Sr. Scientist, ICAR-IINRG, Ranchi (Jharkhand)
[3] Scientist, ICAR-IINRG, Ranchi (Jharkhand)

Abstract

The lesser know fact is that plants do emit hydrocarbons in the atmosphere and are responsible for ozone depletion in the atmosphere in the atmosphere. Most of the hydrocarbon flux from the biosphere to the atmosphere is just one compound, isoprene. There are growing demands for bioenergy from tree plantations currently. Fast growing species are receiving enormous attention due to increasing demand for renewable bioenergy. In addition the potential to reduce greenhouse gas (GHG) concentrations and to mitigate climate change is an additional incentive for bioenergy crop cultivation . But most of the species used for tree plantations across the globe emit volatile organic compounds (VOCs) in large quantities; in particular, the common bioenergy trees (poplar, willow, eucalypt and oil palm) and perennials (giant and common reed) are strong isoprene emitters, therefore hydrocarbon emission from vegetation is of immediate global concern.

Introduction

Global warming is the major concern at present which drew attention of people from almost every domain politicians, scientists, policy makers and environmentalist. Since the dawn of the Industrial Revolution, humans have increasingly been contributing unnatural sources of greenhouse gases into the system. But most of the people are unaware of the fact that plants emit excess of hydrocarbon into the atmosphere than that coming from human activities, particularly during extended warm weather when hydrocarbon inputs into the atmosphere can be especially deleterious. Most of the hydrocarbon flux from the biosphere to the atmosphere is just one compound, isoprene. Isoprene (2methyl-1,3-butadiene) is the simplest plant isoprenoid which is emitted from many plant species (Kesselmeier and Staudt 1999) in large quantities. As a result of its high volatility, once isoprene is synthesized in plant, it is not stored in the plant but is emitted through the stomata into the atmosphere. The annual global emission of isoprene from vegetation is estimated to be 570 Tg (503 Tg of carbon) (Guenther et al. 2006), which exceeds by far the emission rate of any other organic compound

(except methane) of natural or anthropogenic origin. Thus, hydrocarbon emission from vegetation is of immediate global concern. Such a large flux of isoprene from plants to the atmosphere raises curiosity on several aspects such as what happens to the isoprene in the atmosphere and why plants emit isoprene. Isoprene is probably the most studied biogenic volatile organic compound (BVOC) and interest in its production and emission spans a number of disciplines: atmospheric chemistry, plant physiology, and plant biochemistry

The taxonomic distribution of isoprene emission is broad. Mosses, ferns, gymnosperms and angiosperms all have members that make isoprene but also have members that do not. Isoprene synthase has been sequenced from several *Populus* species and from kudzu (*Pureria lobata*). The sequences and gene structures indicate that they are part of the TPS-b family of terpene synthases. Members of this gene family also code for monoterpene and sesquiterpenes synthases in angiosperms but are not found in gymnosperms. The sequences for IspSs among poplars are very similar (sequences are known for *P. alba*, *P.* × *canescens*, *P. tremuloides* and *P. trichocarpa*), but this group is very different from the IspS of kudzu. Antibodies against poplar IspS do not cross react with kudzu IspS and vice versa, and neither antibody recognizes oak IspS. Within any particular group of plants, there are some traits that loosely correlate with isoprene emission but there is significant variability. Indeed, there are some peculiar disjunctions. North American oaks all emit isoprene, but many European oaks do not. Instead, among European oaks a variety of behaviours is found. Some clades emit isoprene, some emit monoterpenes in a light-dependent manner, and some emit very little terpene

Why plants emit isoprene?

"WHY" plants emit isoprene is really asking what advantage isoprene emission provides to the plant that makes it. The energy cost of isoprene emission is quite significant (starting from CO2, 20 ATP and 14 NADPH per isoprene molecule; Sharkey and Yeh, 2001). The balance between cost and benefit likely will vary such that isoprene emission is favoured in some species but not others. This could be a significant influence on the distribution of the capacity for isoprene emission among plants

Emission of isoprene in response against abiotic stresses

The most known advantage plants gain by isoprene synthesize is thermotolerance. The fact that isoprene emission increases dramatically at elevated temperature resulting in high internal leaf concentration led to suggestion that isoprene may play a role in plant protection against high temperature episodes. Many studies support the role of isoprene in thermotolerance. Fumigation of kudzu (*Pueraria lobata* Willd.) leaves with exogenous isoprene shifted the onset of thermal damage to photosynthesis by 48^{o}C . The negative changes in photosynthetic capacity of isoprene-inhibited leaves of *Platanus orientalis* were also reduced by

flowing exogenous isoprene during heat treatment (Velikova et al. 2006). One another studies demonstrated that photosynthesis of *Phaseolus vulgaris*, which naturally does not make isoprene, exhibited increased thermotolerance when leaves were fumigated with exogenous isoprene. Isoprene not only protects during the heat episodes but also helps plant to better recovery form high temperature stress. Photosynthesis of kudzu leaves was almost totally inhibited after heating to 46.8^{o}C, but when temperature was returned to 30.8^{o}C, photosynthesis recovered by 90%. However, photosynthesis recovered only 60% in isoprene-inhibited leaves. When these leaves were fumigated with exogenous isoprene they showed similar recovery as isoprene-emitting leaves (Sharkey et al. 2001). Isoprene-emitting *Phragmites australis* leaves were also able to quickly recover after heat stress in comparison. The mechanisms by which isoprene's protective function as a heat-protectant is achieved are still unclear. One of the proposed mechanisms is based on the capacity of this molecule to stabilize the thylakoid membranes. The reason of this assumption is based on the location of isoprene synthase in the stroma and thylakoids (Wildermuth and Fall 1998), and because isoprene is a hydrophobic molecule and therefore is expected to partition into membranes. Thylakoid membranes become leaky to protons at high temperatures (Pastenes and Horton 1996; Bukhov et al. 1999) and since isoprene is highly lipophilic, it may partition into membranes and can prevent the formation of water channels responsible for the membrane leakiness at high temperatures (Singsaas et al. 1997; Sharkey et al. 2001). Isoprene could also enhance hydrophobic interactions within thylakoids and thereby stabilize interactions lipids and/or proteins during high temperature stress (Sharkey and Yeh 2001). Isoprene stabilizes lipid membranes and reduces the likelihood of a phospholipid membrane undergoing a heat induced phase transition. The protective effect of isoprene can be also related to the double bounds in the isoprene molecule. The importance of double bounds in isoprene molecule has been demonstrated in the experiments of Sharkey et al. (2001). The data showed that hydrocarbons with double bounds (alkenes) provide thermotolerance similarly to isoprene, whereas alkanes make worse heat damages. It was suggested that isoprene can interact electronically and eventually stabilize the double bounds of the thylakoid membranes

THE ANTIOXIDANT HYPOTHESIS

Another hypothesis to explain the generally positive role of isoprene in plant metabolism is the antioxidant hypothesis. It was suggested that isoprene can serve in plant defense system not only by strengthening membrane structure and making them less prone to denaturation, but also because of its possible capacity to quench reactive oxygen species (ROS) produced under oxidative stress. Basically every environmental factor (e.g. high

temperature and light, drought, salinity, heavy metal contamination, gaseous pollution) can cause an oxidative stress to leaves, altering plant functionality. The possible function of isoprene as natural antioxidant in plants was a matter of investigation of several studies. It was proposed that isoprene would use its capacity for ROS scavenging, and thus antioxidant defense in isoprene-fumigated plants is less needed and activated only at a later stage. Several studies demonstrated that isoprene can act as powerful antioxidant, reducing oxidative damages caused by ozone (Loreto et al. 2001; Loreto and Velikova 2001). The isoprene ability to protect photosynthetic machinery against singlet oxygen, another toxic ROS produced under stressful conditions, was also evaluated. It was suggested that the mechanism by which isoprene provides its protection against singlet oxygen may be involved in a direct reaction with this harmful ROS. This assumption is supported by the fact that isoprene emission was significantly lower in stressed leaves compare with controls. Lowered isoprene emission can be accounted for by isoprene consumption associated with singlet oxygen quenching. The assumption that isoprene counteracts oxidative stress by ROS-scavenging mechanisms was made on the basis of chemical structure of the isoprene molecule. Similarly to carotenoids, the presence of conjugated double bounds in isoprene molecule may allow easy electron and energy transfers and heat dissipation; thus isoprene can elevate the antioxidant power of cell. If considering the chloroplast localization of isoprene biosynthesis (Logan et al. 2000), the ROS scavenging ability of isoprene makes it extremely important in plant protection against oxidative stress. There are considerable amount of studies showing the protective role of isoprene under different environmental stresses, but the exact mechanisms remain still elusive.. It is, therefore, important to investigate the long-term consequences of isoprene-mediated interactions between biosphere and the atmosphere

Relevance of isoprene emission in the context of global warming

Isoprene has a significant influence on photo-oxidative mechanisms in the atmosphere as these molecules are highly reactive with OH radicals. Depending on the NOx concentration in the troposphere – high or low – isoprene causes either ozone formation or degradation, respectively. Sunlight photolyses the NO2 and this leads to one ozone molecule per NO2. In the absence of hydrocarbon, the total NOx level in the atmosphere determines the amount of ozone that can be formed. However, oxidation of isoprene by atmospheric hydroxyl radicals can lead to hydroperoxides (RO2) that can convert NO to NO2 allowing more ozone production. Further reactions can form HO2 which can also convert NO to NO2 and generate the OH radical One isoprene molecule can lead to the formation of many ozone molecules when the NOx levels are high. When there is very little NOx, different reactions can dominate and isoprene emission from plants can reduce ozone in the atmosphere.

Isoprene also raises the concentration of aerosols in the atmosphere. Aerosols are particles in the atmosphere which give rise to Frits Went's famous natural blue hazes but also to significant health problems. Isoprene oxidation products, including glycolaldehyde, hydroxyacetone, and ethylglyoxal, may be important constituents of secondary organic aerosol particles. Secondary organic aerosols make an important contribution to the aerosol loading of the atmosphere, with direct and indirect effects on the global radiation balance. The yield of aerosol per molecule in the atmosphere is much lower for isoprene than for monoterpenes and larger molecules, but because there is so much more isoprene entering the atmosphere than other molecules, isoprene may be a significant factor in aerosol formation

Isoprene emission from bioenergy plantations

Currently, there are growing demands for bioenergy from tree plantations, fast growing species are receiving enormous attention because of the increasing demand for renewable bioenergy. In addition to the economic interest in bioenergy from biomass, the potential to reduce greenhouse gas (GHG) concentrations and to mitigate climate change is an additional incentive for bioenergy crop cultivation (Liberloo et al., 2010). Based on their economic and ecological benefits, a worldwide increase in large-scale tree plantations, accompanied by land use changes, is expected, mainly from the afforestation of marginal and apportioned agricultural lands (Beringer et al., 2011). Poplars (Kesselmeier and Staudt, 1999) are fast growing pioneer trees, receiving enormous attention due to increasing demand of renewable bioenergy (Schnitzler et al., 2010). World-wide poplar plantations represent 5.3 million ha with an increasingly positive trend in many countries (International Poplar Commission, Synthesis of Country Progress Reports 2008). With an easy generation of new hybrids and good regeneration from rootstocks, poplar allows for highly productive short-rotation coppice plantations (Laureysens et al., 2005; Aylott et al., 2008). Biomass from poplar is suitable for heat and power production, and is also a viable substitute for fossil fuels (Vande Walle et al., 2007; Aylott et al., 2008). But Poplars are among the strongest emitters of isoprene. Most of the species used for tree plantations across the globe emit volatile organic compounds (VOCs) in large quantities; in particular, the common bioenergy trees (poplar, willow, eucalypt and oil palm) and perennials (giant and common reed) are strong isoprene emitters (Kesselmeier & Staudt, 1999). With expansion of tree plantations, these effects have become increasingly important. Wiedinmyer et al. (2006) developed expected land use changes in model-based estimates of future variations in global isoprene emissions. Their simulations revealed that the conversion of natural vegetation to plantations could substantially increase global isoprene flux by up to 37% compared with the current situation, which subsequently could cause O3 to increase regionally to potentially

unhealthy concentrations. Hewitt et al. (2009) used measurements and models to evaluate, more specifically, the impact of tropical bioenergy oil palm plantations on O3 formation potential and local air quality in Borneo. They showed that this form of land use change would result in much greater emissions of isoprene, leading to severe ground-level O3 pollution depending on how human activities (industrialization and traffic) develop. Recent comprehensive analyses (Hewitt et al., 2009) demonstrated that conversion of tropical rainforest to oil palm plantations in Malaysia results in enhanced isoprene emission that lead to O3 formation.

CONCLUSION

The increasing scarcity of fossil fuels, associated with the combustion of fossil fuels causing increase of greenhouse gas (GHG) emissions, raised growing interest in renewableenergy sources and develops an enormous pressure on land use change (Wiedinmyer et al., 2006). However, the modelling of future land use changes and isoprene emissions is full of uncertainties, and great effort is needed by the scientific community to realistically assess the 'environmental friendliness' of growing bioenergy trees/crops (Beringer et al., 2011)

REFERENCES

Aylott MJ, Casella E, Tubby I, Street NR, Smith P, Taylor G. 2008. Yield and spatial supply of bioenergy poplar and willow short-rotation coppice in the UK. *New Phytologist* **178**: 358–370.

Beringer T, Lucht W, Schaphoff S. 2011. Bioenergy production potential of global biomass plantations under environmental and agricultural constraints. *Global Change Biology Bioenergy* **3**: 299–312

Bukhov NG, Wiese C, Neimanis S, Heber U. 1999. Heat sensitivity of chloroplasts and leaves: Leakage of protons from thylakoids and reversible activation of cyclic electron transport. *Photosynth Res*. 59:81-93

Hewitt CN, Kok GL, Fall R. 1990. Hydroperoxides in plants exposed to ozone mediate air pollution damage to alkene emitters. *Nature*;344:56-58.

Guenther A, Karl T, Harley P, Wiedinmyer C, Palmer PI, Geron C. 2006. Estimates of global terrestrial isoprene emissions using MEGAN (Model of Emissions of Gases and Aerosols from Nature). *Atmospheric Chemistry Physics* 6:3181-3210.

Kesselmeier J, Staudt M. 1999. Biogenic volatile organic compounds (VOC): an overview on emission, physiology and ecology. *Journal of Atmospheric Chemistry* 33:23-88

Laureysens I, Deraedt W, Ceulemans R. 2005. Population dynamics in a 6-year-old coppice culture of poplar II. Size variability and one-sided competition of shoots and stools. *Forest Ecology and Management* **218**: 115–128

Liberloo M, Luyssaert S, Bellassen V et al. (2010) Bio-energy retains its mitigation potential under elevated CO2. PLoS ONE, 5, Article number: e11648.

Logan BA, Monson RK, Potosnak MJ. 2000. Biochemistry and physiology of foliar isoprene production. Trends Plant Sci. 5:477- 481.

Loivamäki M, Gilmer F, Fischbach RJ, Sorgel C, Bachl A, Walter A, et al. 2007. Arabidopsis, a model to study biological functions of isoprene emission? *Plant Physiology* 144:1066-1078.

Loreto F, Mannozzi M, Maris C, Nascetti P, Ferranti F, Pasqualini S. 2001. Ozone quenching properties of isoprene and its antioxidant role in plants. *Plant Physiol*. 126:993-1000

Loreto F, Velikova V. 2001. Isoprene produced by leaves protects the photosynthetic apparatus against ozone damage, quenches ozone products, and reduces lipid peroxidation of cellular membranes. *Plant Physiology* 127:1781-1787

Pastenes C, Horton P. 1996. Effect of high temperature on photosynthesis in beans. 2. CO2 assimilation and metabolite contents. *Plant Physiology* 112:1253-1260.

Schnitzler J P, Louis S, Behnke K, and Loivamaki M. 2010. Poplar volatiles - biosynthesis, regulation and (eco)physiology of isoprene and stress-induced isoprenoids, *Plant Biol*. 12, 302–316.

Sharkey TD, Yeh S. 2001. Isoprene emission from plants. Annual Review of Plant Physiology and Plant *Molecular Biology* 52:407-436.

Sharkey TD,Chen XY, Yeh S. 2001. Isoprene increases thermotolerance of fosmidomycin-fed leaves. *Plant Physiology* 125:2001-2006.

Singsaas EL, Laporte MM, Shi J-Z, Monson RK, Bowling DR, Johnson K, et al. 1999. Leaf temperature fluctuation affects isoprene emission from red oak (Quercus rubra) leaves. *Tree Physiology* 19:917-924

Singsaas EL, Lerdau M, Winter K, Sharkey TD. 1997. Isoprene increases thermotolerance of isoprene-emitting species. *Plant Physio*l. 115:1413-1420.

Vande Walle I, Van Camp N, Van de Casteele L, Verheyen K, Lemeur R. 2007. Short-rotation forestry of birch, maple, poplar and willow in Flanders (Belgium) II. Energy production and CO2 emission reduction potential. *Biomass and Bioenergy* 31: 276–283.

Velikova V, Loreto F, Tsonev T, Brilli F, Edreva A. 2006. Isoprene prevents the negative consequences of high temperature stress in *Platanus orientalis* leaves. *Function Plant Biol*. 33:931-940.

Wiedinmyer C, Tie X X, Guenther A, Neilson R, Granier C. 2006. Future changes in biogenic isoprene emissions: how might they affect regional and global atmospheric chemistry? *Earth Interact*. 10, EI174, doi:10.1175/EI174.1,

Wildermuth MC, Fall R. 1998. Biochemical characterization of stromal and thylakoid-bound isoforms of isoprene synthase in willow leaves. *Plant Physiol*. 116:1111-1123

Kesselmeier J, Staudt, M. 1999. Biogenic organic compounds (VOC): An overview on emission, physiology and ecology. *J. Atmos. Chem*. 33: 23–88.

Slowly Digestible Starch (SDS) and its Health Implications

Ponbhagavathi T R T M*[1], Singh A K[1], Sandhya S, Bensi P S[2], Tanya Tyagi[1], Munirathnama V[1] and Kavitha N[1]

[1]*Department of Food Science and Nutrition, ICAR - NDRI, Karnal - 132001, Haryana*
[2] *Department of Food Science and Nutrition, HSC & RI, Madurai - 625104, Tamil Nadu*
Corresponding author mail: ponbhagavathi2015@gmail.com

Abstract

Non-communicable diseases like diabetes and obesity are the major public health concern in the world. To overcome these problems, healthcare experts are advocating the necessity of incorporating high-quality carbohydrates in the diet. Based on the digestibility, the starch is classified into Rapidly Digestible Starch (RDS), Slowly Digestible Starch (SDS) and Resistant Starch (RS). Among these three starches; Slowly Digestible Starch (SDS) delivers a slow and sustained release of blood glucose along with low glycemic and insulinemic response. Native cereal starch is an ideal SDS structure, causing them to be digested slowly having semi-crystalline A-type structure. These SDS had several health implications, including diabetes, obesity, and cardiovascular diseases.

INTRODUCTION

According to WHO (2016), obesity and diabetes are the major public health concerns in the world. So, health care experts are advocating the incorporation of high quality carbohydrate in the diet. New development in nutritional science concludes slowing down the rate of digestion of glucose helps to blunt glycemia, reduces insulin requirements and causes satiety. In starch, Slow Digestible Starch (SDS) is slowly digested throughout the small intestine, resulting in a slow and prolonged release of glucose into the blood stream, with a low glycemic response. It helps in reducing some of the metabolic syndromes such as diabetes mellitus, obesity, Cardio Vascular Diseases (CVD) and it also, enhances the mental performance (memory status) in human being.

Starch

Starch is the main complex carbohydrate in human nutrition. It is a major component in plant foods and offers a wide range of desired technological properties. The glucose release as a source of energy for the body and the timeline of digestion are the major physiological properties of starch. The digestibility in the human small intestine can be a rapid digestion, slow digestion and indigestion.

Classification of starch:

According to Englyst *et al*, 2005, starch can be classified into 3 types, based on their digestibility:

1. Rapidly Digestible Starch (RDS): The Starch fraction digested within 20 minutes

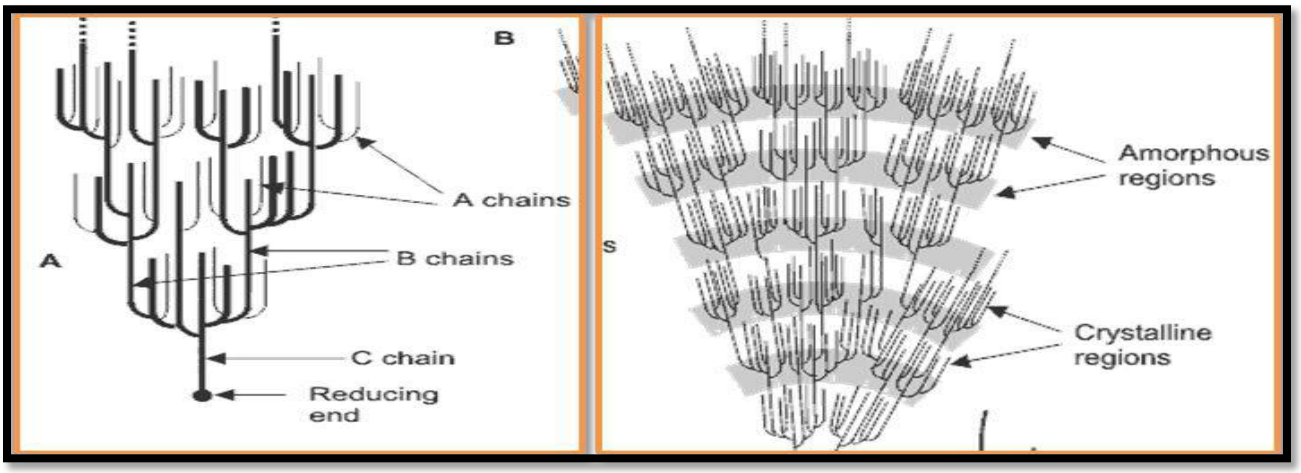
of incubation. The main physiological property of this type of starch is to provide rapid source of energy. Ex: Freshly cooked foods.

2. Slowly Digestible Starch (SDS): The1. Starch fraction digested between 20 and 120 minutes of the incubation. It is slowly2. digested throughout the small intestine3. resulting in slow and sustained source of energy with prolonged release of glucose4. into the blood stream. Ex: Native waxy maize, millets and legumes. 5.

3. Resistant Starch (RS): The Starch fraction that cannot be digested in the incubation6. after 120 minutes. This type of starch has fermented in the colon as a dietary fiber. Ex: Raw potato, staled bread.

Structure of SDS:

Figure 1: Organizational Structure of SDS



SDS is commonly, semi - crystalline A-Type structure in nature. Crystallinity is exclusively associated with the amylopectin component and Amorphous region represents amylose content. SDS structure is the intermediate between more crystalline Resistant Starch (RS) and more amorphous Rapidly Digestible Starch (RDS).

Common SDS food preparation methods:

Annealing and hydrothermal treatments (Kim *et al.,* 2005)

Citric - acid modification (Shin *et al.,* 2007)

Pullulanase and amylase debranching (Guraya *et al.,* 2001)

Partial gelatinization and recrystallization (Chung *et al.,* 2006)

Temperature-cycled retrogradation (Zhang *et al.,* 2011)

Dual-retrogradation treatment (Yaoqi Tian *et al.,* 2013)

SDS content in different foods:

SDS is naturally found in uncooked grains such as wheat, rice, barley, rye and corn. The range of SDS content can be wide even within a single food category due to the influence of the manufacturing process on starch digestibility in the finished product.

Digestion of SDS:

Unlike most starch fractions, molecules of SDS are not disrupted in the mouth by salivary α-amylase or in the stomach by gastric juice. The process is initiated when chyme moves into the small intestine

through gastric empyting and most digestion of SDS occurs in the duodenum by pancreatic *α*-amylase. It converts starch into disaccharides (maltose) and recombinant human enzymes (*α*-glucosidases, including small intestinal sucrase-isomaltase, maltase-glucoamylase) which converts disaccharides into monosaccharides (glucose).

Analytical method for SDS digestion:

In Vitro - Englyst method:

The method most widely used to quantify nutritionally important starch fractions was developed by Englyst *et al*., 1992, it involves stimulation of the human digestion system. In this, the various types of starch constituents are determined by controlled enzymatic hydrolysis with pancreatic amylase and amyloglucosidase at 37°C and the released glucose is measured using glucose oxidase. SDS is calculated by using this following formula:

SDS (%) = (G120 - G20)*0.9 / TS)*100

Where as,

G120 and G20 - Glucose Hydrolyzed after 120 mints and 20 mints, respectively

TS - Weight of the sample,

0.9 - Conversion factor

Health Implications of SDS rich foods

A moderate postprandial glycemic and insulinemic response due to SDS implies that SDS rich foods may provide wide health benefits by reducing common chronic diseases related to diet such as obesity, diabetes and cardiovascular diseases etc.

SDS and Diabetes Mellitus (DM):

One of the goal in diabetes management is to reduce meal associated hyperglycemia in the type 2 diabetes. SDS intake results in a beneficial metabolic response for the prevention and management of diabetes. It reduces postprandial glucose peaks, episodes of hypoglycemia, concentration of glycosylated hemoglobin and increases insulin sensitivity.

Action of SDS on glucose homeostasis

RDS and SDS differ in their ability to stimulate secretion of gut incretin hormones. Glucagon-like peptide-1 (GLP-1) and glucose-dependent insulinotropic polypeptide (GIP) increased in the late postprandial phase (180 - 300 min) after SDS consumption increases cellular glucose metabolism.

SDS and Obesity:

Obesity is becoming more prevalent and is associated with an increase in mortality and morbidity due to diabetes mellitus, hypertension, CVD, stroke and cancer. Obesity is most commonly caused by a combination of excessive food intake, lack of physical activity, and genetic susceptibility. Changes to diet and exercising are the main treatments of obesity. Diet quality can be improved by reducing the consumption of energy-dense foods and by increasing the intake of SDS foods. Slow digestion rate of SDS leads to reduced lipogenesis in adipose and liver tissues and benefits body weight management by promoting satiety and fat oxidation at the expense of carbohydrate oxidation.

SDS and Cardio Vascular Disease (CVD):

According to (FAO, 2016) CVD death rate is around 17.5 million. Role of diet is crucial in the prevention of cardiovascular disease. Diets that mostly include slowly digestible starches have been associated with a

reduced risk of Cardio Vascular Diseases (CVD) by increasing HDL-cholesterol level and decreasing serum triglycerides.

SDS and Mental performance:

Blood glucose level influences mental performance for higher demanding tasks like memory. Breakfast high in SDS counteracted a decline in performance over the morning compared to rapidly available carbohydrates. Individual glucose tolerance and beta cell functioning might be additional effects of glucose on cognition.

CONCLUSION:

SDS as a novel functional component in products delivers a slow and prolonged release of glucose when digested in our body. Native cereal starch is an ideal SDS structure, causing them to be digested slowly having semi-crystalline A-Type structure. SDS can have an impact on postprandial blood glucose, insulin levels and maintains glucose homeostasis It is resulting in reducing metabolic syndromes such as diabetes mellitus, obesity and Cardio Vascular Disease (CVD) and also, enhance the mental performance (memory status) in human being.

Table 1: SDS content in different food items

PRODUCT CATEGORY	SDS CONTENT (gm /100 gm)	REFERENCES
Cereals	1.4 - 12.0	Englyst *et al.,* 1996, 1999
Pasta	9.0 - 12.0	Englyst *et al.,* 1996, 1999
Rice	5.6 - 10.0	Englyst *et al.,* 1996
Legumes	0.8 - 9.8	Englyst *et al.,* 1996
Root, tuber and derivatives	0.4 - 2.8	Englyst *et al.,* 1996
Bakery - products and Crackers	0.7 - 9.6	Englyst *et al.,* 1999, 2003
Breakfast cereals	0.5 - 13.6	Englyst *et al.*, 1999, 2003
Biscuits	3.8 - 22.9	Garsetti *et al.,* 2005