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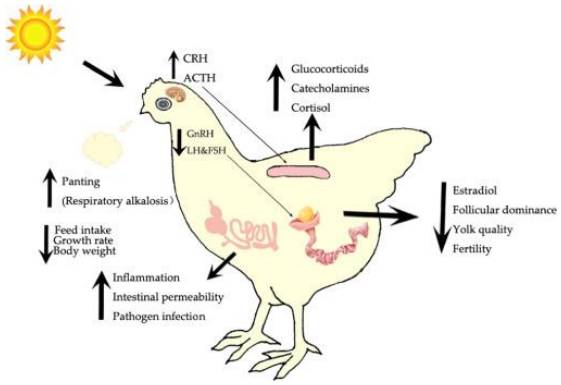

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From the Desk of Editor-in-chief

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I would like to introduce the launch of **"AgriGate - An International Multidisciplinary Monthly e-Magazine Volume 02 Issue No. 07 – July 2022"** with immense pleasure. Our team is privileged to dedicate this issue to World Nature Conservation Day, which is observed on 28 July every year to recognise a healthy environment.

The main objective of the magazine is to provide a publishing platform to young researchers and scientists as well as an information hub for the enthusiast, progressive farmer and also common readers. We envisage providing an online platform that appreciates illuminating articles on various topics related to agriculture and allied sciences monthly that will appraise and update the students, farming community and the whole society at large on the updates in agriculture.

Last but not the least, I wholeheartedly thank the editorial team, authors as well as anonymous reviewers for contributing to the release of this issue.

Our team welcomes your constructive feedback and suggestions to improve delivering fruitful content to hungry minds.

Dr R Shiv Ramakrishnan
Editor-in-chief
AgriGate Magazine

Volume: 02 Issue No: 07

Base editing in crop improvement and a way for cotton genetic enhancement

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Introduction

CRISPR/Cas technology has made genome editing viable in recent years, paving the path for a massive agricultural revolution. The Cas9-sgRNA complex creates double-strand breaks in this system, which are then repaired via either a non-homologous end joining (NHEJ) or a homology-directed repair (HDR) mechanism, resulting in gene insertion, deletion, or replacement (Danner et al., 2017). The latter is recommended over NHEJ since NHEJ is prone to mistakes and makes indels at random. Furthermore, HDR remains a daunting endeavour due to its intrinsically low frequency and small number of contributors to its repair templates (Lee et al., 2018). The main disadvantage of this technology is that it cannot be utilised to perform gene base conversion and is best suited for gene knockout or knock in.

In recent years, single nucleotide editing without the production of DNA double-strand breaks (DSBs) in the

genome has been viewed as an alternative and is gaining popularity in the agricultural industry (Davies, 2019). A base editor is a protein that combines a catalytically inactive CRISPR–Cas9 domain (Cas9 variations) with a cytosine or adenosine deaminase domain to introduce desired point mutations in the target region, allowing for precision genome editing. The base editing approach bypasses CRISPR/limitation Cas9's by using a tethered deaminase domain or nickase Cas9 (inactive CRISPR–Cas9 component) to convert bases from A > G or C > T. DNA and RNA base editors are the two most common types of base editors. Cytidine base editor (CBE), adenine base editor (ABE), Dual Base

editors, Transversion Base editors, and PAMless Base Editors, Simultaneous and Wide Editing Induced by a Single System (SWISS- Multiplex Base Editing), and Prime edition are the several types of base editors now in use. Single-nucleotide alterations influence a wide range of agronomically important plant characteristics (Chen et al., 2019). These base editing tools provide up new avenues for efficiently and precisely modifying single-nucleotide sequences, resulting in agricultural advancement.

Application in crop improvement*:*

SNPs in the genome confer several agriculturally significant features, and base editing has played a critical role in rectifying those point mutations and speeding crop progress. Cytosine and adenine base editors have been effectively utilized to edit specific genes given by single nucleotide polymorphisms in a variety of key crops and model plants (Hua et al., 2018; Li et al., 2018). Through multiplex base editing, several herbicide-resistant point mutations have been introduced into rice plants (Shimatani et al., 2017). StALS and StGBSS, two potato genes, were likewise targeted by A3A-PBE. In potato protoplasts, C-to-T conversion was reported with 11-fold better efficiency than nCas9-PBE. The CRISPR/Cas9-mediated base-editing technique was used to create transgene-free herbicide-resistant watermelon (*Citrullus lanatus*) (Tian et al., 2018). Recently, work was carried out to target the ALS gene in tomato and potato plants using a CBE and Agrobacterium-mediated transformation to produce plants resistant to the sulfonylurea herbicide chlorsulfuron (Veillet et al., 2019). Chlorsulfuron resistance is conferred by a mutation of Proline-186 in the tomato and potato ALS1 gene (Yu et al., 2010). In rice and wheat, ABE7.10 (base editors utilized in human cells) was developed and optimized for use in an adenine base-editing system to induce point mutations at numerous endogenous loci (Li et al., 2018).

Importance in Cotton

Cotton (Gossypium hirsutum) is a valuable fibre and cash crop that contributes significantly to the agricultural economy. With only a few SNPs, many alleles in this allotetraploid species are extremely similar. To induce point mutations that will aid in the functional investigation of these homozygous alleles, a precise method such as base editing is required. A precise base-editing system (GhBE3) was established recently by connecting

the cytidine deaminase domain (APOBEC) with nCas9 and UGI to produce point mutations in cotton in a recent work (Qin et al., 2019). Two cotton genes, GhCLA (a homologous gene to AtCLA1) and GhPEBP, responsible for chloroplast development and multiplex branch developmental processes, respectively, were targeted with a binary vector construct (pRGEB32-GhU6.7) (Mandel et al., 1996). The editing effectiveness of C - T substitution ranged from 26.67 percent to 57.78 percent, according to the sequencing results (Mishra et al 2020). This research will be extremely beneficial to cotton genome genetic enhancement and functional analysis.

Base editing and its limitations:

- A particular PAM sequence (NGG PAM for SpCas9) is required for successful base editing, and the target base must be within a tight base-editing window (Gaudelli et al., 2017). This unique PAM need is a constraint that reduces plant editing efficiency.
- Cytosine deaminase base editors have the ability to edit any C that is present within a 4–5 nucleotide activity window (or up to 9nt). This is also a significant restriction in base editors, leading to low specificity and editing efficiency.
- Off-target editing is still a big challenge, because off-targets occur when extra cytosines proximal to the target base are edited in base editing systems.

To summarise, cytidine and adenine deaminase-based base editors have been effectively designed and employed for base meditating in both plants and animals over the last three years. Expanding the scope of base editing in crop plants by narrowing the catalytic window and using Cas9 variations to improve the existing CBE and ABE base editors. These improved base editors and cytidine deaminase mutants can improve DNA selectivity while reducing off-target activity. Precision breeding can be done with the highly precise base editors in model plants and crops. The newly developed base-editing technology is still in its infancy, and much work remains to be done to optimise and broaden the breadth of editing while also increasing its efficiency.

Reference

➢ Chen, K., Wang, Y., Zhang, R., Zhang, H., and Gao, C. (2019). CRISPR/Cas

genome editing and precision plant breeding in agriculture. Annu. Rev. Plant Biol. 70, 667–697. doi: 10.1146/annurev-arplant-050718-100049

- Danner, E., Bashir, S., Yumlu, S., Wurst, W., Wefers, B., and Kühn, R. (2017). Control of gene editing by manipulation of DNA repair mechanisms. Mamm. Genome 28, 262–274. doi: 10.1007/s00335-017-9688-5
- Davies, K. (2019). All about that base editing. Genet. Eng. Biotechnol. News 39, 54–56. doi: 10.1089/gen.39.05.16
- Gaudelli, N.M., Komor, A.C., Rees, H.A., Packer, M.S., Badran, A.H., Bryson,D.I., et al. (2017) Programmable base editing of A-T to G-C in genomic DNAwithout DNA cleavage. Nature 551, 464–471. https://doi.org/10.1038/nature24644
- Hua, K., Tao, X., Yuan, F., Wang, D. and Zhu, J.K. (2018) Precise AT to GC baseediting in the rice genome. Mol. Plant. 11, 627–630. https://doi.org/10.1016/j.molp.2018.02.007.
- Lee, S. H., Kim, S., and Hur, J. K. (2018). CRISPR and target-specific DNA endonucleases for efficient DNA knock-in in eukaryotic genomes. Mol. Cell 41, 943–952. doi: 10.14348/molcells.2018.0408
- Li, C., Zong, Y., Wang, Y., Jin, S., Zhang, D., Song, Q., et al. (2018) Expandedbase editing in rice and wheat using a Cas9-adenosine deaminase fusion.Genome Biol. 19, 59. https://doi.org/10.1186/s13059-018-1443-z
- Mishra, R., Joshim, R. K., and Zhao, K. (2020). Base editing in crops: current advances, limitations and future implications. Plant Biotechnol. J. 18, 20–31. DOI: 10.1111/pbi.13225
- Qin, L., Li, J., Wang, Q., Xu, Z., Sun, L., Alariqi, M., et al. (2019) High efficientand precise base editing of C•G to T•A in the allotetraploid cotton(Gossypium hirsutum) genome using a modified CRISPR/Cas9 system. PlantBiotechnol. J. 1–12, https://doi.org/10.1111/pbi.13168.
- Shimatani, Z., Kashojiya, S., Takayama, M., Terada, R., Arazoe, T., Ishii, H., et al.(2017) Targeted base editing in rice and tomato using a CRISPR-Cas9 cytidinedeaminase fusion. Nat. Biotechnol. 35, 441–443. https://doi.org/10.1038/nbt.3833
- Tian, S., Jiang, L., Cui, X., Zhang, J., Guo, S., Li, M., et al. (2018) Engineeringherbicide-resistant watermelon variety through CRISPR/ Cas9-mediated base editing.Plant Cell Rep. 37, 1353–1356. https://doi.org/10.1007/s00299-018-2299-0
- Yu, Q., Han, H., Vila-Aiub, M.M. and Powles, S.B..(2010) AHAS herbicideresistance endowing mutations: Effect on AHAS functionality and plantgrowth. J. Exp. Bot. 61, 3925–3934. https://doi.org/10.1093/jxb/erq205.

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DESIGNER MILK THROUGH NUTRITIONAL INTERVENTION

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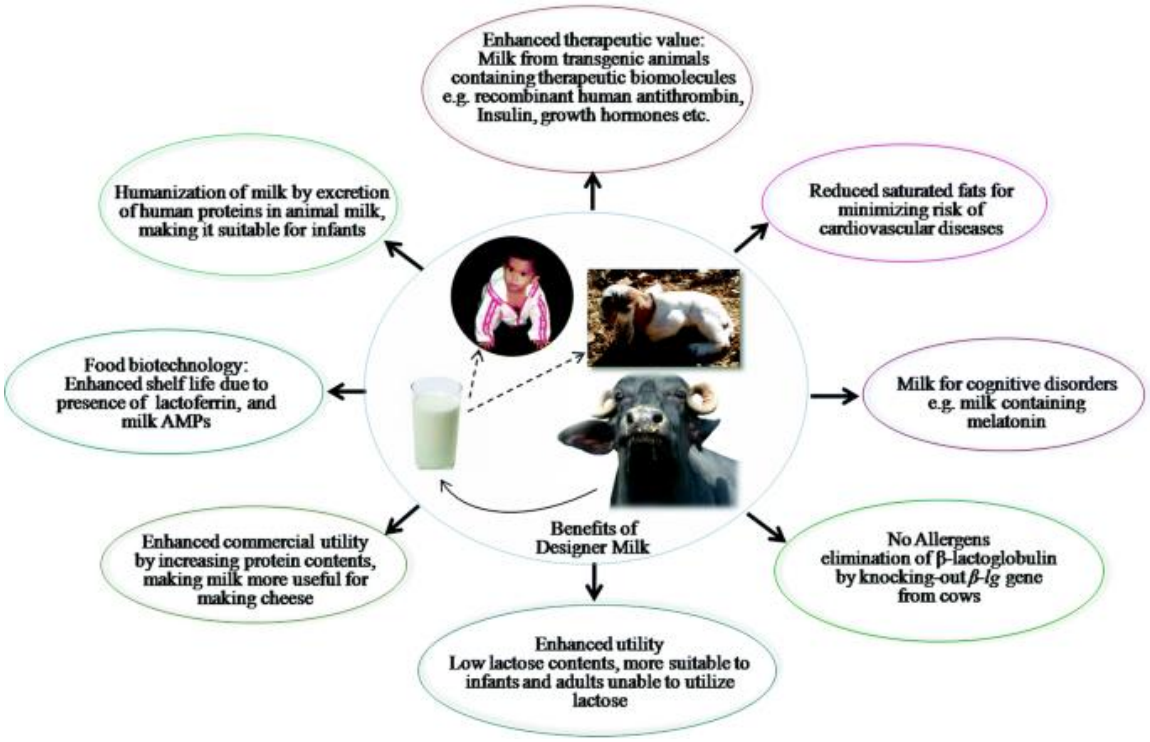
ABSTRACT

Designer milk is simply tailor made to provide the dual advantage of processing and health benefits to the consumer. Designer milk from the dietary and health point of view was to increase the proportion of unsaturated fatty acids in milk and thereby lowering the risk of cardiovascular diseases. Opportunities exist to modify the composition of milk fat from dairy animals through nutritional intervention. Nutritional strategy can be adopted for production of milk with increased content of beneficial fatty acids as healthy designer milk for consumers.

INTRODUCTION

From the beginning of civilization mankind has been make use of different animal species for a variety of purposes *viz.* production of milk, meat, wool, egg and leather etc. Livestock contribute by converting low-value materials, inedible or unpalatable ingredients for people, into milk in food chain. In the recent years people have become more conscious of the relation between food and their health. Designer food refers to the food that is designed to have some health benefits other than its traditional nutritional value. According to the global market surveys the demand for designer foods is very large and growing at rapid pace and at an annual growth rate of 8-16%. Designer milk is simply tailor made to provide the dual advantage of processing and health benefits to the consumer. Designer milk from the dietary and health point of view was to increase the proportion of unsaturated fatty acids in milk and thereby lowering the risk of cardiovascular diseases.

Many countries have most stringent regulations for designer foods manufactured and imported into their countries for its sale, like Food and Drug Administration (USFDA) in the USA, The State Food and Drug Administration for China (SFDA), European Food Safety Authority for European Union (EFSA, 2002), Health Canada for Canada



(Health Canada,1998), Food Safety and Standards Authority of India (FSSAI) and Ministry of Food Processing Industry (MOFPI) (FSSAI ,2006) for India and Ministry of Health, Labor and Welfare for Japan (MHLW). Only Japan is having specific regulatory approval process for designer foods.

NUTRITIONAL INTERVENTIONS

Dietary factors in manipulating milk composition.

1. **Effective and potentially useful**

For altering milk fat concentration

- Dietary fiber concentration by roughage index.
- Type of carbohydrate in the concentrates.
- Frequency of concentrates with low roughage diets.

For altering milk protein concentration

- Possibly forage: concentrate ratio and type of carbohydrate in the concentrates, but responses are inconsistent.

2. **Effective but difficult to exploit**

For altering milk fat concentration

- Lipid supplements, but both the size and direction of response are variable and advances in feed technology are needed.
- Energy intake; high intakes tend to reduce milk fat concentration

For altering milk protein concentration

- Increasing energy intake leading to increasing milk protein concentration, but intake in a herd is usually determined by broader management considerations than milk composition.
- Lipid supplements generally reduce milk protein concentration.

3. Not effective

Dietary protein does not reliably alter protein or fat concentration

ALTERING MILK FAT CONCENTRATION

It can be achieved by suitably altering the feeding pattern of the dairy cows. In general, milk contains 3 to 4% milk fat. Milk contains 70% saturated fatty acids (SFA), 25% mono-unsaturated (MUFA) and 5% poly-unsaturated fatty acids (PUFA). Majority of the dairy scientists are of the opinion that the ideal milk shall contain less than 10% poly-unsaturated fatty acids, less than 8% saturated fatty acids and more than 82% mono-unsaturated fatty acids. The modification of milk fat can be achieved by reducing the level of SFA, increasing the level of conjugated linoleic acid (CLA) content and increasing the omega3 fatty acids in milk. Saturated fatty acids are often associated with heart diseases because of their ability to the blood cholesterol. But not all the saturated fatty acids are bad. The fatty acids with less than 12 carbon atoms, in fact, decrease the cholesterol content since they are all catabolized. SFA such as Lauric (C12:0), Myristic (C14:0) and Palmitic (C16:0) which increase the plasma concentration of cholesterol. Their share is 44% in the total milk fatty acids.

Dietary ingredients have impact on composition of milk. It is feasible to alter composition of milk by dietary interventions. Supplementing extruded linseed, rich in a-linolenic acid, in the diet of lactating cows increased the proportion of potentially pro-health milk fatty acids *viz.*, oleic acid, vaccenic acid, rumenic acid, a-linolenic acid, total polyunsaturated fatty acids (PUFA) (Kumar and Kumar, 2015). Feeding lipid sources rich in linoleic and linolenic acids either as seeds or free oil increases the CLA content of milk when oil is accessible to the rumen microorganisms for bio hydrogenation (Dhiman *et al.*, 2000). Feeding highly unsaturated oils (e.g., soybean oil) caused depression in milk fat, but increased the proportion of unsaturated fatty acids to SFA in milk (Singh, 2019). Supplementing the dietary dry matter with 2% or 4% soybean resulted in a

237% or 314% increase in CLA content of milk compared with the control. Incorporating CLA along with soy oil in the diet of cows increased the CLA levels, simultaneously decreasing the SFA in milk fat (Pszczola *et al*., 2000).

The ruminant diet generally has polyunsaturated fatty acids (PUFA), but ruminant products such as meat or milk contain saturated fatty acids and some amounts of conjugated linoleic acids (CLAs) (Stanton,2000).This is due to microbial enzymatic lipolysis and bio hydrogenation of PUFA in the rumen. *Butyrivibrio fibrisolvens* are the major bio hydrogenating bacteria cultured from the rumen. Rumen ecosystem offers opportunities to modify lipid profile of meat and milk by altering nature of fatty acids (FA) for uptake by intramuscular and mammary tissue (Grummer, 1991).

Fish and other seafood souses are rich in EPA and DHA (especially cold-water fatty fish, such as salmon, mackerel, tuna, herring, and sardines), Nuts and seeds (such as flaxseed, chia seeds, and walnuts) and Plant oils (such as flaxseed oil, soybean oil, and canola oil) are rich in alpha linoleic acid (ALA) (Cheek, 2006). .

Feeding of dairy cows with unsaturated fats in protected form through encapsulation increases the unsaturated fat content in milk. However, the unsaturated fatty acids are converted into saturated one in the rumen by the rumen microorganisms. To prevent this, rumen by pass is the only way out. This can be achieved when small droplets of lipids are encapsulated in thin layer of protein through formaldehyde treatment and fed to the dairy cows. Increase in bypass fat containing omega-3 fatty acid increased omega 3 fatty acid concentration in the milk (Subrahmanyeswar *et al*., 2021).

CONCLUSION

Designer food approach is advantageous as it does not require change in dietary habit of the population and it can meet the recommended amount of nutrients regularly and can be easily merged with existing system of food production and distribution. In developed countries designer foods played a major role in improving the diet and eliminating nutritional deficiencies.

REFERENCE

- Cheek, M. (2006). Go organic. www.dailyrecord.co.uk/news.
- Dhiman, T.R., Satter, L.D., Pariza, M.W., Galii, M.P., Albright, K., and Tolosa, M.X. (2000). Conjugated

linoleic acid (CLA) content of milk from cows offered diets rich in linoleic and linolenic acid. J. Dairy Sci. 83, 1016–1027.

- EFSA Panel on Plant Protection Products and their Residues (PPR), 2010. Scientific Opinion on the development of specific protection goal options for environmental risk assessment of pesticides, in particular in relation to the revision of the Guidance Documents on Aquatic and Terrestrial Ecotoxicology (SANCO/3268/2001 and SANCO/10329/2002). *EFSA Journal*, *8*(10), p.1821.
- FSSAI, A., 2006. A kalank's food safety and standards Act, rules and regulation.Mason, S. (2001). Manipulating milk composition. ProLivestock. www.afns.ualberta.ca.
- Grummer, R.R. (1991). Effect of feed on the composition of milk fat. J. Dairy Sci. 74, 3244–3257.
- Kumar, S. and Kumar, D., 2015. Designer Milk and Role of Gene Manipulation in Producing Low Fat and High Protein Milk. Trends in Biosciences.
- National Forum on Health (Canada), 1998. *Canada health action: Building on the legacy* (Vol. 3). Sainte-Foy, Québec: Éditions MultiMondes.
- Pszczola, D.E., Katz, F., and Giese, J. (2000). Research trends in healthful foods. Food Technol. 54, 45–52.
- Singh, B., Mal, G., Gautam, S.K. and Mukesh, M., 2019. Designer milk. In Advances in Animal Biotechnology (pp. 421-427). Springer, Cham.
- Stanton, C. (2000). ''CLA: A Health-Promoting Component of Animal and Milk Fat. End of Project Report.'' The Dairy Products Research Centre Moorepark, Fermoy, Co. Cork. DPRC No. 26, pp. 1–13.
- Subrahmanyeswar G, S. Senthil Murugan , Sanies Juliet , C. Sudharsan and Biju Chacko, 2021. Effect of dietary supplementation of rumen protected rapeseed oil on milk omega-3 fatty acid profile of lactating crossbred cows. *Ind. J. Vet. & Anim. Sci. Res.* 50 (4): 36-46

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COMPARATIVE DIFFRENCE IN THE NUTRITION BETWEEN DOG AND CATS

Article ID: AG-V02-I07-03

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Introduction

Dogs are omnivores and cats are carnivores. Dog food is rich in Vitamin A than cat food. Cat food is high in Vitamin A leads to health problems incat. Order Carnivora, only cats are considered "obligate" carnivores. This indicates that cats must eat animal-derived protein to healthy.

Cat specializations as follows:

1. The cat has limited ability to regulate the catabolic enzymes of amino acid metabolism, which causes the cat to require a higher level of dietary protein for maintenance than the dog.
2. The cat has a lower capacity to synthesize the sulphonic acid taurine than the dog and is unable to conjugate bile acids to glycine. Unlike the dog, cannot meet its taurine requirement from dietary S-containing amino acids.
3. The cat cannot synthesize sufficient nicotinic acid from tryptophan because of an increased activity of a-picolinic acid decarboxylase leading to the end product glutamate rather
4. than nicotinic acid.
5. The cat is unable to convert carotene to retinol and cannot satisfy its vitamin A requirements with a herbivorous diet alone.
6. The cat cannot convert sufficient linoleic acid to meet its requirement for arachidonic acid.
7. The cat seems to be unable to cope with high levels of carbohydrate in its diet and appears to be in a constant state of gluconeogenesis.

The reasons for cats requiring more S amino acids than dogs are still not explained; one suggestion is that it is related to the thick coat of the cat.

Difference between dog and cat diet contents

S.No	Dog	Cat
1.	Taurine amino acid is not essential for dogs.	Taurine is an essential component of a cat's diet. It's not added mean heart problems, respiratory tract disorders and blindness will be there.
2.	Dog's body converts beta-kerotene to vitamin A	Cats do notconvert. Pre-formed vitamin A should be included in the diet.
3.	Dog food does not contain Arachidonic acid, as dogs do have this ability to synthesis.	Cat food contains Arachidonic acid, which is a necessary fatty acid. Cats do not have the ability to synthesis in the diet
4.	Dog food will not contain high amounts of protein	Cat food contains a higher level of protein.Cats need more protein because they use the proteins as an energy source.
5.	Dogs need 11 essential aminoacids	Cats have 12 essential amino acids .
6.	Dogs need less thiamine when compared to cats.	Cats also require five times more thiamine in their diets than do dogs. Its deficiency leads to poor quality coat, loss of appetite, a hunched posture, neurologic problems including seizures and can eventually die. Thiamine deficiencies can arise when cats eat a lot of uncooked, freshwater fish because it contains an enzyme that breaks down thiamine.
7.	Not needed	Cats need for a moisture-dense diet, as they are not as responsive as dogs and other mammals to the instinct to feel thirst or dehydration.
8.	The natural diet of dogs could be higher in carbohydrates ,	Less carbohydrate and high protein
9.	Dogs will get Niacin by converting a dietary amino acidTryptophan into Niacin.	Cat gets Niacin only by eating that vitamin not able to convert.
10.	Dogs can tolerate prolonged fasting and utilize fat reserves for energy.	Do not mobilize fat reserves for energy.Break down non-fatty body tissues for energy. This upsets the internal chemical factory and can lead to a very dangerous feline disorder called hepatic lipidosis.
11.	The dog intestine is longer than cat.	The cat's small intestine is with a shorter transit time; shorter than thedog.

12.	Well-developed caecum	The cat has a slightly less well-developed caecum.
13.	The dentition of the dog includes molars for crushing plant material.	The cat lacks these teeth.
14.	Dogs will eat ripped food.	Cats do not have the metabolic means to digest "*ripe*" food and get rid of any toxic by-products; Cat havevery specific taste and scent capabilities that would prevent them from eating unfreshed food.
15.	Vitamin D intolerance could make dogs very sick. Fish- or marine-based cat foods should not be fed to dogs.	Cats have a much higher safety tolerance.
16.	Cat foods are made with more fat than dog foods. Dogs prone to fat intolerance should not allowed eating cat foods. This will leads to pancreatitis and digestive upset.	Cat were fed with only dog food mean then protein, amino acid and fatty acid deficiencies will be there. Dog food lack of taurine so not preferred for cats.
17.	Dog food may contain ingredients that are harmful to cats. For example, propylene glycol is commonly used in semi-moist dog foods. It's perfectly safe for dogs.	Higher levels can cause health problems in cats.
18.	Cat food is very tasty to dogs	Dog food is not tasty as much as cat food.

References

- Ballard, F. J. (1965). Glucose utilization in mammalian liver.Comparative Biochemistry & Pliy.v,'OlOgy 14, 437443.
- Burger, I. H..Blaza, S. E., Kendall, P. T. & Smith, P. M. (1984).The protein requirement of adult cats for maintenance. Feline Practice 14, 8-14.
- Da Silva, A. C..Fried, R. & De Angelis, R. C. (1952).The domestic cat as a laboratory animal for experimental nutrition studies. Journal of Nutrition 46, 399-409.
- De Castro. F. T., Brown, R. R. & Price, J. M. (1957). The intermediary metabolism of tryptophan by cat and rat tissue preparations.Joirrnal of Biological Chemistry 228, 777-784.
- Sutton SC. Oral Anatomy and Physiology in the Companion Animal. In: *Advances in Delivery Science and Technology*. Springer US; 2012:59-68. doi:10.1007/978-1-4614-4439-8_4.
- .Zaghini G, Biagi G. Nutritional Peculiarities and Diet Palatability in the Cat. *Vet Res Commun*. August 2005:39-44. doi:10.1007/s11259-005-0009-1

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MANAGEMENT TECHNOLOGIES IN AGRICULTURE TO REDUCE GHGS'

Article ID: AG-V02-I07-04

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Introduction

Agriculture today contributes about 13% of greenhouse gas emissions (Fig 1) – a significant part of the overall total (Tubiello *et al*., 2022). Agricultural emissions is predicted to rise almost 40 per cent by 2030 given the growing demand for food, fuel, fibre, and other materials supplied by agriculture.i.e., between 5 and 6 gigatonnes (Gt) of CO_2 equivalents (CO_2e) per year (Uprety *et al*.,2012). **The GHG emissions from agriculture are mainly due to three gases: carbon dioxide (CO_2), methane (CH_4), and nitrous oxide (N_2O).**

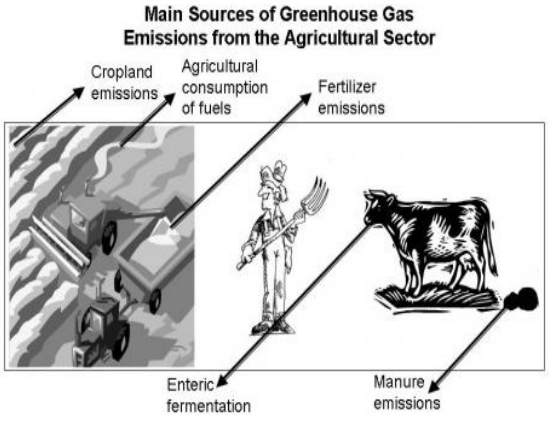

Figure 1. Sources of Greenhouse Emissions from the Agricultural Sector

Emission of greenhouse gases due to burning of crop residues

Total crop residues generated by these nine major crops are about 566 Mt of which about 93 Mt are subjected to burning in the fields.Burning of crop residues in fields emitted 0.25 Mt of CH_4 and 0.007 Mt of N_2O in 2007 (Fig 2). The burning of rice straw contributed the maximum (39%) to this GHGs emission. Large-scale burning of rice residues in Punjab, Haryana and western Uttar Pradesh is a matter of serious concern not only for GHGs emission but also for problems of pollution, health hazards and loss of nutrients (Pathak *et al.,* 2010). Emission of GHGs due to burning of crop residues in field has, however, remained almost similar over the years.

Methane Emissions

Methane is produced in soil during microbial decomposition of organic matter under anaerobic conditions. Rice fields submerged with water, therefore, are potential source of methane. Continuous submergence, higher

organic C content and use of organic manure in puddled soil enhance methane emission. Burning of crop residues also contributes to the global methane budget (Bhatia*et al*., 2013).

Measures to analyze the emission

a) measure methane emission from rice ecosystems,

b) evaluate the effect of irrigation and fertilizer management on methane emission,

c) assess the influence of organic amendment on methane emission,

d) measure the methane emission potential of different soils of India and

e) develop an inventory of methane emission from Indian agriculture using indigenous, site specific emission coefficients

Nitrous oxide

Nitrous oxide is a gaseous intermediate in the reaction sequence of denitrification and a by-product of nitrification that leaks from microbial cells into the soil and ultimately into the atmosphere. One of the main controlling factors in this reaction is the availability of inorganic nitrogen (N) in the soil. N_2O emissions result from human-induced net N additions to soils (e.g., synthetic or organic fertilizers, deposited manure, crop residues, sewage sludge), or of mineralization of N in soil organic matter following drainage/management of organic soils, or cultivation/land-use change on mineral soils (e.g., forest land/grassland/ settlements converted to crop land).Methane and nitrous oxide emissions from agricultural soil in different states of India is given in Fig 3.

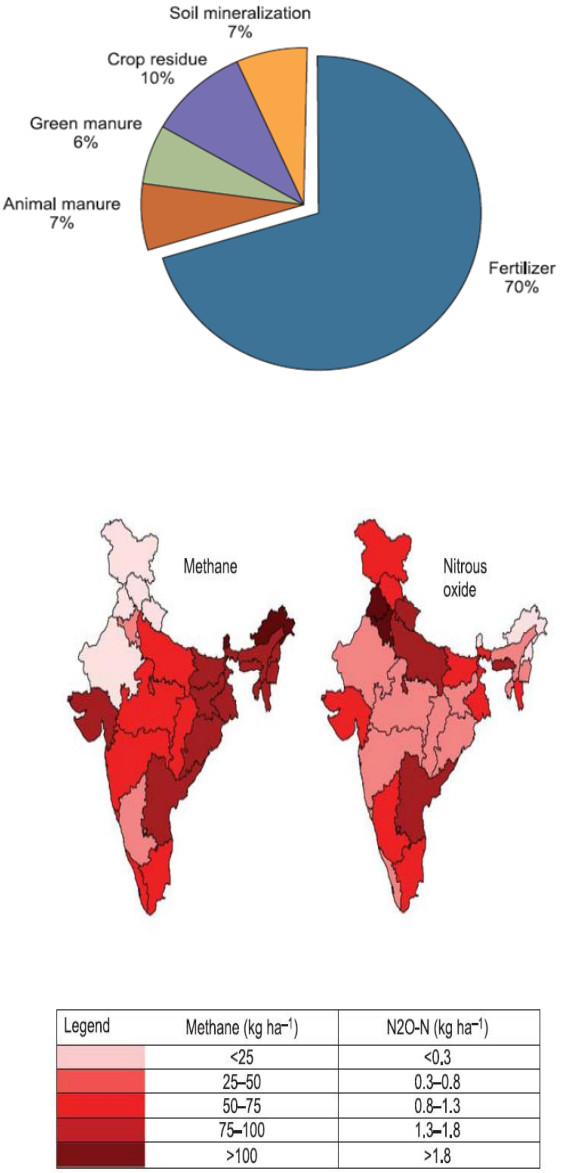

Figure 3. Methane and nitrous oxide emissions from agricultural soil in different states of India

Measures to analyze the emission

a) Measure nitrous oxide emission from soil
b) evaluate the effect of crop management on nitrous oxide emission
c) develop an inventory of nitrous oxide emission from agricultural soils of India
d) evaluate the mitigation strategies and
e) develop a simulation model for estimating nitrous oxide emission

Carbon-di-oxide

Since agricultural soils act both as a source and a sink for carbon dioxide, the net flux is very small. The main source of carbon dioxide from agriculture is through soil management such as tillage which triggers carbon dioxide emission through biological decomposition of soil organic matter (Rastogi*et al.*, 2002). Tillage breaks soil aggregates, increases oxygen supply and exposes surface area of organic material promoting the decomposition of organic matter.Fuel use for various agricultural operations and burning of crop residues are other sources of carbon dioxide emission.An off-site source is the production of carbon dioxide for manufacturing fertilizers and pesticides.(Hussain*et al.*, 2021)

Moving towards solution

Mitigation of GHG emission from agriculture

There are six broad mitigation measures that can contribute to mitigation of these gases from the agriculture sector (Smith *et al.,* 2008)

1. Cropland management
2. Livestock management
3. Manure/bio-solid management
4. Bioenergy
5. Grazing land management/pasture improvement
6. Management of organic soils and restoration of degraded lands
7. Organic Agriculture

These seven measures contribute to mitigation of the three key greenhouse gases in three ways:

1. By reducing emissions of CH_4 and N_2O from agriculture
2. By enhancing removal of atmospheric greenhouse gases
3. By avoiding emissions of fossil fuels which are inputs for agriculture.

Mitigation of GHG emission from agriculture can be achieved by

- Sequestering C in soil
- Change in land-use management

- Changing crop mixes to include more plants that are perennial or have deep root systems increases the amount of carbon stored in the soil
- Cultivation systems that leave residues and reduce tillage, especially deep tillage, encourage the buildup of soil carbon
- Shifting land use from annual crops to perennial crops, pasture, and agro-forestry increases both above- and below-ground carbon stocks.
- Changes in crop genetics and
- Management of irrigation, fertilizer use, and soils can reduce both nitrous oxide and methane emissions.
- Conservation Agriculture

Conservation Agriculture technology

Conservation agriculture with adoption of resource-conserving technologies such as zero- or minimum tillage with direct seeding, permanent or semi-permanent residue cover, and crop rotations have potential to improve the use efficiency of natural resources such as water, air, fossil fuel and soil. The technologies can improve the sustainability of agriculture by conserving the resource base with higher input use efficiency and also mitigating GHG emission.

Modeling Greenhouse Gas Emission From Agriculture

Simulation models can be used to quantify the effects of climate, soil, crop and management on emission of GHG from soil. A generic simulation model, InfoCrop, has been developed for estimation of methane, nitrous oxide and carbon dioxide emission from agricultural soils (Aggarwal et al., 2006). This model can simulate the effects of weather, soils. The model has been calibrated using the data generated in various experiments conducted at IARI (Aggarwal et al., 2006). The preliminary validation of the model showed a good agreement between observed and predicted values of methane and carbon dioxide, indicating that the model can be used to predict greenhouse gas emission. Efforts are being made to further validate the model with more data sets from different agro-ecological regions of India to update the emission inventories and assess the impact of agricultural management, mitigation and policy options on greenhouse gas emission from agriculture.

Mitigating Methane Emission From Rice Fields

The strategies for mitigating could be altering:

- water management, particularly promoting intermittent irrigation and mid-season drainage;
- Direct seeding of rice
- improving organic matter(manure) management by promoting aerobic degradation through composting or incorporating it into soil during off-season drained period;
- use of rice cultivars with few unproductive tillers, high root oxidative activity and high harvest index;
- Application of fermented manure like biogas slurry in place of unfermented farmyard manure.

Bioenergy

The contribution of biofuels to GHG reductions will be highly dependent on policies, fossil fuel prices, the specific fossil fuels replaced, the technologies used to convert biomass into energy, and per acre yields of energy crops (Cherubini*et al.*, 2009). In a "best-case" scenario, where energy crops are produced on 15 percent of current agricultural land at four-times current yields, bioenergy could supply a total of 20 exajoules (EJ)—almost one-fifth of the total demand for energy. This corresponds to a 14 to 24 percent reduction. However, agriculture as a sector is unique in that it can function as a sink for both CO_2 and methane, helping to reduce their concentrations in the atmosphere.Utilization of agriculture's sink capacity is primarily accomplished through increasing soil carbon stocks. Soil carbon increases, which are typically in the 0.1 to 1 tonnes per hectare per year range, could be achieved through adoption of practices such as:

- **Reducing the frequency and intensity of soil tillage;**
- **Including more hay crops in annual rotations;**
- **Production of high-residue-yielding crops and reduced fallow periods;**
- **Improved pasture and rangeland management; and**
- **Conservation set-asides and restoration of degraded lands.**

Climate-smart crops- '*Developing climate-smart crops for 2030 world*'

Agriculture also has the potential to reduce its contribution to climate change without compromising food

security.To mitigate climate change, we must lower emissions from agriculture while also sustaining or improving food security and livelihoods. Many agricultural practices can help reduce emissions or sequester carbon, and research will provide more techniques and decision-making tools going forward.

Climate-smart agriculture (CSA) is an integrative approach to address these interlinked challenges of food security and climate change, that explicitly aims for three objectives:

- sustainably increasing agricultural productivity, to support equitable increases in farm incomes, food security and development;
- adapting and building resilience of agricultural and food security systems to climate change at multiple levels; and
- Reducing greenhouse gas emissions from agriculture (including crops, livestock and fisheries).

Low emission agriculture

CCAFS Low-Emissions Agriculture supports agricultural development that reduces greenhouse gas emissions or sequesters carbon while improving the livelihoods of smallholder farmers.CCAFS Low-Emissions Agriculture is identifying and implementing mitigation options that will yield the most mitigation impact, from global to regional to national scales, including sustainable intensification, climate-smart agriculture and climate-smart villages, and avoided conversion of high carbon forests or grasslands.

Green House Action Plan

It contains a commitment to reducing agricultural greenhouse gas emissions by three million tonnes of CO_2 equivalent per year from 2018-2022. The Action Plan aims to meet this target without compromising domestic production, as it is too simple a solution to produce less and import more. Instead the Action Plan focuses on how farmers, across all sectors and farming systems, can become more efficient to help reduce greenhouse gas emissions and make cost savings per unit of production.

Conclusion

Agricultural management has substantial mitigation potential. But, in order for this mitigation potential to be transformed into the actual mitigation practices on a wide and effective scale, many obstacles have to be overcome.

These challenges come from the political, economic and socio-cultural spheres of life. To conclude- Is agricultural management a viable and potentially effective tool for mitigation? The answer depends distinctly on the determination and resolve of today's international community as a whole.

References

- Aggarwal, P. K., Kalra, N., Chander, S., & Pathak, H. (2006).InfoCrop: a dynamic simulation model for the assessment of crop yields, losses due to pests, and environmental impact of agro-ecosystems in tropical environments. I. Model description. Agricultural systems, 89(1), 1-25.
- Bhatia, A., Jain, N., & Pathak, H. (2013). Methane and nitrous oxide emissions from Indian rice paddies, agricultural soils and crop residue burning. Greenhouse Gases: Science and Technology, 3(3), 196-211.
- Cherubini, F., Bird, N. D., Cowie, A., Jungmeier, G., Schlamadinger, B., &Woess-Gallasch, S. (2009). Energy- and greenhouse gas-based LCA of biofuel and bioenergy systems: Key issues, ranges and recommendations. Resources, conservation and recycling, 53(8), 434-447.
- Hussain, S., Hussain, S., Guo, R., Sarwar, M., Ren, X., Krstic, D., ...& El-Esawi, M. A. (2021). Carbon Sequestration to Avoid Soil Degradation: A Review on the Role of Conservation Tillage. Plants, 10(10), 2001.
- Pathak, H., Bhatia, A., Jain, N., & Aggarwal, P. K. (2010).Greenhouse gas emission and mitigation in Indian agriculture–A review. ING bulletins on regional assessment of reactive nitrogen, bulletin, 19, 1-34.
- Rastogi, M., Singh, S., & Pathak, H. (2002).Emission of carbon dioxide from soil.Current science, 82(5), 510-517.
- Smith, P., Martino, D., Cai, Z., Gwary, D., Janzen, H., Kumar, P., ...& Smith, J. (2008). Greenhouse gas mitigation in agriculture. Philosophical transactions of the royal Society B: Biological Sciences, 363(1492), 789-813.
- Tubiello, F. N., Karl, K., Flammini, A., Gütschow, J., Conchedda, G., Pan, X. & Torero, M. (2022). Pre-and post-production processes increasingly dominate greenhouse gas emissions from agri-food systems. Earth System Science Data, 14(4), 1795-1809.
- Uprety, D. C., Dhar, S., Hongmin, D., Kimball, B. A., Garg, A., &Upadhyay, J. (2012). Technologies for climate change mitigation: agriculture sector. Department of Management Engineering, Technical University of Denmark.

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GOLD NANOPARTICLE AS A POTENTIAL TOOLFOR FISH DISEASE DIAGNOSIS

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Introduction:

Aquaculture is essential to cover fish product demands, providing seafood in high quantities and covering more than the half amount of fish consumed worldwide. This fact drives a strong demand for high production efficiency in aquaculture industry in order to cover the feeding needs of the world's growing population, in the middle of an increasing environmental crisis. As a result, the aquaculture industry has continuously increased profits in a high rate. However, outbreaks of diseases caused by infectious agents are significantly restricting intensified aquaculture. According to literature, 22.6% of all disease outbreaks are caused by viruses. Among these, viral nervous necrosis (VNN), also named vacuolating encephalopathy and retinopathy or encephalomyelitis, is a devastating disease, which induces cell necrosis accompanied by vacuolation in fish retina and brain. Its clinical symptoms include changes in skin colour with abnormal swimming, low feed ingestion and altered buoyancy in affected fish. The disease is caused by Nervous Necrosis Virus (NNV) or Noda virus, affecting more than 30 different fish species, worldwide. NNV causes high mortalities (80–100% in several species e.g. European sea bass), emerging as a major problem especially in the Mediterranean area, since it cannot be prevented by vaccination or effective treatment. Several detection methodologies have been proposed for Noda virus, including virus isolation in cell cultures, light-and electron-microscopy, enzyme-linked immunosorbent assay (ELISA), immunofluorescence antibody test, and molecular assays, i.e.in situ hybridization, polymerase chain reaction (PCR), reverse transcription PCR (RT-PCR) and real time RT-PCR. Recently developed methodologies are gold nanoparticles play and vital role for detection of fish diseases.

Nanotechnology has become an extensive field of research due to the unique properties of nanoparticles, which enable novel applications. Nanoparticles have found their way into many applications in the field of fisheries, including diagnostics, vaccination, drug and gene delivery. In this study, the antimicrobial effects of nanoparticles, with particular emphasis on the problem of antibiotic resistant bacteria in fisheries. The use of nanoparticle-based vaccines against many viral pathogens is a developing field in fish medicine research. Nanoparticles have gained much interest as a specific and sensitive tool for diagnosis of bacterial, fungal and viral diseases in aquaculture.

Nanotechnology is the science of producing and utilizing nano meter-sized particles. Only recently we have developed approaches to understand and control matter at Nano scale dimensions (between approximately 1 and 100 nm). Particles in this size range have unique properties, which pave the way for novel applications. Nano material's can be divided into two large groups, ultrafine Nano-sized particles that are present normally in nature and not intentionally produced and engineered nanoparticles that are produced in a controlled and intended way. Nano medicine is the application of nanotechnology in both human and veterinary medicine. This science deals with designing and utilizing nanoparticles and Nano devices for biomedical applications.

Synthesis of nanoparticles:

Generally, there are two main approaches for nanoparticle synthesis: top-down or bottom-up.The top-down approach involves mechanical grinding of bulk metal to convert it from macro or microscale to nanoscale, which is followed by addition of stabilizing agents like colloidal protecting agents to ensure that the nanoparticles do not oxidize, or re-assemble back to the microscale.Bottom-up methods include construction of nanoparticles by various physical and chemical methods, including electrochemical reduction of metals and sonodecomposition.

Physical and chemical synthesis Nanoparticle synthesis can be carried out by using thermal decomposition in organic solvents. For metal nano particles, cryo chemical synthesis yields nano particles in the range of 5 to80 nm in diameter. The physical synthesis using microwaves has been adopted for silver nano particles, which involves

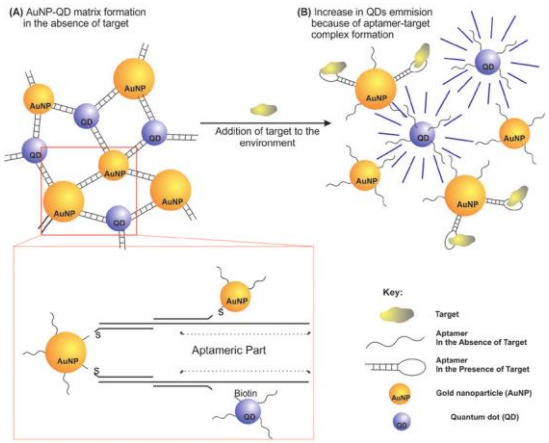
physical reduction of silver using different microwave radiation frequencies. This method was more rapid and gave a higher concentration of silver nano particles when compared with at hermal method, given the same temperature and exposure. Jiangetal also found that the higher the concentration of silver nitrate used, the longer the reaction time and the higher the temperature, the larger the particle that could be obtained. Use of high poly vinyl pyrrolidone (PVP) concentrations (used for nanoparticle coating) resulted in smaller gold particle sizes, between 15 and 25 nm.

There is great interest in finding eco-friendly and economical methods to synthesize nanoparticles. Biological methods are regarded as the key for this approach. Biologically synthesized nano particles are derived from three main groups of organisms: bacteria, fungi, and plants. Bio-synthesis of nanoparticles is a bottom-up approach that mostly involves reduction/oxidation reactions. Microbial enzymes or plant phytochemicals with antioxidant or reducing properties act on precursor compounds to produce the desired nanoparticles. The three main components of a biosynthetic nanoparticle system are: a solvent medium for synthesis, an environmentally friendly reducing agent and a nontoxic stabilizing agent.

Gold nanoparticles (Au-NPs)

There is currently great interest toward investigating the antimicrobial effects of gold nanoparticles, due to their low toxicity to eukaryotic cells. The gold nanoparticle (Au-NPs) can interact with biological proteins and non-proteins, e.g. Lipopolysaccharides (LPS), and have biological functions. Gold nano particles supported on zeolite exhibited bactericidal effects against Escherichia coli and Salmonella typh. Functionalized Au-NPs inhibited the growth of MDR bacterial isolates. Gold nano particles made by ‘green' synthesis showed antibacterial activity against fish bacterial isolate. There are three pathways along which gold nanoparticles exert their antibacterial effects. The first way is via interfering with oxidative phosphorylation process with changing the potential of bacterial cell membrane; this leads to decrease in the activity of F-Type ATP synthase with a net decrease in ATP synthesis and metabolism. The second path is interference with binding of tRNA to the two ribosome subunits. The third way is

achieved through enhancing chemotaxis. Fungicidal activity against Candida species was reported for gold nanoparticles. Their efficacy was size-dependent, with smaller gold nanoparticles having higher antifungal effects.



Nanoparticles in the diagnosis of fish pathogens

Nanoparticles have been adopted for rapid and sensitive diagnosis of diseases, and these nanoparticle-based detection methods are called nano diagnostics. One of the most widely used nanoparticles in diagnostics is gold nanoparticles, which are appropriate for use in different methods.

Diagnosis of bacterial and mycotic fish diseases

The first report of using gold nanoparticles for detection of fish pathogen was with A. salmonicida antibody-gold nano particles conjugated for the specific immune diagnosis of furunculosis in fish tissues. Kuan et al,designed an electrochemical DNA biosensor for detection of Aphanomycesinvadans in fish, based on conjugation of Au-NPs with a DNA reporter probe. This assay could detect fungi at a lower level than PCR.

Diagnosis of viral fish diseases

The combined aAuNPs colorimetric assay with loop-mediated isothermal amplification (LAMP) for visual detection of yellow head virus in shrimp. This method was rapid, was specific, and showed high sensitivity. A similar combination of DNA-functionalized AuNPs with LAMP was developed for the detection of white spot syndrome virus (WSSV) in shrimp. This method was specific, sensitive and suitable for field applications.

In another study, Toubanaki et al, developed a method for NNV detection using a gold nanoparticles-based biosensor for detection of viral nucleic acids after amplification by RT-PCR. This method was quite cost effective, as it did not require antibody conjugation. Yang et al, report an immunomagnetic reduction assay for nervous necrosis virus (NNV) in grouper fish using magnetic nanoparticles coated with rabbit anti-NNV antibody. When an

external magnetic field was applied, immune diagnosis was based on the motility of magnetic nanoparticles: if the antibody coated-nanoparticles bound to the viral antigen, they form clusters which decrease their motility. The virus titer was calculated using a magnetic immunoassay analyzer. A colorimetric assay for detection of spring viremia of carpvirus (SVCV) was developed using unmodified Au-NPs. The probe, which was complementary for SVCV, was added first, followed by gold nanoparticles. If target viral RNA was present, it hybridized to the probe, thereby preventing the probe from stabilizing the gold nanoparticles. The Au-NPs could aggregate, with a resultant change in the solution, from red to blue. If no viral nucleic acid was present, the probe could freely adsorb on to the surface of gold nanoparticles and prevent their aggregation, and the solution stayed red. This method was highly specificity and rapid, without the need for prior amplification of viral nucleic acids. The same principle was adopted for the development of a rapid, specific and sensitive assay for the detection of the DNA virus, cyprinid herpes virus-3 (CyHV-3).

Summary and Conclusion

The current applications of nanoparticles for diagnosis, and treatment of fish pathogens. A range of different methods has been employed for nanoparticle synthesis, and the emerging use of ‘green' synthetic methods appears safer and more environmentally friendly while retaining the efficacy of the formed nano particles. Naked metal nano particles exhibit antimicrobial effects, and have been applied to combat microbial resistance in aquaculture.

Many nanoparticles are reported to be excellent vehicles for drug, gene and vaccine delivery due to their unique properties. The most investigated nanoparticles in fish medicine for these applications are polymeric chitosan nanoparticles and Poly D, L-lactide-co-glycolic acid (PLGA) nanoparticles. Both unmodified and conjugated nanoparticles have been shown to facilitate rapid, cost effective and specific detection of fish pathogens. There are, however, many research gaps in the field of nanotechnology applications in fish medicine. Different forms of nanoparticles like nanocapsules, liposomes, dendrimers and nanotubes could theoretically have applicability in fish diseases research. The antifungal and antiviral effects of

nanoparticles against fish diseases have yet to be explored.

More studies for vaccine development in fish are essential if nanotechnological approaches are to be applied widely. Few studies have examined nano particle applications for diagnosis of bacterial and mycotic diseases in aquaculture. Given the demonstrated potential of nanoparticles, there are needs for more targeted investigations of their application in many fish medicine research topics, to promote more efficient fish disease diagnostics and therapy, to meet the ever-growing aquatic animal health demand.

References:

- Mílton, C., F. F. Carlos, P. Pedrosa, A. Lopez and P. V. Baptista. 2016.Gold Nanoparticles for diagnosis: Advances towards points of care.Diagnostics.6:43-63.
- Gotesman,M., M. L. Simon, S. Mona, M.B. Sven and E. M. Mansour. 2018. A new age in Aqua Medicine: Unconventional approach in studying aquatic diseases.BMC Veterinary Research.14-178.
- Ravikumar S., R. Gokulakrishnan and J. Anandha Raj. 2012. Nanoparticles as a source for the treatment of fish diseases. Asian Pasific Journal of Tropical Diseases.703-706.
- Aneta, J. M., J. M.Willem, A. F. Zahiand P. C. David. 2013. Multifunctional gold nanoparticles for diagnosis and therapy of disease.Molecular Pharmacy.10(3):831-847.
- Hemedy, M. E., H.,D.C. Michele, A.H. Hussein, A.S. Taher, H.E. Ayman, M.E. Mohamed, P. Guilia and S. Dario.2018. Development of gold nanoparticles biosensor for ultrasensitive diagnosis of foot and mouth disease virus.Journal of Nanotechnology.16(48):1-12.

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HEAT TOLERANCE IN POULTRY

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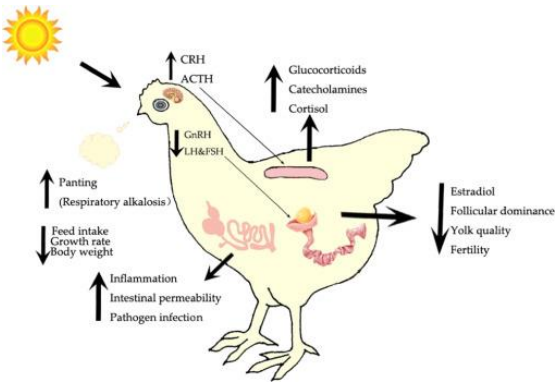
Introduction

The poultry sector is noted for its remarkable contribution to world nutrition and food security, which mainly helps in the provision of protein, essential micronutrients and energy to the human population. Recently, there has been a remarkable increase in global environmental temperature, which poses a serious threat to the livestock farming sector in both tropical and subtropical regions. If the temperature exceeds the normal range (thermo-neutral zone), it disturbs normal physiological functioning and induces cell injury in all living organisms. Usually, high ambient temperature and high humidity lead to stress-associated problems such as low production, higher mortality, metabolic changes, growth depression and poor feed efficiency.

Most of the breeding stocks developed in temperate climates are now being circulated and used throughout the world but they may not be the best genetic material for all the environmental conditions. Therefore developing chicken strains that are resistant to heat stress and that have all the other economic characteristics is indeed for a more profitable business.



It is important to point out that selection for heat resistance alone will not lead to profitable commercial poultry farming. Mostly in laying birds traits, such as age at sexual maturity, egg production, egg weight, size, shell quality, interior egg quality, fertility, hatchability, disease resistance and feed efficiency must be improved or maintained. For broilers, traits such as body weight, dressing percentage, conformation and leanness must also be considered.

BREEDING FOR HEAT TOLERANCE-Selection

In broiler production, environmental stress caused by various factors, which mostly include ambient temperature, severely affects the bird's normal physiological function and leads to poor production performance and food safety.

In animals, any type of stress mostly manifests in three stages.

1. The recognition of external stress by the body - state of alarm.
2. Stress-inducedced immune mechanism which tries to adapt to that new environment if stress persists.
3. Body still fails to cope with that stress, which leads to the exhaustion stage.

Every living organism responds to heat stress mainly depending on the intensity and duration of stress. Various studies reported that reduction in feeding and movement in birds under heat stress conditions as heat-stressed birds spend most of their time acclimatizing activities such as panting, drinking more water, and resting to cope with the heat stress.

There exists a negative correlation between heat tolerance and growth rate, hence, practically commercial genetic selection programme is not possible in birds. It is also noted that heritability for heat tolerance was very low in broiler chickens due to their fast growth rate. Heat acclimation/adaptation in broilers can be improved by applying selection in a hot environment. However, such selection may have resulted in a reduced growth rate at normal temperatures (22ºC) and the association between growth rate and heat tolerance has to be evaluated in such cases. On the other hand, the heritability of body weight gain is decreased by high temperature, whereas the heritability of feed efficiency is unchanged. Therefore, the parameters used in the selection criteria should be season adapted in broilers.

Use of Major Genes

There is a correlation that exists between heat resistance with reduced feather density and lower growth rate. Lamont, S. (2014) indicated that identifying alleles with different effects on heat stress tolerance is a reasonable goal to develop heat resistance variety. There are several genes that reduce the feather cover, such as the dominant gene for the naked neck (*Na*), which

affects the trait directly by reducing the feather cover. While others, such as the sex-linked recessive gene for dwarfism (*dw*) reduce the body size and thereby reduce metabolic heat output.

Nacked neck

Nacked neck is an incompletely dominant autosomal gene that reduces feather cover by 20-40 percent so that there is better heat dissipation and subsequently better heat tolerance. The heterozygotes *(Na na*) can be identified by a tuft of feathers on the ventral side of the neck. Sharifi *et. al. (*2010) reported that Na causes high embryonic mortality which is one of the negative impacts of naked neck gene. But this mortality is compensated by reduced mortality during heat stress in the tropical climate.

Frizzle

Frizzle is an incompletely dominant autosomal gene thatcauses contour feathers to curve outward away from the body. The curving is extreme in homozygotes, which reduces the insulating properties of the feather cover. Sharifi *et. al.*(2010) reported that reproductive performance improves in heat stress if the frizzle gene is present in homozygous form. Oke, 2011 concluded that the frizzle genome may be involved in breeding for developing native foundation stock for the production of meat-type chicken in the humid tropics.

Dwarf

Dwarf Gene is a sex-linked recessive gene. The main effect of the dwarf gene *(dw*) is to reduce the body weight of the homozygous males by about 43% and that of homozygous females by 26–32%. There are many other associated physiological and biochemical effects of the gene. Gowe, R. Sand Fairfull, R. W. (2008) reported the *K gene with the indirect* effects:

1. Reduced protein requirement
2. Reduced fat deposit during juvenile life
3. Increased heat loss during early growth, all of which may assist the bird in resisting heat stress.

Interactions with Major genes

Various gene interactions were reported between major genes of heat tolerance in which the combined effect of the gene is better than the individual effect. Yunis *et al.,* 1997 reported that crossing Na and F has an additive positive effect on broiler performance under heat stress.The dwarf gene is known to depress the egg weight but

the Na gene may compensate for this reduction.

Gene Introgression of Major genes

Any gene can be introduced into a population by crossing the donor line with the recipient line. Multiple backcrosses are made so that the background of the donor line is reduced from the progeny line. Only the progeny containing the major gene is selected for further backcrossing.

- Cross between donor and recipient lines to produce F^1
- Repeated **back-crosses** of the F^1 individuals and the subsequent progeny with the recipient to recover its genetic background
- Intercross of the backcross progeny to **fix the introgressed genes** in the population.

Heat shock proteins

When the birds are exposed to heat stress, the synthesis of most of the proteins was delayed or leads to denaturation of the proteins. But, a group of highly conserved proteins is synthesized in response to heat stress. These proteins were named Heat Shock Proteins (HSPs). These HSPs play an important role in the survival of stressed cells and the stabilization of the internal environment. Based on the molecular weights, HSPs are broadly classified into HSP20, HSP60, HSP70 and HSP90. Among these, HSP70 and HSP 90 are correlated with the development of thermo-tolerance. However, HSP 70 is one of the most conserved and important proteins in the family and has been studied extensively (Ming *et al.,* 2010).

Association of HSP and Heat Tolerance in chicken

Yahav *et al.,* 1997 reported that HSP 70- Provides thermo tolerance to cells on exposure to heat stress and binding to antigen cells and presenting them to the immune system. Studies indicate that HSP has a positive impact on the immune system. Soleimani*, et al.* 2011 reported that Red jungle fowl showed a lower heterophil :lymphocyte ratio, higher plasma corticosterone concentration, and higher heat shock protein 70 expressions than Village fowl and cross-breed chicken. Heat conditioning and dietary ascorbic acid supplementation decreased H/L ratio, TI duration, serum corticosterone concentration and Hsp 70 expression and also increased antibody titer against NDV, indicating a lower stress level.

References

- Ming, J., J. Xie, P. Xu, W. B. Liu, X. P. Ge, B. Liu, Y. J. He, Y. F. Cheng, Q. L. Zhou and L. K. Pan. 2010. Molecular cloning and expression of two HSP70 genes in the Wuchang bream (Megalobrama amblycephala Yih). Fish Shellfish Immunol. 28: 407 - 418.
- Sharifi, A. R., Horst, P and Simianer, H. 2010. The effect of naked neck gene and ambient temperature and their interaction on reproductive traits of heavy broiler dams. Poultry Science, 89(7): 1360-1371.
- Soleimani, A. F., I. Zulkifli, A. R. Omar and A. R. Raha, 2011. Physiological responses of 3 chicken breeds to acute heat stress. Poult. Sci. 90: 1435 - 1440.
- Yahav, S., Shamay, A., Horev, G., Bar-Ilan, D., Genina, O and Friedman-Einat, M. 1997. Effect of acquisition of improved thermotolerance on the induction of heat shock proteins in broiler chickens. Poultry Science, 76(10): 1428-1434.
- Yunis, R. E. E. M and Cahaner, A. V. I. G. D. O. R. 1999. The effects of the naked neck (Na) and frizzle (F) genes on growth and meat yield of broilers and their interactions with ambient temperatures and potential growth rate. Poultry science, 78(10): 1347-1352.
- Oke, U. K. (2011). Influence of some major genes on growth traits of local pullets in humid tropical environment. Agricultural Biology Journal of North America, 2(4), 570-576.

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DOPING IN ANIMALS

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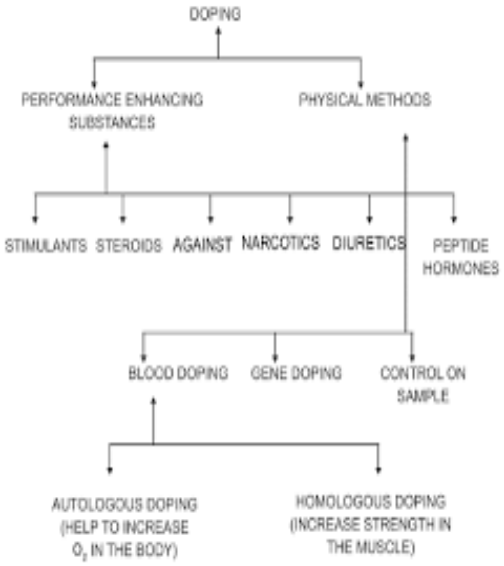
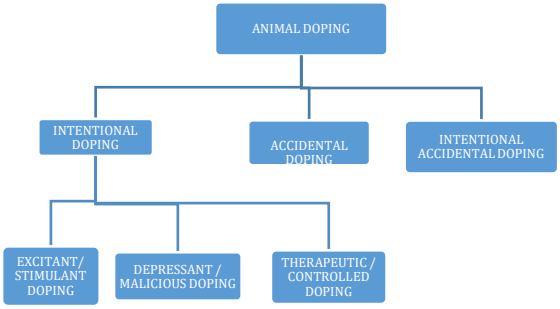
Introduction:

Animal doping is defined as an act of employing drugs in animals to deceive public about the health and performance of an animal in any competitive animal show, exhibition, trade and other activity. The chemicals or drugs used for doping purpose are called dope while the treated animal is termed doped.

The term "dope" was originated from a Dutch word "dop" which means an alcoholic beverage made of grape skins used by Zulu warriors to enhance their endurance in battle fields or as a stimulant drink used to energies themselves in ceremonial dances. These dopes produce clinical manifestations in the form of sedation, hallucinations, confusion, mental excitability etc. Earlier days, doping was commonly used in human athletic events and was aimed at improving the appearance or functioning of an athlete in sports event. This serious problem has been raised by several countries and nearly 139 countries are signatories to UNESCO convention against doping in Sport. The Government of India is actively contemplating to reframe legislation and regulations on anti-doping laws that shall be in compliance with guidelines from World Anti-Doping Agency (WADA).

TYPES OF DOPING





1. **Intentional doping:** This may further divided in to three forms:

   Excitant or stimulant doping: This form was also called as doping to win wherein the dope was used to improve the performance (courage, stamina or endurance) of the animal.

   Depressant doping or malicious doping: In this form, a dope is used to impair the performance of a competing animal in a show or race in which drugs are used to depress the animal.

   Therapeutic doping or controlled medication: Wherein a dope was used to confer soundness to an unfit, unsound or disabled animal. The act enables to mask the weakness in the animal.

2. **Accidental doping:** This refers to a state of doping that most often results from ingestion of prohibited agents via food that are normal constituents of some feedstuff or of contaminating herbaceous plant known to contain prohibited agent.

3. **Intentional- accidental doping:** This peculiar type of doping must be always suspected whenever accidental doping involving feeding of plant material is concerned. There is always tendency to use such plants for feeding that are known to contain some active components that affect the performance of the animal and the intent is to evade legal implications. Intentional aspect of accidental doping must always be suspected in such events.

DRUGS IMPLICATED IN DOPING:

A variety of chemicals and drugs have been employed in doping and injudicious and unethical use of these might lead to several medical concerns including drug resistance. The major substances are listed below:

CNS STIMULANTS: It Improves performance and locomotor activity. Examples: Amphetamine, Methyl amphetamine, Methyl phenidate, Pemoline, Caffeine. It also acts on central nervous system (CNS) in equines with role as performance enhancer. Examples: Ephedrine, Etaminophylline, Nitroglycerine.

OPIOIDS: Agonists: These produce amphetamine like effects in horses and raise nociceptive threshold. e.g. Morphine, Apomorphine, Fentanyl

CNS DEPRESSANTS: These agents are intentionally used in 'doping to lose' or to confer soundness to nervous or aggressive animals. e.g. Acepromazine, Azaperone, Diazepam, Xylazine, Detomidine, Medetomidine.

ADRENOCEPTOR AGONISTS: Agents like epinephrine improves cardiac function and energy mobilization, whereas Clenbuterol and Terbutaline improves respiratory function, bronchodilation, increase lean meat content, decrease fat deposition, improve skeletal muscle vascularity and motor functioning.

ANTI-INFLAMMATORY AGENTS: Agents such as corticosteroids e.g. Prednisolone etc. improves tissue perfusion and cellular metabolism in cases of shock, reduce loss of cellular enzymes during exercise, covers pounder and prevent allergy mediated bronchospasms. On the other hand, NSAIDs e.g. Salicylate, Flunixin, Naproxen etc. suppress pain and inflammation of musculoskeletal origin or even visceral pain.

DIURETICS: It includes several drugs such as Furosemide, thiazides etc. Furosemide relieves pulmonary edema, increases urine output, decreases urinary concentration of suspect dope etc.

MISCELLANEOUS DRUGS: e.g. Systemic alkalizers, Methylxanthines, Anabolic Steroids, Local anesthetics etc.

The list of classes of prohibited substances and methods of doping according to the World Anti-doping Agency is updated at least once a year. The effective version of 2007 is presented below. Substances prohibited in all situations are anabolic agents (mainly steroids), hormones, beta 2-agonists, agents with anti-estrogenic activity, diuretics and masking agents. Methods to increase oxygen transfer, manipulations of the sample and the practice of gene doping are also prohibited. In addition, Stimulants, Narcotics, Cannabis derivatives and Glucocorticosteroids are also prohibited in a competitive situation. All these banned substances must not be present in tested urine samples, therefore, laboratories report the presence of such compounds in the samples on a qualitative basis.

ANALYSIS OF DOPING AGENTS

SAMPLES : urine, blood, saliva, hair

Doping agents can be analyzed by initial screening techniques which are based on simple colour reactions of the analyte with the test reagents. As a rule, Anabolic steroids and Corticosteroids are screened by Gas liquid chromatography (GLC) and Mass Spectrometer (MS) or by RIA. RIA can provide useful first line screening procedure for the assessment of Etorphine induced doping in race horses. Gas chromatography coupled to mass spectrometry constitutes the most significant tool for identification of unknown. ELISA tests provide sensitive and effective screening for drug abusers.

SIDE EFFECTS OF DOPING:

- Premature heart disease
- Hepatocellular damage
- Cardiovascular disease
- Cancer
- Arrythmia
- Psychological disturbance
- Musculoskeletal effects
- Increased mortality
- Kidney problem

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SOCIAL CAPITAL INVESTMENT ON FARMERS' INTEREST GROUPS

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Introduction

The Capital constitute the wealth of the nations and form the basis of economic development and growth. Capital formation or capital building approaches are increasingly recognized as central to poverty alleviation programs. Traditionally, this has included natural capital, physical capital and human capital which determine the process of economic development since they overlook the way in which economic actors interact within communities and organize themselves to produce demanded goods and services and also increase the existing amount of the different types of capital. In this context, the concept of social capital is emerged. Social capital links people, their communities, and their surroundings. It influences the ability of individual smallholders to take advantage of emerging economic opportunities.

Social capital refers to quality of human relations with in some well-defined social group that enables members of this group to act in cooperation with one another for achieving mutual benefits. More formally, it is defined as "features of social organization such as networks, norms, and social trust that facilitate cooperation and coordination for mutual benefits''(Putnam 1995).

World Bank (1999) defined social capital as the institutions, relationships, and norms that shape the quality and quantity of a society's social interactions.

Social capital is the aggregate of the actual or potential resources which are linked to possession of a durable network of more or less institutionalized relationships of mutual acquaintance and recognition. Social capital ponders to the characteristics of a society that stimulates cooperation among individuals and it can create a

service which can enhance the output obtainable from other inputs. Networks, norms, trust are considered as important attributes of social capital. Unlike human and physical capital, social capital lies as a latent resource waiting to be mobilized and utilized, growing and development with use.(Morris *et al.,* 2006).

Importance of Social capital

Social capital allows citizens to resolve collective problems more easily and social capital greases the wheels that allow communities to advance smoothly. Where people are trusting and trustworthy, and where they are subject to repeated interactions with fellow citizens, everyday business and social transactions are less costly. People who have active and trusting connections to others whether family members, friends, develop or maintain character traits that are good for the rest of society.The encompassing view of social capitalincludes the social and political environment that enables norms to develop and shapes the social structure. Thereis growing evidence that social capital canhave an impact on development outcomes – growth, equity and poverty alleviation.

Associations and institutions provide an informal framework to organize information sharing, coordination of activities, and collective decision-making. These types of associations (cultural, civic, religious, developmental, women's and youth associations, environmental groups, etc.) play an important role in the social structure of territories and further contribute to the defense of cultural and natural heritage, social cohesion, the promotion of entrepreneurial initiatives and to the construction of a social identity.

Social capital in Farmers' interest groups

Social capital is extremely important for farming communities in developing countries where agricultural production highly depends on collective action, co-operation, reciprocity and inter-relations among farming households. Social capital has increasingly gained recognition in many aspects of agriculture, natural resource management and rural development in developing countries. This is due to its perceived positive consequence for development and opportunities for those who lack possession of and access to financial, human or physical capital.

Social capital through farmer groups helps to bridge this gap by enhancing cooperation, coordination, and collective action making market exchange easier. Membership to social networks generates social capital that members can rely on to access the market. The Farmers groups can plays a major role in promoting commercialization of agriculture through providing farm inputs, credit and improved technologies to members, small-scale processing and value adding of primary agriculture products, marketing of primary as well as processed agriculture products in domestic as well as international markets, capacity building of member farmers in technical as well as management aspects of agricultural production and marketing; promotion of sustainable use of local resources, community development, policy lobbying for farmer-friendly agriculture, networking with government and non-government service providers to tap resources for the benefit of farming communities, and promotion of social inclusion and social harmony in the community.

Membership in these farmers' groups enables individuals to have access to capacity building effort such as training and study tour as well as information pertaining to new agricultural technologies. The binding interrelationships among farmers affect groups' performance and the effectiveness of the social capital dimensions depends on the enabling environment, which includes the relationships among individual farmers, between farmer groups and the market. The effective functioning of marketing groups is based on the ability of groups to cooperate on the basis of trust between members.

The social relationships among farmers may play in the sustainable development of rural regions. Social relationships, networks may affect the economic sustainability of farmers by influencing farming practices and their propensity to adopt newer technologies via the supply of information through these networks. Farmers can then learn new techniques and acquire know-how, obtain informal training from others who have already adopted such practices and even obtain official assistance to implement various practices.

Social capital may also indirectly impact agricultural productivity and economic sustainability, as well as regional social sustainability, since it

affects the quantity of labor available either through the immediate and extended family or the social relationships available to the individual. The regional social sustainability may also be achieved by the role that farmers may play in the network of associations in rural areas of non-agricultural nature. Social capital among farmers, as built through community involvement, may also enhance social responsibility by promoting the use of sustainable agricultural farming practices and thereby contributing to environmentally sustainable development.It can also enhance the access of farmers to other forms of capital required to sustain production levels and maintain livelihoods.

Emerging challenges in Agriculture

The major challenges of agriculture in India are part of the rapid socio-economic, cultural and demographic transformation taking place in recent decades associated with factors including high population growth, natural resource degradation, climate change, internal conflict, globalization and market liberalization. These changes have impacted on every aspect of rural livelihoods.

The changing structure of agricultural production, the specialization of supply chain participants, and the diversification of consumer demand have led to challenges for small farmers. Most of the farmers in India are smallholder farmers and majority of those are illiterate, unorganized and scattered. They do not have a knowledge and skill about new technologies in agriculture and marketing of their produce with high transaction costs.

The lack of coordination among them deprives them of the remunerative price for their produce, and they have been exploited by middlemen in market. To help the farmers, The government has taken various steps for overcoming these challenges faced by farmers through explaining collective action of farmers in the form of Farmer interest groups (FIG), Commodity groups, Farmers producer company (FPCs) etc.,

Farmers' groups in India have also been known to enhance the productivity of agribusiness and used as channels for delivery services. Members of a group have an opportunity to exchange experiences, organize trainings and marketing campaigns for their produce. Therefore, farmers overcome market failures and maintain

their market access through the formation of farmers or producer groups.

Scenario of FIG in Tamil Nadu

Nearly 92% of farm holdings in Tamil Nadu being small and marginal holdings, have limited capacity to mobilize credit, adopt latest technologies and to add value to their agricultural produce. Hence, to make them avail these benefits and to increase their income, the government of Tamil Nadu is launching an innovative program for organizing small and marginal farmers into Farmers interest groups, producer groups which will be federated into 'Famers producer organizations' to promote collective farming for credit mobilization, better adoption of technology and to facilitate effective forward and backward linkages. The government have a target of formation of 10,000 farmer's interest groups and 2,000 Farmers producers groups to be promoted with a total allocation of Rs.100 crore has made for this purpose for 2017-2018. This scheme will be scaled up in coming years to benefit 40 lakh farmers in next five years.

The success of the farmers groups mainly depends on social capital, which is the internal structure of the groups. The decline of social capital in farmers groups will affect the performance of farmers groups which has been understood as a reason for failure and success of farmers groups.

Conclusion

The current study investigates the prospect for different categories of farmers to develop new collective forms of agricultural production, analyzing their needs and constrictions over carrying out agricultural activities. Collective farm activities will be a joint investment in inputs such as agricultural machinery, land pooling and joint cultivation by small ownersor by lease. This type of cooperation between people in the same community is based not only by active connection between people, but also on their reciprocal trust, mutual understanding, and shared values.

Further, the policy makers and development planners can facilitate the buildup of social capital by providing an adequate framework through development and by sustaining mutually beneficial relations among the farming communities and external institutions (may it be governmental or market-based). This will not only

increase farm yields, but will also contribute positively to the economic viability of small farms, being an important step in the effort to reduce poverty and promote a better livelihood of this category of farmers.

References

- Putnam, R.D. 1995. Tuning in, tuning out: The strange disappearance of social capital in America. PS: Political science & politics, **28**(4): 664-684.
- World Bank. 1999. The World Bank and Participation. Operation and Policy Department. World Bank, Washington.
- Morris, S., Woodworth, W. and Hiatt, S. 2006. The value of networks in enterprise development: Case studies in Eastern Europe and Southeast Asia. J. Dev. Entrepreneurship,11(4): 345-356.

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SELECTION CRITERIA FOR COCONUT MOTHER PALM

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Abstract

The coconut palm, *Cocusnucifera L.,* is one of the most beautiful and useful palms in the world. It provides a variety of useful products like food, fuel and timber. It is grown in India in about 1.51 million ha. With an annual production of about 9283.4 million nuts. It ranks third in world in area and production, first and second being Indonesia and Philippinesrespectively. Among the different coconut growing states in India, Kerala, TamilNadu, Karnataka andAndhra Pradesh account for nearly 90persent in area and production.Coconut seedling production involves substantial pre-bearing investment, greater emphasis must be given for the selection of the right type of planting material.

Introduction

The coconut palm, *Cocusnucifera L.,* is one of the most beautiful and useful palms in the world. Origin of coconut is believed to be somewhere in South East Asia. Coconut, botanically Cocas nucifera has only one species under the genus Cocus. It is a tall stately unbranched palm growing to a height of 12m to 24m. The stem is marked by rings of leaf scars which are often not prominent at the base. The palm has an adventitious root system, having numerous thick roots from the base of the stem almost throughout its life. The roots are localized generally at the lower most region of the stem which has been termed the bole. Leaves are large, long, borne on the crown. The palm is monoecious with relatively few female flowers. Male flowers are numerous small with six stamens and in female flowers, the ovary is tricarpic, usually one ovuled.

Fruit is large, one seed drupe. The outer layers of the pericarp are thick and fibrous. The inner layer (endocarp of shell) is very hard, horny or stony and the thin testa cohering to the endocarp is lined with white albuminous endosperm (meat), enclosing a large cavity, partially filled with sweet fluid. The inflorescence develops within a

strong, tough pointed double sheath called spathe which after full developed splits along its underside from top to bottom and releases the inflorescence. This usually occurs from 75-95 days after the first appearance of its tip in the leaf axil. The primordia of the inflorescence begin to form the leaf axil about 32 months before the opening of the spathe. In bearing coconut palm every leaf axil can produce a spadix and under normal conditions it varies from 12-15 per annum. However, this number may be reduced due to adverse weather condition. In India, the female flower production is high during the period from March- May and low from September – January. In general, the number of female per inflorescence varies from 10-50. Female flowers normally become receptive 19-20 days after the opening of the spathe. Genetically the dwarf palms are autogamous while tall types allogamous. Both winds and insects are considered to be the main pollinating agents. A large number of buttons (female flowers) fail to develop into due to lack of pollination and fertilization, defect in the flowers, physiological disorders, genetic nature of the variety, pests and disease and unfavorable environment etc. Generally not more than 2 to40% of the female flowers to reach maturity under normal conditions.

Quality seed nuts and seedlings are obtained through a series of selections made at various stages.

MOTHER PALM SELECTION

For production of quality planting materials, it is essential to have good quality mother palms of the desired varieties. Mother palms are selected based on the following procedure

The important features of superior mother palms are:

- ✓ Age of the palm should be minimum 20 years and maximum 60 years with regular yielding for four years consistently
- ✓ A mother palm should have at least 30 fully opened leaves having leaf orientation in all directions i.e., umbrella shaped

fronds, spherical or semi spherical crown

- ✓ Straight stout trunk with even growth and closely spaced leaf scars.
- ✓ Every leaf axil should have one inflorescence with large number of spikes (30 to 35 spikes per inflorescence) and one or two female flowers per spike.
- ✓ Select palms with strong petiole with wide leaf base firmly attached to the stem.
- ✓ Bearing twelve bunches of nuts with strong bunch stalks.
- ✓ Fully dried unhusked nuts should weigh more than 1.20 kg and husked nut should be more than 600 g with copra content of 150 g and above.
- ✓ High yielding mother palms giving not less than 100 nuts/palm/annum under irrigated condition (70-80 nuts/annum under rainfed conditions) should be chosen for collecting seed nuts
- ✓ Nuts of round and oblong shape should be selected
- ✓ Free from pests and diseases.

Avoid palms which have the following characteristics

- ✓ Palm selection should be restricted to 5 to 10 % in each block
- ✓ Long and thin petioles are not desirable because they are liable to be weak and may easily bend or break under pressure.
- ✓ Palms producing barren nuts or those shedding large number of immature nuts should be discarded.
- ✓ Palms produce long, narrow, small sized or barren nuts
- ✓ Palms showing alternate bearing tendency also should be avoided.
- ✓ Palms are grown under favorable environmental conditions. E.g. Trees near manure pits.

Maturity of Seed Nut

- ✓ The seed nuts takes about 12 months for its full maturity. The mature nuts are harvested when at least one nut in the oldest bunch starts becoming dry.
- ✓ In Tall varieties, it takes 11-12 months to become a matured seed nut whereas in dwarfs, nuts will mature in 10-11 months after emergence of the inflorescence.
- ✓ Immature nuts will produce dull sound.

- ✓ Harvest the bunches intended for seed nut by lowering them to the ground using a rope to avoid injury to seed nuts when palms are tall and ground is hard.

Selection of Seed Nuts

- ✓ Harvest seed nuts during the months of February - August in Tamil Nadu to get maximum germination and good quality seedlings.
- ✓ Tall varieties are sown one or two months after collection whereas dwarfs should be sown immediately after harvest (within 10 to 15 days).

Selection of seedlings

- ✓ Seed nuts, which do not germinate within 5 months of sowing as well as those with dead sprouts should be removed.
- ✓ Only 9 – 12 months old good quality seedlings should be selected based on early germination normally 2 to 3 months (8 to 10 weeks), rapid growth and seedling vigour should be selected.
- ✓ The vigourous seedlings which are one year old, having minimum of six leaves and girth of 10 cm at the collar should be selected. Collar girth of the seedling should be 10-12 cm.
- ✓ Early splitting of leaves is a good indicator of the rapid development and early bearing.
- ✓ The colour of the petiole and seedling vigour can be used as a selection criterion for dwarfs and hybrids.
- ✓ The dwarfs should exhibit the petiole colour of the mother palm.
- ✓ Hybrids usually exhibit hybrid vigour at the seedling stage itself. Seedlings of dwarf varieties can be easily identified by their early germination (3 months after sowing), short height, short and sturdy leaves with short and narrow leaflets.

Conclusion

Production of Coconut Seedlings since coconut cultivation involves substantial pre-bearing investment, greater emphasis must be given for the selection of the right type of planting material.Mother palm should be selected based on the criteria like age of the mother palm,High yielding palms for more than three consecutive years,Nut shape, Free from pests and diseases, Selection of seed nuts based on vigorous growing condition should be followed

Reference

- P. Subramanian,C. Thamban,A. Joseph Rajkumar , VinayakaHegde ,K.B. Hebbar,Ravi Bhat and V. Nira.Coconut. ICAR - Central Plantation Crops Research Institute,Kasaragod, 671 124, Kerala, India

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SENSING, RECOGNITION AND MYCOPARASITISM OF FUNGAL PATHOGENS BY FUNGAL ANTAGONISTS

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Abstract

Biocontrol agents are beneficial microorganisms which possess disease control ability in plants by different mechanisms. These agents identify the pathogenic host by sensing, recognition and mycoparasite it and thus deliver the effective plant disease management. Majority of the fungal biocontrol agents are utilized to manage the fungal plant pathogens. These are normally present in soil, organic matter and other substrates which naturally possess the biocontrol activity.

Keywords: Biocontrol, Sensing, Recognition, Mycoparasite and Plant Pathogens

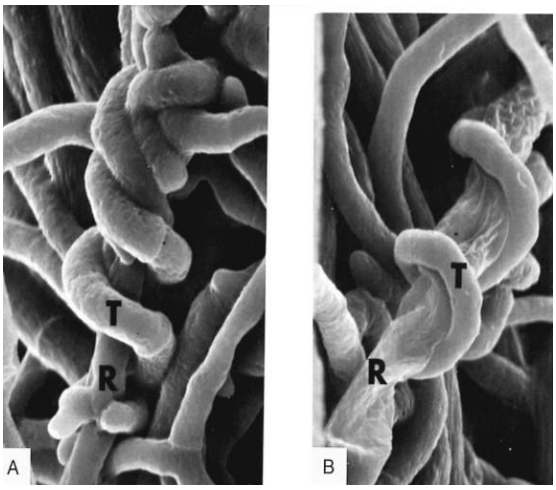
Introduction

Plant pathogens are harmful organisms which affect the normal function of the plant. Among plant pathogens fungi are dominant causal agents of plant diseases. Pathogenic fungi use diverse strategies to colonize and to cause disease in plants. Some are biotrophic which requires a living host and others as necrotrophic which kills the host on subsequent infection. To manage these pathogenic fungi, a set of antagonistic biocontrol agents are utilized to reduce the severity of diseases and to induce plant growth. These biocontrol agents are normally surviving in the soil, organic matter and decaying woods. These bioagents are commercially utilized against *Sclerotium rolfsii, Rhizoctonia solani, Pythium spp., Fusarium spp., Botrytis cinerea* and *Sclerotinia sclerotiorum.* The biocontrol is a combination of different mechanisms working synergistically to achieve disease control. The antagonist imparts different methodologies from sensing the pathogen host, recognition of host and killing the host by mycoparasitism. Some of the mycoparasite which are developed for their mycoparasitic activity are *Trichoderma spp., Verticillium biguttatum, Coniothyrium minitans, Chaetomium globosum, Pythium oligandrum* and *Ampelomyces quisqualis.* These are alternatives to chemical

management of plant diseases. These bioagents possess some other activities in combination such as nutrient competition, secretion of antifungal metabolites and formation of morphological changes to kill the host.

Mechanisms in sensing and mycoparasitism

Major mechanisms involved sensing the host, chemotrophic growth towards host, recognition of host, attachment to host cell wall and degradation of host cell wall followed by penetration inside the host cell. Fungal cell wall is made up of carbohydrate polymers and glycoproteins. The three major components are chitin, mannans and beta 1,3 – glucans which constitute the cell wall. The first step in sensing is the production of high molecular weight compounds from the biocontrol agents. These high molecular weight compounds such as cell wall degrading enzymes which move towards the host and make the host cell to release low molecular weight degradation compounds. These two phases happen in the biocontrol agents, thus activating the mycoparasitic gene expression cascade. In host sensing, the biocontrol agents secrete proteases which release the cell wall oligomers in the host. The cell wall components such as peptides and small molecules including lectins are breakdown from the host cell structure as in case of*Sclerotium rolfsii.* The antagonistic hyphae sense these chemical stimuli released by the pathogen host. There are some interactions between cell surface components and their extracellular environment. Example, the interaction of lectin initiates the cell differentiation in *Trichoderma*spp. and induces the formation of infection structures.



Chemotrophic growth

Once the host pathogen is sensed by the biocontrol agents, it started to grow towards the chemical stimulus from the host and establish the chemotrophic growth. Positive hyphal tropism happens when the compounds from the host attracts the biocontrol agent growth. Some of the host chemotrophic growth inducers are

extracellular chitinases, cell wall oligomers, amino acids and sugars.

Recognition

Once the chemotropic growth is achieved, the biocontrol agent recognizes the host by transcriptional changes due to increased expression of cell wall degrading enzymes. These enzymes make the host cell wall to release the oligonucleotide compounds which attracts the mycoparasite towards the host. The released cell wall oligomers induced the host sensing in mycoparasite by act as a ligand for G protein coupled receptors (GPCRs). Later, Mitogen activated protein kinase (MAPK) essential for the sporulation, mating, hyphal growth and pathogenicity. Further, cyclic Adenosine MonoPhosphate (cAMP) pathway occur via the stimulation of cAMP dependent protein kinases (PKA). This is responsible for the growth, morphogenesis and virulence.

Attachment to host

The attachment of host happens due formation of morphological changes once the hyphae moved towards the host and coiling around the host hyphae occurs. Later it started to produce appressoria or papillae like structure after coiling. The formation of appressoria leads to the attachment of mycoparasite on host cell wall. The coiling around the host hyphae was also triggered by the glycoproteins present on the host cell wall.

Penetration on host cell

Once the mycoparasite is attached to the host cell surface, its starts to penetrate inside the host by secreting cell wall degrading enzymes such as chitinases, glucanases, and proteases. These enzymes cleave the cell wall components and made it to permeable for the entry of the mycoparasite hyphae. Sometimes, it also revealed that before coiling the mycoparasite produces these hydrolytic enzymes which was triggered by the lectins present in the host cell wall. After penetration into the host cell, the mycoparasite produces haustoria to absorb nutrients from the host.

Trichoderma

Trichoderma spp. are the major mycoparasite which are utilized for the management of soil borne plant pathogens. This mycoparasite is attracted towards the prey by the molecules present on the host. Lectins associated with host cell wall induces coiling around the host hyphae after physical contact, but the production of

cell wall degrading enzymes by the mycoparasite are triggered by early events. This is due to the signaling molecules present in the cell wall of *Trichoderma*spp.which are G protein coupled receptors. This GPCRs are involved in mycoparasitism. It constitutes three sub-units such as Gα, Gβ and Gγ. The MAP kinase and cAMP pathway are actively involved in mycoparasitism. When the ligand binds to the receptor, G protein is released which leads to exchange of GDP to GTP in Gα subunit. GTP bound α dissociates from its ßγ partner and allow both signaling units to regulate the activities of downstream effectors. Highly conserved heterotrimeric G-proteins act as signal transducers which then couple cell surface receptors to cytoplasmic effector proteins. *T. atroviride* subgroup I Gα subunit Tga1 is involved in both coiling and conidiation. In MAPK signaling, Signals are transduced by Mitogen activated protein kinase (MAPK) cascades. There will be a sequential activation of serine-threonine protein kinases by phosphorylation. This in turn controls the gene expression. It stimulates cAMP-dependent protein kinases (PKA) which consists of two regulatory(R) and two catalytic(C) subunits. In *T. virens* adenylate cyclase are involved in growth, germination and mycoparasitism.Chitinases and ß-1,3-glucanases are secreted by*T. hamatum* on *Rhizoctonia solani* cell walls. Cellulases level is increased to 30-fold in *P. aphanidermatum*amendedsoil.

Verticillium biguttatum

It is an important mycoparasite on *Rhizoctonia solani*, which includes germination on the host followed by coiling and adpressed growth along the host hyphae, penetration into host hyphae and finally grows inside the host and sporulate outside the host cell. Sometimes, it doesn't produce appressorium rather directly contact the host hyphae. Cell wall degrading enzymes such as beta- glucanase, chitinase and protease are produced in the *V. biguttatum* when mycoparasite on the pathogens *R. solani.*

Coniothyrium minitans

Coniothyrium minitans infect sclerotia of many ascomycetous fungi such as *Sclerotinia minor, Sclerotinia sclerotiorum, Sclerotinia trifoliorum,* and *Sclerotium cepivorum.* The mycoparasite doesn't produce appressorium, instead directly penetrate the sclerotial rind through hyphal tips intracellularly or through intercellular gaps. It penetrates

either by mechanical pressure or by production of β-glucanase and chitinase which cause lysis and disintegration of cell wall.

Chaetomium globosum

*Chaetomium globosum*was reported to act against *fusarium, Helminthosporium, Pythium, Alternaria, Phytophthora*pathogens. *C. globosum* inhibit the pathogen growth either by mycoparasitism or by the production of antifungal principle. The role of coiling around the host hyphae and secretion of cell wall enzymes and lysis of cell wall followed by secretion of antibiotics such as chaetoglobosin A, chaetomin.

Pythium oligandrum

It is the cellulose walled group belong to oomycote, which have biocontrol effect on different pathogens. It is the potent cell wall degrading biocontrol agents by producing different enzymes. It coils around the host and secrete enzymes and thereby enter into the host. After coiling, a papillae like structure were formed near the penetration site. After the degradation of cell wall, the protoplasm released from the host site and thereby *P. oligandrum* cells were released from the dead host hyphae. The chemotropism attraction of *P. oligandrum* hyphae towards the cells of *Phytophthora parasitica* follows the adhesion and attachment of biocontrol to cell surface. *P. oligandrum* was multiplied inside the host and started to divide in the cells and released from the host.

Ampelomyces quisqualis

It is an obligate parasite on powdery mildews which actively attacks the host. It penetrates the powdery mildew hyphae and grow internally from cell to cell through septal pores. Later, it produces pycnidia intracellularly in *Erysiphe* hyphae, conidiophore, immature ascomata and inhibit conidial production and cleistothecial development.

Conclusion

Different mycoparasites are available for the effective management of plant pathogens. These mycoparasites can effectively sense and colonize the host. These mycoparasites are host specific and non-specific, which can ably manage the growth of plant pathogens, conidial production and inhibit the production of fruiting bodies. Application of mycoparasites on targeted plant pathogens can be helpful in sustainable agriculture.

References

- Zeilinger S, Omann M. 2007. *Trichoderma* biocontrol: signal transduction pathways involved in host sensing and mycoparasitism. Gene Regul Syst Bio. 8(1):227-34.
- Erkol, D., C. Eken and E. Dane, 2009. Biologicalcontrol of *Rhizoctonia solani* on potato by*Verticillium biguttatum*. Afr. J. Biotechnol., 8:2503-2507
- Amanda J. Bennett, Carlo Leifert, John M. Whipps. 2006. Survival of *Coniothyrium minitans* associated with sclerotia of *Sclerotinia sclerotiorum* in soil. Soil Biology and Biochemistry. 38(1): 164-172. ISSN 0038-0717.
- Hung, Phung Manh. 2015. Efficacy of *Chaetomium*species as biological control agents against *Phytophthora nicotianae*root rot in citrus.*Mycobiology*. 43(3):288-96. doi:10.5941/MYCO.2015.43.3.288
- Rey, P.; Le Floch, G.; Benhamou, N.; Tirilly, Y. 2008.*Pythium oligandrum* biocontrol: Its relationships with fungi and plants. In Plant-microbe interactions; Research Signpost: Trivandrum. 43–67, ISBN: 978-81-308-0212-1 *(9).*
- Liyanage, K. K., Khan, S., Brooks, S., Mortimer, P. E., Karunarathna, S. C., Xu, J., & Hyde, K. D. 2018. Morpho-Molecular Characterization of Two *Ampelomyces* spp. (Pleosporales) Strains Mycoparasites of Powdery Mildew of *Hevea brasiliensis*. *Front. Microbiol.*, *9*, 12.

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BIOFUEL – 'AN ECOFRIENDLY BIOENERGY'

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Abstract

Biofuel is one of the sustainable energy sources obtained from processing various feedstocks such as plant, algae, or animal waste. Biofuels are typical forms of either biodiesel (produced from vegetable oils, re-used wax or animal fats) or bioethanol (alcohol produced by fermenting sugar and starch crops such as corn) or biogas. Biofuels of the first generation are created from oil-basis plants, sugar, and starch yields. Biofuels of second generation are non-food yields and are principally produced from agricultural and woodland residues. The third generation biofuels produced by algae and the fourth generation of biofuels uses engineered cyanobacterial development. Biofuels are developed as a substitute for petroleum because of their nontoxic, sulfur-free, biodegradable nature, originating from the renewable sources. It is an ecofriendly bioenergy that would help to mitigate greenhouse gases and preserve the environment.

Keywords: Biofuel, Bioethanol, Biodiesel, Biogas, Fossil fuel

Introduction

Biofuels

Biofuel is the fuel created through contemporary processes from biomass instead of the very gradual geological processes associated with the formation of fossil fuels such as natural gas or oil. In simpler words, **biofuels** are derived from recently dead or living plant material and animal waste. This differs from fossil fuels, which are derived from long-dead plant and animal matter. Unlike the non renewable fossil fuels, biofuel can be produced continuously without exhaustion since we can always grow more crops to turn in to fuel. Also, the green house emission potential of biofuel is negligible when compared to fossil fuels. At this point, biofuel turns out to be the suitable renewable energy source and a great alternative for fossil

fuels. **And the biofuel has all the characteristics required in an ideal fuel (Fig.1).**

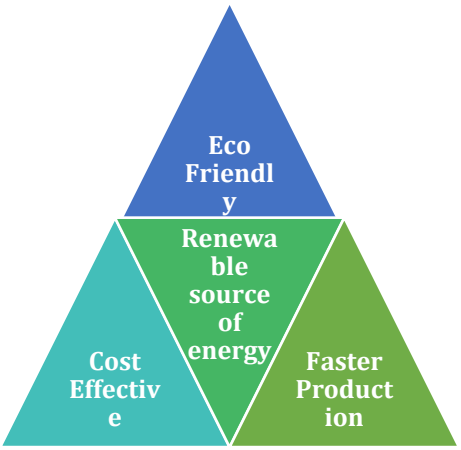

Fig.1 Characteristics of an ideal fuel

Biofuels are derived from food and non-food sources. The food sources are plants and animal products used for consumption of human beings. Products like sugar, starch or vegetable oil are made into biofuels using conventional methods such as fermentation and trans-esterification. The non-food sources are non-edible parts of plants, waste material derived from food sources that are not suitable for human consumption. They are made in to biofuels using advanced technology such as hydrocracking, where feedstock is broken down in the presence of hydrogen. Biofuels may be solid, liquid or gaseous in nature.

- **Solid** - Wood, dried plant material and manure
- **Liquid –** Bioethanol, Biodiesel, Algal fuel
- **Gaseous** – Biogas and Syngas

Types of Biofuels

Biofuels come in different forms to meet different energy needs. They are divided into different types of biofuels based on their source from which they originate.

1. Solid Biofuels

a. Wood

- It can be obtained from trees as well as from plants and is used for fuel in the form of firewood, sawdust, chips, charcoal, and pellets.
- It is one of the most common biofuels which is derived from organic matter.

b. Energy Crops

- It is the primary category of the type of **solid biofuels.**
- These crops are usually produced for burning purpose.
- Switch grass or elephant grass are the crops usually **grown for combustion.**

2. Liquid Biofuels

a. Bioethanol

- It is produced by fermenting corn, sugarcane, sugarbeet or algae. Initially, starch is broken down to simple sugars and then

converted to ethanol by **fermentation process.**

- It may be used as a blended form with gasoline which is called gasohol.
- It is used as an alternative source of petrol.
- It is environment friendly and produces much less carbon when burn-in vehicles as fuel.

b. Biodiesel

- It is derived from vegetable oils like soybean oil or palm oil, animal fats and from non edible crops by a biochemical process called transesterification.
- Transesterification is the reaction of an alcohol with oil or fat to produce fatty acid alkyl esters, otherwise known as biodiesel.
- It is an alternative for the conventional diesel fuel.
- It produces very less or no amount of harmful gases as compared to diesel.

c. Algae Based Biofuels

- Algae are the highest source of energy in the class of **biofuels**.
- Algae have **20 to 80%** oil content which can be converted into different fuels.
- Production of diesel from algae is the **easiest way**.
- They are the most **advanced form of biofuels.**

3. Gaseous Biofuels

a. Biogas

- Biogas is produced by anaerobic decomposition of organic matter like sewage from animals and humans.
- The decomposition of sewage produces methane gas, which is used as a fuel and the leftover material called slurry is used as manure in the agriculture fields.

b. Syngas

- Syngas is a mix of carbon monoxide, hydrogen, and other hydrocarbons, which is produced by partial combustion of biomass.
- Syngas can be utilized to make methanol, dimethyl ether and hydrogen.

Classification of Biofuels

Depending upon the feedstock, biofuels are categorized into four types (Fig. 2).

Fig. 2 Biofuel generations (*Picture Courtesy*: Khan *et al.,* 2021)

1G. First Generation Biofuels

Biofuels, which derive energy from the conventional source or food sources are called first-generation biofuels.

Sources: Sugarcane, Corn, Vegetable oil from plants like soybean, Jatropha, Rapeseeds and Animal Fats

Examples: Bioethanol, biodiesel, biogas

2G. Second Generation Biofuels

The fuels derived from non-food sources and the waste left from the food resources are called second generation biofuels. They are **cellulosic biofuels**.

Sources:

1. Grasses like switch grass, Indian grass, and myscanthus
2. Unsuitable plant materials like wood chips, agricultural waste (*i.e.* Sugarcane bagasse)
3. Non-edible plant parts
4. Municipal solid waste
5. The waste vegetable oil

Examples: cellulose ethanol, biodiesel.

3G. Third Generation Biofuels

Third-generation biofuels are produced by certain species of **algae (algal fuels)**.

Source: The alga consists of 40% of lipids which can be converted to biodiesel or synthetic petroleum. The Algae have the potential of producing the highest amount of energy among all the sources as they **photosynthesize** and create their own energy. *The green alga Chlorella is targeted.*

Examples: Biodiesel, Butanol, Gasoline, Jet fuel, Methane

4G. Fourth Generation Biofuels

The most promising advanced biofuels are those from the fourth generation of biofuels. ***Source:*** The feed stocks of the fourth-generation biofuels are genetically engineered microalgae, microbes yeast and cyanobacteria.

Benefits

- ✓ ***Price*** - The price of regular fuel is increasing due to increasing demand, while biofuel is less expensive due to progress in agriculture.
- ✓ ***Sources /raw materials*** - Fuels have limited sources while biofuel has large resources like crops (edible & non-edible)

manure and other waste materials.

- ✓ ***Renewability /biodegradable*** - It takes very long time for fossil fuel to produce, biofuel is much more easily renewable.
- ✓ ***Security*** - Biofuel can be produced locally, which decrease the nation's dependence upon foreign energy.
- ✓ ***Carbon cycle*** - When biofuel burn, produces very low CO_2 and the same is absorbed for photosynthesis by plant itself.
- ✓ ***Nontoxic/safer*** - Biofuel doesn't contain sulfur and other toxic substance that actually produced by burning of regular fuel.
- ✓ ***Greenhouse effect*** - Ethanol blended biofuel such as Ethanol 85% reduces up to 37.1% of the greenhouse effect
- ✓ ***Economic stimulation/employment*** - Biofuel manufacture plants can employ hundreds or thousands of workers, creating new jobs in rural area

Challenges

Just like other fuels, there are some challenges involved with producing biofuels. These include the cost of production and the source of the feedstock. New technologies can make biofuel production cheaper. And researchers will find ways to use feedstocks not otherwise used for food. If these things happen, biofuels might soon become one of the best substitutes for fossil fuels.

Conclusion

Biofuels are environment-friendly, non-toxic, biodegradable, have no sulphur or aromatics, high oxygen content for efficient combustion and ends up in reduced risk of global warming. Due to ecofriendly nature, it can be a potential renewable energy alternative and more appealing power source in near future.

References

- ➢ Khan, N., Sudhakar, K., Mamat, R. 2021. Role of biofuels in energy transition, green economy and carbon neutrality. Sustainability,13:12374. https://doi.org/10.3390/su132212374.
- ➢ https://thebiologynotes.com/plants-used-as-a-biofuel-production/ - 20, January 2020.
- ➢ https://studiousguy.com/biofuel-types-uses-examples/ - January 2013.

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VEGETABLE PIGEONPEA – A PROTEIN RICH FOOD

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Introduction:

Pigeon pea is an often cross pollinated (20 – 70%) crop. With the diploid chromosome number of 2n=2x=22 and has the genome size 1C = 858Mbp. It is a short-lived perennial shrub that is traditionally cultivated as an annual crop in developing countries. It is an important legume crop mostly produced in Asia, Africa, Latin America, and the Caribbean region. Considering the vast natural genetic variability in local germplasm and the presence of numerous wild relatives, India is probably the primary center of origin of pigeon pea. It is a hardy, widely adapted and drought tolerant crop with a large temporal variation (90 – 300 d) for maturity. It is a perennial plant that allows continuous flowering and podding. Under sufficient moisture conditions, the plants allow more than one flowering and harvesting of green pods. In small seeded varieties, the pod load on each plant is much greater than those of large seeded varieties. Pigeonpea pods sold as vegetables are generally picked 25-30 days after flowering. The optimum growth stage for harvesting of commercial vegetable pigeon pea is fully grown bright green pod stage is mostly preferred, so the pods are harvested before they start losing their green color.

Hand-picking or mechanical harvesting of green pods has become common practice for vegetable pigeonpea, and for large-scale processing for canning and freezing. Under sub-tropical growing conditions, it takes about 45-50 days from pollination to seed maturity. Deposition rate of dry matter into the seed reaches maximum at a certain age after anthesis, known as physiological maturity (PM). Determination of the right stage of PM is

essential because at PM, dry matter content, viability and vigor, germination ability, pod size, green seed yield and different nutrient contents are at highest condition in the seed. During this period, both pods and seeds pass through a number of physiological, morphological and chemical changes.

Generally, three days after fertilization, the floral petals wither completely and the ovary starts emerging. A young pod of about one centimeter length is visible after about a week. Such pods grow rapidly and achieve their full length in about 25 days. During this period of pod growth, the young seeds (ovules) inside the pods remain intact but do not gain any noticeable size and weight. In some vegetable type lines, the immature seed size is large but their dry seed size reduces rapidly with maturity. The number of ovules in a pod varies from 2 to 9, but all the ovules do not develop to their full size due to ovule abortion.The exact reason for the ovule abortion is not fully understood but there appears to be some sort of blockage in food translocation, insect damage or fungal infection that restricts or stops the process of ovule development inside pods. Soon after achieving the potential pod length, a greater proportion of food reserves of the plant are diverted towards the ovules and rapid increases in their sizes and weights are observed for the next 10-12 days.Mostly the pod length ranges between 5-12cm in vegetable pigeon pea and weight around (15g/100 bean when dry).

Nutritional value

Vegetable pigeonpea is a good source of protein, vitamins (A, C, B complex), minerals (Ca, Fe, Zn, Cu), carbohydrates and dietary fibre. In comparison to green peas (*Pisum sativum*), the vegetable pigeonpea has five times more beta carotene content, three times more thiamine, riboflvin and niacin content anddouble vitamin 'C' content. Besides it has higher shelling percent (72%) than that of green peas (53%). These all factors indicate that pigeonpea is nutritionally rich vegetable and it can be used in daily cuisine.Pulses are known to be rich in edible proteins. In India, the most commonly grown pulses, in order of their importance, are chickpea, pigeonpea, green gram, black gram, peas, common beans, and cowpea. In spite of their higher nutritive value and being important part of daily cuisine, most farmers give low priority to pulses in cultivation and are assigned to rainfed and relatively less productive

portions of their fields.However, recent escalation in prices of pulses has brought about some changes in the mind set of some farmers and they are taking the cultivation of pulses more seriously than before.

Green pigeonpea seeds are superior to dal in nutrition. Singh *et al.* (1984) reported that the vegetable type pigeonpea had high polysaccharides and lower crude fiber content than dal, irrespective of its seed size. The crude fiber content in vegetable type pigeonpea and garden pea *Pisum sativum* (L.) were almost similar. Trypsin inhibitor activity was also higher in pigeonpea than in garden pea but its magnitude was less than soybean (*Glycine max* [L.] Merr). The pigeonpea dal is superior to vegetable type with respect to starch and protein, while the vegetable pigeonpea grains had higher crude fiber, fat, and protein digestibility. As far as mineral and trace elements are concerned, green pigeonpea was better in phosphorus by 28.2%, potassium by 17%, zinc by 48.3%, copper by 20.9%, and iron by 14.7% .On the other hand, the dal had 19.2% more calcium. Like other legumes, pigeonpea seeds also contain considerable amounts of some anti-nutritional factors. In dry pigeonpea seeds, certain amounts of poly–phenolic tannin compounds are also present, which inhibit the normal activity of digestive enzymes such as trypsin, chymotrypsin and amylase.

In the growing seeds, the starch content was negatively associated with their protein and sugar pigeonpea content. The amount of crude fiber content in the growing seeds increased slowly with maturation. Soluble sugars and proteins decreased but the starch content increased rapidly between 24 and 32 days after flowering. Vegetable pigeonpea genotype ICP 7035 had high soluble sugars. Both vegetable pigeonpea and its dal are good sources of these mineral nutrients. Some of the minerals also play an important role in improving cooking quality of pigeonpea . In pigeonpea, seed and pod size are positively correlated and the varieties

with large pods invariability have large immature and dry seeds.On the contrary, in some vegetable type lines, the immature seeds are large but their size reduces gradually with approaching maturity. Saxena (2008) observed that in the long podded genotypes, all the ovules did not develop properly to their full size due to ovule abortion. The exact reason for the loss of ovules is not fully understood but there appears to be some sort of blockage in the supply of carbohydrates and other vital nutrients to the growing ovules resulting in their pre-mature cessation.

Conclusion:

Vegetable Pigeonpea varieties *viz.,*ICP 13442 with purple pods had green beans. On the other hand, ICP 8514, ICP 12746 and ICP 15222 producedpurple pods with mottled green seeds. Varieties for ICP 7035, BRG-2, Anand Vegetable Pigeonpea 1, T 15–15, Hy 3C, TTB 6, ICEAP 00068, ICEAP 00540, ICEAP 00557, ICEAP 00911, ICEAP 00902, ICEAP 00554, ICEAP 00850 and KIONZA are also used as vegetable types.

Comparison of green pigeonpea seeds and dal for important quality traits

Constituents	Green seeds	Dal
Starch content(%)	48.4	57.6
Protein(%)	21.0	24.6
Protein digestibility(%)	66.8	60.5
Soluble sugars(%)	5.1	5.2
Crude fiber(%)	8.2	1.2
Fat(%)	2.3	1.6

Mean values for trace and mineral elements (mg/100g) in green seeds of vegetable variety ICP 7035 and dal of a popular variety C 11

Element	Green seeds (ICP 7035)	Dal (C 11)
Phosphorus	264	206
Potassium	1.498	1.279
Calcium	92.3	114.3
Zinc	3.07	2.07
Copper	1.39	1.15
Iron	5.16	4.50
Manganese	0.99	1.11
Magnesium	108.3	108.5
Singh *et al.* (1984)		

References

- Saxena, K. B., R. V. Kumar and C. L. L. Gowda. 2010c.Vegetable pigeon pea-a review. Journal of Food Legumes. 23(2) : 91-98.
- Singh U, Jain KC, Jambinathan R and Faris DG. 1984. Nutritional quality of vegetable pigeonpea (*Cajanuscajan L.*). Mineral and trace elements. Journal of Food Science 49: 645-646.

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