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BACTERIAL AND VIRAL DISEASES IN SHRIMP LARVAE AND JUVENILES : THEIR SYMPTOMS, TREATMENT AND PREVENTIVE MEASURES

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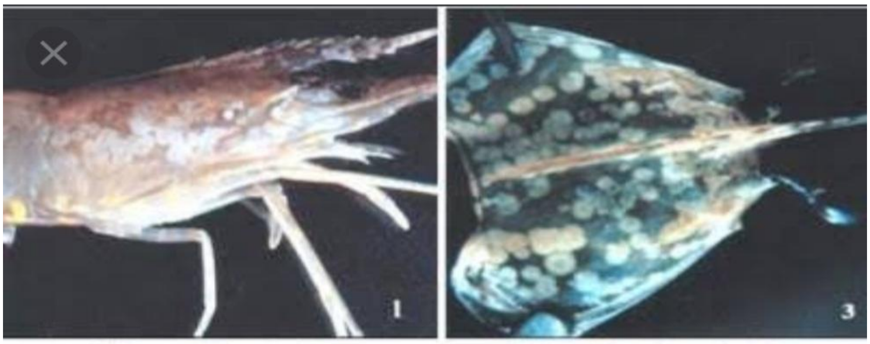
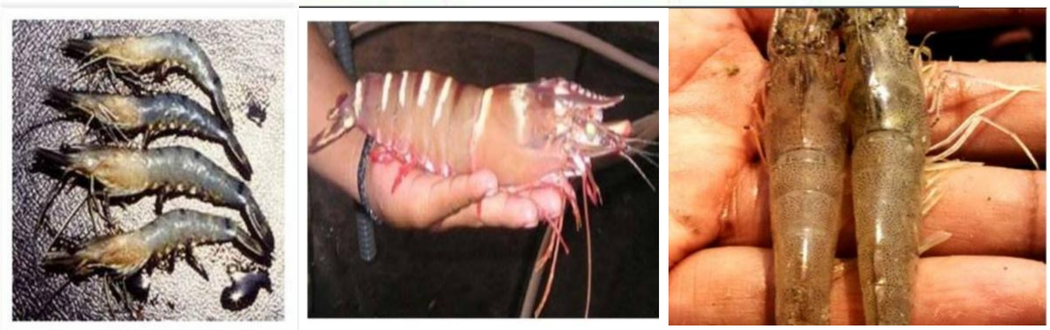
Shrimp is not only among the world's most valuable aquaculture species, but also a species that encounter higher economic losses due to diseases.Shrimp has been one of the most successful species during the blue revolution. Aquaculture industry especially the shrimp industry has been witnessing decline in production in last few decades



White spot disease in shrimp   White spots on the cephalothorax



due to outbreak of various disease. The effect of these diseases are mainly observed in the early stages of life (juvenile and post larvae) leading to mortality and cleaning of entire stocked population. Series of practices has to be done in pre and post management stocking practices in order to prevent and overcome such viral and bacterial diseases.

Bacterial Diseases

1.Vibriosis

Among the vibrio species 14 of them have been reported in shrimp culture. They areas*Vibrioharveyi,V.splendidus,V.orientalis,V.fischeri,V.pelagicus,V.ordalii,V.mediterrani,V .anguillarum* etc.Among these *V. harvey*i are considered to cause 80-100% mortality in *Penaeus monodon* hatcheries by releasing exotoxins.

★ Symptoms of Vibriosis in shrimp Larvae & juveniles

Symptoms of Vibriosis in post larvae and young juveniles are characterized by redness of pleopods, pereopods and gills. The post larvae shows mortality within 48 hours.The eyeball colour of infected shrimp changes into brown colour and leads to mortality in few days. In case of Shell disease caused by vibrio species lesions of cuticles are observed, these lesions are brown or black and also found on gills and appendages. Moreover many species of Vibrio like *harveyi* and *Splendidus* renders luminescence that make shrimp visible during night making them available for predators. In case of systemic vibriosis septic hemocytic nodules are formed in lymphoid organs,hepatopancreas,heart,muscles and in connective tissue of gills.Infected hepatopancreas are observed to be vacuolated showing reduced lipid and glycogen reserves.In *P. monodon* spheroids are formed in lymphoid organ.

★ Treatment for Vibriosis

Bacterial disease like Vibriosis is caused due to poor water quality and unhygienic environment. The main controlling factor is the continuous water management and improved sanitation that will ultimately reduce stress on shrimp larvae and juveniles. Proper site selection and pre stocking management is very essential. Water exchange at regular interval and partial harvesting.Since it is a bacterial disease probiotics like BioRemid- Aqua,ultrazyme PFS are supplied into the water directly or given via feeds. AscoSol-C an immuno-stimulant has also been found effective. In case of luminescent Vibriosis the eggs are washed by iodine and formaldehyde. Chlorine dioxide are used for cleaning the water column of V. harveyi. 40 ppm copper prevent the growth of *V.harveyi*,decreasing luminescence.

★ Preventive measures

Vibrio species get accumulated in water and in the biofilms that may be formed at the contacts surface of different structures at hatcheries and farms, resulting in damaging quality of water. Hence cleaning of hatchery, structure to be used and exchanging water at regular interval should be done. Regular monitoring of the shrimp should be done to cure injury. Feed should be checked while supplying. Keep the stressed ones separate for monitoring.

2. Brown Spot Shell Disease

Brown spot disease are caused by Vibrio species and pseudomonas species, mostly in freshwater prawn and Penaeus speciesspecies cultured in India.

★ Symptoms observed

Brown to black spots and eroded area appears on the body surface and appendages of the infected shrimp. Exoskeleton appear eroded with stooped posture.Inflammation along with necrosis can also be observed.

★ Treatment for White spot shell disease

For cure the infected shrimp Tetramycin is Incorporated with the feed @ 0.45 mg per kg of feed and it is given for two weeks.Addition to this bath treatment with 0.05-1 mg malachite green per litre of water is also found beneficial.

★ Preventive measures

Regularly exchange of water at proper interval and cleaning the filter and tank properly helps in in preventing this disease.Moreover avoiding overcrowding by removing the infected prawn prevents the mass mortality.Flake food should be supplied with within one month of opening. Equipments like net should be used after disinfecting.

Viral Diseases

1. Yellow Head Disease

Yellow head disease is caused by single ssr RNA,rod-shaped,enveloped Yellow head virus. This disease has reduced the shrimp consumption widely.

★ Symptoms observed

Infected post larvae and Juvenile shrimp seems to have pale body,swollen cephalothorax, yellowish gills and hepato-pancreas. Many of them appear to swim slowly near the surface of the dyke and stay motionless afterwards.Within 3 to 5 days from the onset of disease 100% of the population face mortality.

★ Treatment for Yellow Head Disease

There is no treatment for Yellow head disease is yet available.

★ Preventive measures

The most effective preventive measures for this virulent disease is the appreciate selection off post larvae. Time to time monitoring and avoiding horizontal transmission has to be practiced. Pond and equipment has to be disinfected with 30 ppm chlorine solution. The water quality should be well managed and the feed has to be well checked.

2. _White spot Disease

It is caused by white spot syndrome virus that is a baculovirus like agent. It is also and enveloped rod to elliptical shaped virus.The susceptible species of this disease is on growing shrimp juvenile from 1 to 3 months old mostly.

★ Symptoms observed

The infected juvenile appears to have broken antenna and white spot ranging upto to 1 mm in size in the cuticle. Red discoloration may also be seen. Guts seem empty and swelling in lymphoid organ and fouling of the cuticular epibiont are observed. The infected juveniles aggregate motionless at the dyke.80-100% of mortality can be observed within 2 to 7 days.

★ Treatment for White spot Disease

No treatment for this disease is yet found.

★ Preventive measures

The best preventive measure for white spot disease is the avoidance of infection by white spot syndrome virus. Also keep the culture environmemt contamination free.

3. Monodon Baculovirus Disease

The disease originating in Taiwan has been distributed worldwide and along the Indo Pacific coast of Asia is caused by enveloped, rod-shaped,double stranded DNA Monodon-type baculovirus in *Penaeus monodon*.It is observed at all life stages including post larval and young juveniles.

★ Symptoms observed

The shrimp faces anorexia and appears to be lethargic. The growth rate is retarded and the shrimp losses its appetite and has dark coloration infected shrimp have fouling of appendages and gills. Due to many other secondary infection the epithelial cell of hepatopancreas are damaged and lost.

★ Treatment for MBV disease

There has been no particular treatment so far available for this disease.

★ Preventive measures

Proper management and monitoring can help in controlling this disease. Although the best preventive method for this disease is the screening of the post larvae of monodon before stocking it into the pond.

4. Hepato Pancreatic Parvo Virus Disease

Around 7 penaeid shrimp species like *P.japonicus, P.esculentus* get this infection by hepatopancreatic Parvo-like virus.

★ Symptoms observed

The major symptom is the the retarded growth rate in penaeid juveniles. The abdominal musculature seems to become opaque. Due to many other secondary infections the hepato-pancreas become whitish and atrophied. Body gets discoloured and fauling of gills is seen.

★ Treatment for Disease

No treatment is available for hepatopancreatic Parvo virus disease.

★ Preventive measures

Similar to monodon baculovirus disease in this disease also the best preventive method is the screening of post larvae prior to stocking into the pond for culture.

Conclusion

The imbalance in the relationship of host pathogen and environment leads to disease. In case of all bacterial and viral diseases discussed for shrimp larvae and Juvenile have been the result of poor water quality and unhygienic environment. Bacterial disease has got treatment like potassium permanganate, copper sulphate and immuno-stimulants but for viral disease only preventive measures can be taken to avoid the outbreak of disease.

Reference

Flegel, T.W., (2006). Detection of the major penaeid shrimp viruses in Asia, a historical perspective with emphasis on Thailand. Aquaculture 258, 1-33.

Lightner, D.V., (1996). A hand book of shrimp pathology and diagnostic procedures for diseases of penaeid shrimp. World Aquaculture Society, Baton Rouge, LA, USA, 304.

FAO (2012). Species Fact Sheets-Penaeus monodon (Fabricius, 1798).

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ENERGY FROM URBAN AND INDUSTRIAL WASTES

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A diversity of wastes the human societies produce on earth, *viz.*, liquids, slurries and solids, when considered superfluous by that society become waste.The quantities of the various waste streams depend on a variety of factors, such as cultural patterns, prosperity, technological development, climate, region etc.The quantity of wastes produced in a society particularly depends on its prosperity, and in general it can be stated that the more prosperous the societies are, the more wastes are set free in society. Consequently, the more potential resources are lost. Due to this non-sustainable life-style, and despite all the publicly advocated concern of politicians about the quality of the environment and the needs and interests of coming generations, these societies are faced with enormous amounts of surplus materials.

Waste to Energy Option

Human activity all over the world generates large amounts of waste material. These wastes have serious environmental and ecological consequences and are also potentially harmful to public health. The fact that our surroundings have a limited capacity to absorb these wastes is being realized all over the world. Earnest efforts are on to handle wastes in an efficient and scientific way. While attempts are being made to minimize the generation of wastes and to reuse and recycle them, the energy recovery option is also being pursued as a viable option. Thus, any integrated waste management system which aims at beneficial use of wastes should have the waste to energy option built into it, in order to maximize environmental protection and economic viability. In this context urban and industrial wastes assume significance with their proven potential as sources of energy generation.

The decision of the Government of India in this decade to expose out industries to global competition has compelled many major industries to look into the areas of efficient processes, energy and water conservation, conformation to environmental legislation with regard to waste disposal, air pollution control measures and solid waste disposal.

Conventional Approach for Sewage Disposal

Conventional domestic sewage treatment approach aggravates the problems in the wastewater treatment. Day by day new chemicals are being synthesized and produced commercially. Some of the problems faced in wastewater treatment are: (i) development of suitable micro-organisms to treat many obnoxious synthetic chemicals pertaining to particular industries and related nutrient requirements for the special microbes, (ii) the problem of high total dissolved solids in the wastewater which inhibits bacterial growth and (iii) colour removal in certain types of waste water.

Large quantities of urban, municipal and industrial wastes are generated every day in our country. The studies conducted by the Central Pollution Control Board, New Delhi and Operations Research Group, Vadodara in a few Class-1 cities indicated that the per capita generation of municipal solid waste (MSW) in urban areas is about 0.4kg. per day with a collection efficiency of about 60% and liquid waste of 150 litres per day with a collection efficiency of about 60% and liquid waste of 150 litres per capita per day. Total waste availability for class-I cities has thus been estimated at about 27 million ones of MSW and about 4400 million cubic metre of sewage per annum. In addition, large quantities of wastes are also generated by several industries, such as, sugar mills, distilleries, pulp & paper mills, dairies, slaughterhouses, tanneries, pharmaceutical industries, etc., Unscientific methods of collection and disposal of these wastes have led to increase in pollution an environmental degradation, posing considerable hazard to public health and local as well as global environments.

Recent Developments in Waste Treatment and Disposal

In recent years, several waste-to-energy technologies have been developed and demonstrated, which not only help in reducing the quantity of waste but also generate substantial quantities of energy. Besides recovery of large quantity of energy, these technologies help in reducing the quality of waste and also improving its quantity for meeting the pollution control norms. A potential of generating about 1000 MW of power from urban and municipal wastes and about 700 MW from industrial wastes has been conservatively estimated over a decade ago, which is likely to increase with further economic development.

In our country, where access to safe drinking water is not yet guaranteed to the considerable fractions of the population, it is of great importance to maintain the hygienic quality of surface waters as high as possible: it is likely that all the quantity of surface water will, at least for some time, be used as drinking water. Therefore, it is necessary to eliminate as completely as possible the microorganisms present in sewage that may cause the proliferation of water-borne diseases. Most biological treatment systems are inadequate for the removal of these so-called pathogenic micro-organisms and an extra treatment step in specific unit is normally needed to effect pathogen removable and thus obtain an effluent with an adequate hygienic quality. Different methods, including chemical (disinfections), physic-chemical (ultraviolet irradiation) and physical (sand filtration) have been used. In tropical countries the use of lagoons is an attractive alternative. The effluent of a treatment plant is discharged into shallow ponds, where it remains for a sufficiently long period to obtain significant pathogen removal by natural die-off. The rate in these lagoons, also called maturation ponds, may be accelerated by using the available sunlight to create adverse environmental conditions for the organisms, such as high temperature, a high pH (by photosynthetic carbon dioxide consumption) and direct sunlight radiation.

Once the minimum effluent quality has been specified (particularly the maximum admissible concentrations of solids, organics, nutrients and pathogens which can settle out), the objective of the treatment is to attain reliable the set standards. The role of the design engineer is to develop a process that will guarantee the technical feasibility of the treatment process, taking into consideration other factors such as construction and maintenance costs, the availability of construction materials and equipment, as well as specialized labour.

Primary treatment alone will not produce an effluent with an acceptable residual organic material concentration. Almost invariably biological methods will be used in the treatment system to effect secondary treatment, i.e., the removal of organic material. In biological treatment systems the organic material is metabolized by bacteria. Depending upon the required final effluent quality, tertiary treatment methods and / or pathogen removal may also be included.

In practice, the overwhelming majority of waste – water treatment plants use aerobic metabolism for the removal of organic material. The most familiar aerobic processes are the activated sludge process, the oxidation ditch, the trickling filter and aerated lagoons. Stabilization ponds use both the aerobic and the anaerobic mechanisms. In recent years there has been a growing interest in anaerobic treatment of wastewaters, including sewage. Several demonstration and full-scale systems, notably of the 'Up flow Anaerobic Sludge Blanket' (UASB) process, have been operated successfully in regions with tropical and subtropical climates and to a lesser extent, in moderate climate.

The Anaerobic Process

During the past decade anaerobic process technology has come to be recognize as a commercially viable treatment technology to deal with high, medium and low strength wastewater incorporating different types of advance reactor systems in place of conventional reactors. The advancement in the understanding of anaerobic microbiology and the engineering to retain the biomass inside the reactors has replaced the normal drawbacks of conventional anaerobic system and thus have resulted in the evolution of high rate anaerobic system e.g. Upflow Anaerobic Sludge Blanket (UASB), Anaerobic Fixed Film Reactor (Upflow& Down flow), Expanded / Fluidized Bed Reactor, Hybrid Reactor System etc. bearing different trade names for commercial application.

The Anaerobic Process for Energy Production

Conventionally, both aerobic as well as anaerobic methods have been employed for biological degradation of complex organic carbon in industrial effluents. However, anaerobic digestion of organic carbon present in these effluents produces a combustible gas, methane, thus allowing waste treatment to be coupled with bioenergy production. This singular feature has made anaerobic system e.g.Upflow Anaerobic Sludge Blanket (UASB), Anaerobic Fixed Film Reactor (Upflow& Downflow), Expanded / Fluidized Bed Reactor, Hybrid Reactor System etc. bearing different trade names for commercial application.

The Anaerobic Process for Energy Production

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In the aerobic process, the organic carbon present in the effluent is used up the mixed aerobic microbial consortium as its carbon and energy source. The complex organics finally get converted to microbial biomass (sludge) and carbon-dioxide.

In the anaerobic process, the complex organics are first broken down to a mixture of volatile fatty acids (VFAs), mostly acetic, propionic and butyric acids. This is achieved by "acidogens", a consortium of hydrolytic and methane by acetogenic (acetogens) and methanogenic (methanogens) bacteria respectively.

Thus, while both aerobic as well as anaerobic degradation routes can equally remove complex organic from the effluents, the anaerobic route has an obvious advantage in that it produces methane, a combustible gas with a reasonably good calorific value (24 MJ/m^3). The production of methane, a renewable energy source, is alone a strong ecological reason for employing anaerobic treatment or "Biomethanation" and preferring it wherever applicable.

Biomethanation requires adequate infrastructure facilities. The first and the foremost among them is the bioreactor in which the treatment is to be carried out. Extremely large volumes of effluents are encountered for treatment. Thus, an optimally designed bioreactor can decrease the treatment time and increase the treatment efficiency, leading to an overall lowering of the treatment cost.

Selection and design of bioreactors are dictated by process kinetics. In biomethanation, kinetics of the acidification reaction (acidogenesis) as well as the methane formation reaction (methanogenesis) are taken into account. Since the average growth rate of the methanogens is much lower than of acidogens, the overall rate of the biomethanation process is therefore controlled by the methanogenic step. It is seen that the rate of biomethanation can be accelerated only by enhancement of the rate of conversion of VFAs to methane.

Conclusion

For the successful implementation of waste management there should be gainful co-ordination among all stake holders including municipal departments, private enterprises, recycling trade and industry, waste collectors, NGOs and resident welfare associations for undertaking the collection, transport and disposal of urban solid waste. At the municipal level, and in the industries a separate department should be responsible for waste management. The hospital wastes should be handled as per the stipulated rules of medical waste management. Appreciating that the existing infrastructure may be appropriate, it is stressed that appropriate funds be provided to enable the provision of facilities, and necessary levels of services, in solid waste management.

Reference

Guiot, S. R., Cimpoia, R., &Carayon, G. (2011). Potential of Wastewater-Treating Anaerobic Granules for Biomethanation of Synthesis Gas. Environmental Science & Technology, 45(5), 2006–2012.

Mouftahi, M.,Tlili, N.,Hidouri, N.,Bartocci, P.,Alrawashdeh, K.A.b., Gul, E.,Liberti, F.&Fantozzi, F. Biomethanation Potential (BMP). (2021). Study of Mesophilic Anaerobic Co-Digestion of Abundant Bio-Wastes in Southern Regions of Tunisia. Processes 2021, 9, 48.

Palaniselvam, V., Kamaraj,A., Ramesh, D.,&Sriramajayam, S. (2020). Experiment on Evaluation of Biomethanation Reactor for Treatment of Sago Industrial Waste Water. *Int.J.Curr.Microbiol.App.Sci.* 9(01): 624-631.

Tabatabaei, M., Sulaiman, A., M., A., Yusof, N., &Najafpour, G. (2011). Influential Parameters on Biomethane Generation in Anaerobic Wastewater Treatment Plants. Alternative Fuel. doi:10.5772/24681

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MICROBIOME INTERACTIONS ON PHYLLOSPHERE: IT'S IMPACT ON PLANT HEALTH

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The Plant Microbiome is the sum of the genomic contributions made by the various microbial communities that inhabit the surface and internal tissues of plant parts. Members of these microbial communities interact with one another and with the plant, and there is growing evidence that the microbial community may promote plant growth and aid in pathogen defence. As a result, it is critical to comprehend the mechanisms that influence the composition and structure of microbes. Plants have evolved a sophisticated innate immune system comprised of membrane-localized receptors (PRRs) and intracellular receptors (NLRs) that detect elicitors and activate immune responses. The plant's innate immunity is stimulated by microbiota, which confers resistance against various pathogens (ISR). Aside from these, the microbiome suppresses pathogens through hyperparasitism, the secretion of antimicrobial compounds, and competition for resources such as nutrients or space, which ultimately reduces pathogen growth. Understanding tritropic interactions even better for the development of plant probiotics and the identification of potential agents for more eco-friendly disease combat.

Joshua Lederberg coined the term "microbiome" to describe an "ecological community of commensal microorganisms, symbionts, or pathogens that literally occupy a space everywhere," and plants' microbiome can be defined as "the sum total of the genomic contribution made by the diverse microbial communities that inhabit the surface and internal tissues of the plant parts" (Fernando et al., 2014). Plants are home to a wide variety of microorganisms. Members of these microbial communities interact with one another and with the plant, and there is growing evidence that the microbial community may promote plant growth, aid in pathogen defence, and even aid in environmental remediation. As a result, it is critical to better understand the mechanisms that influence the composition and structure of microbial communities, as well as the role that the host may play in the recruitment and control of its microbiome in order to combat diseases in a more environmentally friendly manner. Phytobiomes live in various parts of plants, including the Rhizosphere, Endosphere, and Phyllosphere.

1. Rhizosphere Microbiome

The rhizosphere is defined as the soil region influenced by roots. The microbial community that lives in this niche differs from that found in the bulk soil; against pathogens, the plant can defend more specifically with the help of the rhizosphere microbiome. The term'suppressive rhizosphere' refers to a microbial community that has evolved in the rhizosphere and is capable of limiting pathogen development even in the presence of the host plant. *Pseudomonas fluorescens*, *Bradyrhizobium japonicum*, *Rhizobium leguminosarum*, *Bacillus cereus*, *Bacillus amyloliquefaciens*, *Burkholderia cenocepacia* are the most common pathogen-fighting microorganisms found in the rhizosphere.

2. Phyllosphere Microbiome

The plant microbiome is made up of organisms that colonise the phyllosphere, which is the external area of aerial plant tissues. Although this term can refer to any external surface of a plant, it is most commonly used to describe the leaf surface. The phyllosphere's microbial communities play critical roles in plant development processes by protecting plants from invading pathogens and biosynthesizing phytohormones. Fungi (filamentous and yeasts), bacteria, algae, protozoa, and nematodes make up the phyllosphere community. The bacterial community is the most abundant, with between 10^5 and 10^7 cells per cm^2.

3. Endosphere Microbiome

Endophytes are microorganisms (bacteria, fungi, or actinomycetes) that live in plant tissues in a symbiotic relationship. Endophytes can synthesise bioactive compounds that plants use to defend themselves against pathogens. These bioactive compounds include alkaloids, terpenoids, flavonoids, and steroids.

Phytobiome Recruitment

There are numerous potential sources of new microbial strains and species to join phytobiome communities. The importance of each of these routes is likely to shift over the course of a plant's life cycle (Baltrus *et al.*, 2017).

• Vertical transmission from plant to seed • Invasion of seed endosphere by root endophytes and vice versa

• Invasion of the seed endosphere from an environmental source

• Invasion of the roots from an environmental source

• Colonization of the leaves from root associated microbes

• Colonization of the leaves from an environmental source

• Cross-species colonisation

• Insect vectoring

Composition of Plant Microbiome

Plant microbiomes above and below ground are being compared. Microbial communities in the phyllosphere have a low species diversity and a high rate of change. Rhizosphere microbial communities are far more complex than phyllosphere communities, and they are remarkably consistent from sample to sample (Lemanceau *et al*., 2017).

Evolution of Plant and Associated Microbiome

The microbiome in plants evolves through processes such as natural selection, diversification, dispersion, and drift, which result in a functional trait of microorganisms that increases plant fitness against pathogens. Natural selection is the most common mode of evolution among these (Lemanceau *et al*., 2017).

Plant-microbiome Interaction

The plant microbiome refers to the interaction between host plants and the entire microbiome (both pathogen and beneficial microbes). Plant-pathogen interaction causes physiological changes in the plant system, i.e., plant innate immunity in resistance condition; otherwise, the plant becomes diseased. Plant-beneficial microbe interactions result in the development of induced systemic resistance as well as improved plant health via hormonal regulation (Kusari *et al*., 2012).

Plant innate Immunity

Plants are invaded by a variety of pathogens, only a few of which cause disease. Others' attacks are countered by the plants' sophisticated immune system. Microbial-associated molecular-patterns-triggered immunity (MTI) and effector-triggered immunity (ETI) are the two broad categories of the plant immune system (ETI).

Molecular pattern Triggered Immunity (MTI)

MTI is a generalised plant defence that is also known as horizontal resistance. Plants are governed by several genes that code for protein, which becomes receptors known as PRRs. Usually multigenic and contribute to plant immunity in a minor way via PRR signalling or MTI. Hundreds of thousands of MTIevents are happening on the plant surfacethat is similar to innate immunity exhibited by animals. Plant divert its metabolic energy towards this event. Usually this form of immunity is long lasting.

Effector Triggered Immunity (ETI)

Plants are controlled by one or a few genes that code for proteins that become receptors, which are referred to as R-genes. Typically monogenic, they play a significant role in plant immunity via R-gene signalling. On the plant's interior, there are very few R-gene triggered events. This is similar to the adaptive immunity displayed by animals. This event directs the plant's metabolic energy. Usually this form of immunity is short lived and leads to R-gene breakdown.

Effector Triggered Susceptibility (ETS)

MTI suppression is enabled by "specialised molecules," which can be a pathogen or race specific. These molecules are known as pathogen effectors or effectors. The pathogen that is successful is the one that renders MTI ineffective. The primary distinction between microbes and pathogens is that pathogens suppress MTI while microbes do not. MTI cannot be suppressed by a general microbe. The suppression of MTI aids the pathogen's population establishment within the plants. The phenomenon is known as colonisation, and it is also known as tangible "plant disease."

[(MTI– ETS) + ETI] is the ultimate amplitude of disease resistance or susceptibility.

Steps Involved in Molecular Pattern Interaction With Plants

Chemically pure MAMPs/PAMPs (microbe or pathogen associated molecular pattern) can reach all cells and activate their receptors simultaneously when applied to suspension-cultured plant cells or cells in thin segments of plant tissue.

Very Early Responses (1–5 Minutes)

i. Ion fluxes

Alkalinization of the growth medium due to changes in ion fluxes across the plasma membrane is one of the earliest and most easily recordable physiological responses to MAMPs and PAMPs in plant cell cultures, beginning after a lag phase of 0.5–2 min.

These changes include an increase in H+ and Ca2+ influx, as well as a concomitant efflux of K+; an efflux of anions, particularly nitrate, has also been observed. Ion fluxes cause membrane depolarization. MAMPs are known to stimulate Ca2+ influx from the apoplast, resulting in a rapid increase in cytoplasmic Ca2+ concentrations, which may act as a second messenger to promote the opening of other membrane channels or to activate calcium.to promote the opening of other membrane channels or to activate calcium-dependent protein kinases (Pieterse *et al*., 2009).

ii. Oxidative burst

The oxidative burst is another very early response to MAMPs, with a lag phase of 2.0MIN. Reactive oxygen species can act as antibiotic agents directly, as has been demonstrated in macrophages, or they can contribute indirectly to defence by causing cell wall cross-linking; additionally, reactive oxygen species can act as secondary stress signals, inducing a variety of defence responses. Several studies have found that MAMP causes the reactive oxygen species nitric oxide (NO), a well-known second messenger in animals, to be produced..

ISR and SAR responses

Systemically acquired resistance (SAR), induced by the exposure of root or foliar tissues to abiotic or biotic elicitors, is dependent on salicylic acid and associated with the accumulation of pathogenesis-related (PR) proteins. Plants use pattern-recognition receptors to recognize conserved microbial signatures. SAR is a systemic defense network in plants that is triggered by exposing the plant to some virulent, avirulent, and nonpathogenic microbes.

Induced systemic resistance is caused by exposing roots to PGPR, is dependent on ethylene and jasmonic acid, and is not associated with PR protein accumulation.

Rhizobacteria can mediate ISR responses, which have been shown to be effective against necrotrophic pathogens and insect herbivores that are vulnerable to JA/ET defences.

Microbiota-mediated Extension of The Plant Immune System

The stimulation of plant innate immunity by microbiota has been extensively described in order to confer resistance against various microbial leaf pathogens (a phenomenon referred to as priming or induced systemic resistance [ISR]). ISR has been well described in Arabidopsis thaliana, and the mechanisms that control its onset appear to be conserved across organisms. The transcription factor MYB72, in particular, is important in the regulation of ISR triggered by the bacterium Pseudomonas simiae. MYB72 is also involved in the response of A. thaliana to iron deficiency, implying a direct link between nutrient stress and immunity.ISR may occur because plants have evolved to use microbial molecules as developmental signals for the maturation of their immune systems, implying that early contact with microbe-derived molecules is required for plant survival in natural soils (Vannier *et al*., 2019).

Mechanism of Pathogen Control by Beneficial Microbes

1. Competition

The majority of biocontrol agents are rapidly growing and compete with pathogens for space, organic nutrients, and minerals. E.g., Fe has a low water solubility and is a limiting factor for both pathogens and microbes. Plants and microbes both obtain Fe by producing Siderophore, which are Fe binding compounds. Pseudomonas fluorosens, which produces Pseudobactins, aids in the control of the soft rot pathogen.

2. Antagonism

Antagonism mediated by specific or non-specific metabolites of microbialorigin, by lytic agents, enzymes, volatile compounds or other toxic substances is knownas antibiosis.

a. Antibiotics

Antibiotics are organic compounds with low molecular weight that are produced by microbes. Antibiotics are harmful to the growth or metabolic activities of other microorganisms at low concentrations. *Gliocladium virens*, for example, produces gliotoxin, which caused *Rhizoctonia solani* to die on potato tubers. *Trichoderma viride* colonisation of pea seeds resulted in the accumulation of a significant amount of the antibiotic viridin in the seeds

b. Bacteriocins

These are antibiotic-like compounds with bactericidal activity that are closely related to bacteriocin producers. E.g. Crown gall (caused by *Agrobacterium tumefaciens*) is controlled by the related *Agrobacterium radiobacter* strain K 84 through the production of bacteriocin, Agrocin K84.

c. Volatile compounds

Antibiosis mediated by volatile compounds has been produced by *Enterobacter cloacae*. The volatile fraction responsible for inhibition was identified as ammonia.

3. Hyperparasitism

Hyperparasitism is the direct parasitism or lysis and death of a pathogen by another microorganism while the pathogen is in the parasitic phase. *Cladosporium cladosporioides*, for example, on *Puccinia striiformis* f. sp. tritici.

Rational Design of SynComs with Predictable Pathogen Biocontrol Activities

SynComs are small consortia of microorganisms. It will observed function and structure of the microbiome in natural.It may also increase stability through synergistic interactions between their members. This is based on microbial ecology and genetics of predictable traits. The role of each microbial member can be investigated & factors governing community assembly. SynComs could confer more efficient plant protection than individual strains (Vannier *et al*., 2019).

Case Studies

1. The microbiome of the leaf surface of Arabidopsis protects against a fungal pathogen

The study's main goal was to test the hypothesis that phyllosphere microbes, including epiphytes and endophytes, contribute to Arabidopsis thaliana resistance to Botrytis cinerea, with a focus on the cuticle. Three different types of Arabidopsis plants (wild type, Bdg mutant, and Lacs2.3 cuticle mutants) were inoculated with Botrytis cinerea and allowed to develop disease. Based on the severity of the disease, microbes from the phylloshere were collected to identify the microbe involved in controlling botrytis. To determine the role of phyllosphere microbes in A. thaliana resistance to pathogens, leaf washes of three Arabidopsis forms were sprayed on both sterile and non-sterile plants, but leaf washes from cuticle mutant Bdg provided good resistance against pathogen. Resistance of sterile Arabidopsis thaliana Col-0 and cuticle mutants to *Botrytis cinerea* after treatment with microbes extracted from nonsterile plants' phyllospheres. Individual microbial strains extracted from the phyllosphere of the bdg mutant have an effect on Arabidopsis thaliana Col-0 plant resistance to *Botrytis cinerea*.

Summary

The role of the phyllosphere microbiome in plant resistance is investigated in the cuticle mutants bdg (BODYGUARD) or lacs2.3 (LONG CHAIN FATTY ACID SYNTHASE 2) that are highly resistant to the fungus Botrytis cinerea. The presence of microbes on the plant surface contributes to resistance to B. cinerea. When inoculated under sterile conditions, bdg plants became as susceptible as wild-type (WT) plants, while lacs2.3 mutants retained their resistance. Adding washes of its phyllosphere microbiome could restore bdg mutant resistance, whereas lacs2.3 resistance is due to endogenous mechanisms.When WT plants were compared to cuticle mutants, the phyllosphere microbiome showed distinct populations. Pseudomonas spp isolated from the bdg microbiome provided resistance to *B. cinerea* on *Arabidopsis thaliana* as well as apple fruits.

2. Endophytic bacteria enhancing growth and disease resistance of potato (*solanum tuberosum* L.)

The primary goal was to investigate the impact of endophytic strains *Pseudomonas* spp IMBG294 and *Methylobacterium* spp IMBG290 on plant growth and inducible defences.

Potato plants were inoculated with the endophytes *Pseudomonas* sp IMBG294 and *Methylobacterium* spp IMBG290, and three weeks later they were infected with the pathogen *Pectobacterium atrosepticum* to study the development of disease resistance genes and enzymes. Endophytes were tested for their ability to induce disease resistance in potatoes against the soft rot disease caused by *P. atrosepticum*.

Summary

Potato shoot growth is encouraged. *Psuedomonas* sp. improved potato resistance to soft rot disease. The size of the bacterial population used to induce disease resistance by *Methylobacterium* sp. was inversely proportional to the size of the bacterial population used. Some endophytes are capable of activating both basal and inducible plant defence systems.

Conclusion

Plant developmental and evolutionary dynamics are shaped by the phytobiome, which can protect hosts from pathogen infection and produce plant growth hormones. Phytobiome is a low-cost, environmentally friendly tool for managing plant diseases. More research is needed to better understand the tritropic interactions for the development of plant probiotics and the identification of potential agents for more eco-friendly disease combating.

References

Armengol, G., Filella, I., Llusia, J. and Penuelas, J., (2016), Bidirectional interaction between phyllospheric microbiotas and plant volatile emissions. *Trends Plant Sci.,* **21**(10): 854-860.

Baltrus, D. A., McCann, H. C., & Guttman, D. S. (2017). Evolution, genomics and epidemiology of Pseudomonas syringae: challenges in bacterial molecular plant pathology. Molecular plant pathology, 18(1), 152-168.

Fernando, D., Gumiere, T.and Durrer, A., (2014), Exploring interactions of plant microbiomes. *Sci. Agric.*, **71**(6): 528-539.

Jones, P., Garcia, B. J., Furches, A., Tuskan, G. A. and Jacobson, D., (2019), Plant host-associated mechanisms for microbial selection. *Front. Plant Sci.,* **10**: 862-868.

Lemanceau, P., Blouin, M., Muller, D. and Moenne-loccoz, Y., (2017), Let the core microbiota be functional. *Trends Plant Sci.,**22***(7): 583-595.

Kusari, S., Hertweck, C., & Spiteller, M. (2012). Chemical ecology of endophytic fungi: origins of secondary metabolites. Chemistry & biology, 19(7), 792-798.

Pavlo, A., Leonid, O., Natalia, K. and Maria, P. A., (2011), Endophytic bacteria enhancing growth and disease resistance of potato (*Solanum tuberosum* L.). *Biol. Control*, **56**(1): 43-49.

Ritpitakphong, U., Falquet, L., Vimoltust, A., Metraux, J. P. and Lharidon, F., (2016), The microbiome of the leaf surface of Arabidopsis protects against a fungal pathogen. *New Phytol*., **210**(3): 1033-1043.

Vannier, N., Agler, M. and Hacquard, S., (2019), Microbiota-mediated disease resistance in plants. *New Phytol.*, **15**(6): 100-124.

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GEL FEED: AN INNOVATIVE APPROACH FOR ORNAMENTAL FISH

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Gel feed is a viscoelastic substance and many gelled feed products are manufactured around the world. A gel feed is a form of substance intermediate between solid and liquid as well as exhibits mechanical rigidity. Gels are a form of colloid composed of a firm three-dimensional structure enclosing a liquid phase. Gels are produced when a substance changes from a gel (solid) to a sol (liquid). These polymers consist of molecules that are intertwined and interconnected by molecular network cross-links.

Ornamental fish farming is an ancient practice. Colorful and peculiar fish are commonly called "ornamental fishes". These fish kept in the aquarium are used to decorate the house. Recently, they have occupied an important position in commercial trade, especially in earning foreign exchange. In India, *Botia dario*, *Botia rostrata*, *Colissa fasciata*, *Trichogaster labiosa*, and various species of *Nemacheilus botia* and *Schistura papulifera* are considered colorful ornamental fish. The Indian ornamental fish trade is dominated by freshwater fish (90%), of which 98 percent are raised and 2 percent are caught in rivers, lakes, and ponds. The remaining 10% are marine fish of which 98% are caught and 2% are reared. Most ornamental fish breeders in India breed exotic fish and very few breeds of native, marine, and saltwater fish. Goldfish are the most popular among hobbyists, and as a result, goldfish breeding dominates the Indian ornamental fish business.

Indigenous Freshwater Ornamental Fishes

Some of the indigenous freshwater ornamental fishes are as follows. Such as *Botia lohachata, Brachydanio rerio, Chanda nama, Trichogaster chuna, Labeo nandina, puntius conchonius, Puntius sophore, Colisa lalia, Oreichthys cosuatis, Labeo calbasu, Puntius arulius,* *Dawkinsia filamentosa*, *Macrognathus aral*, *Nandus nandus*, *Notopterus notopterus*, *Horabagrus brachysoma*, *Mystus vittatus*, *Botia dario*, and *Botia rostrata*, etc.

Commercially Important Ornamental Fishes

Some of the commercially important freshwater ornamental fishes are as follows. Such as Goldfish, Koi carp, Guppies, Molly, Swordtail, Platy, Barbs, Gourami, Oscar, Bala Shark/Silver Shark, Siamese Fighting Fish, Firemouth Cichlid, Kissing Gourami, Red-tailed Black Shark, Cardinal Tetra, Neon Tetra, Angelfish, Rasbora, Harlequin Fish, Asian Arowana, Discus/Pompadour Fish, Three Spot Gourami, Zebrafish, Marble Molly and Sail Fin Molly, etc

Ingredients for Making Gel Feed

Fresh fish meat - 100 gm, salt - 2%, corn flour - 7%, gelling agent - 2.5%, vitamin-mineral premix - 0.5%, and yeast - 0.5%.

Gel Feed Preparation

The fine/powdered ingredients are thoroughly mixed to form a gel feed. All ingredients are mixed in a mixer for a short period. (i) providing a gelling agent, a source of additional fiber, and water; (ii) a mixture of gelling agent and little-fiber to form a mixture; (iii) by mixing water and a mixture to form a gel feed; (iv) take gel feed in an aluminum foil and sealed with sealing machine; (v) boiling of gel mixture at 40 C for 30 minutes and 90 C for 45 minutes; (vi) cooling the gel feed with ice to form a firm, flexible gel feed; (vii) gel transferring/ kept in deep freezer for one night. Gel feed can be frozen in one or more molds, and/or frozen as a single feed (which can then be rehydrated and used).

Fig: Gel feed

Application of Gel Feed

Gel Feed as a Drug Carrier

Fish in aquaculture sometimes require medication/other health treatment. It is known to use gel feed as a carrier of drugs or other additives on the feed according to its holding capacity. Water stable gel feed that efficiently transfers drugs or other additives to aquaculture species, resulting in maximum utilization of the additional drug or additive. Immuno-stimulants, probiotics, and other medications may also be added to the gel.

Gel feed as a Carrier of Carotenoids and Pigments

The use of a liquid carotenoids supplement present like an emulsion in a gel feed has a high bioavailability and results in changes in skin color in animals, especially fish. The performance of such emulsions can exceed that of dry formulations. Liquid carotenoids supplement already added to dry food for vacuum penetration. This allows carotenoids to enter the fat, thereby increasing bioavailability. The liquid gel continues to protect the vitamins, carotenoids, and feed against oxidation after use in the composition of the feed product.

Advantages of Gel Feed

Gel feed can be rapidly prepared and fed as a single moistened piece or compressed to form a block and the block can be cut into pieces of the size and shape that are being fed. It is suitable for ornamental fish species. Alternatively, the gel can be pressed into feeders such as corals for saltwater fish. The gel can also be pressed onto a rope or optional feeder for presentation. This is especially important when feeding fish in captivity. Gel feed can be frozen without loss of its nutritional content, and defrosted gel retains its gel structure and gel properties so that a frozen and defrosted gel is almost indistinguishable from an unfrozen gel. This gel is useful for storing the product. It is water stable for more than one day without degradations in water. High feed acceptance by the ornamental fishes such as Goldfish, *Botia dario*, Puntius species, and other fishes.

Conclusion

A gel feed is a form of substance intermediate between solid and liquid as well as exhibits mechanical rigidity. Gels are a form of colloid composed of a firm three-dimensional structure enclosing a liquid phase. Gel feed can be frozen without loss of its nutritional content, and defrosted gel retains its gel structure and gel properties. The gel can also be pressed into a rope or optional feeder for presentation. This is especially important when feeding fish in captivity. Gel feed is used as a carrier of drugs, carotenoids as well as pigments in ornamental fishes.

Reference

Banerjee, S., & Bhattacharya, S. (2012). Food gels: gelling process and new applications. *Critical reviews in food science and nutrition*, 52(4), 334-346.

Geach, M. (2004). Gel feed. *Patent cooperation treaty*, 1-14.

Swain, S. K., Singh, S. K., Routray, P., & Barik, N. K. (2008). Indigenous ornamental fishes: status, issues, and strategies for propagation and conservation. *e-planet,* 20.

Cheong, L. (1996). Overview of the current international trade in ornamental fish, with special reference to Singapore. *Revue scientifique et technique (International Office of Epizootics)*, 15(2), 445-481.

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ADVANCES IN FEEDING MANAGEMENT OF SMALL RUMINANTS

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Cost of feeding forms the major expenditure in sheep and goat farming. Here we have discussed the recent advances being done by CIRG-Makhdoom and CSWRI-Avikanagar to reduce and economize the scientific feeding of small ruminants. Researches have been done on feeding of Azolla and hydroponics, strategic supplementation of concentrate mixture,anti-methanogenic feed resources, higher bio-mass producing fodder system which would economize the small ruminants feeding. Not only this but modern appliances for goat feeding are also made to reduce feed wastage. CSWRI-Avikanagar have also evaluated the feeding of sheep with nutrigenomics in physical and chemical nutrition, rumen bio-films and its role in therapeutic nutrition have also been studied.

Cost of feeding forms the major expenditure in sheep and goat farming. Since they are pastoral in nature and so the expenditure on feeding the stock will be lower as compare to other livestock species as most of the nutrient demand is being fulfilled by the grazing only but they need supplementation when grazing resource is poor. Here we will discuss the recent advances being done for the small ruminants to increase the productive life of them without compromising the economy of the farmer as goats forms the second largest population of livestock and 3% of total milk yield in India.

Feeding habits of goat is that they are browsers and are more selective while sheep are grazers and less selective in nature. It is advisable to feed goats in hay-racks or hang the feed in bundles from a peg in a wall or from a branch of a tree. Double-sided portable hay-racks are the most suitable and convenient for stall feeding. They prefer mostly leguminous fodder and dislikes maize, sorghum, silage or straw, hay prepared from forest grasses. Common fodders available for goats includes tree leaves (gular, pakar, pipal, mango, neem, ashok etc), shrubs, herbs & climbers (ber, jharbari, karonda, hibiscus, rose etc), vegetable wastes like carrot, raddish, cabbage leaves, spinach etc, cultivated fodders foreg: lucerne, berseem, cowpea, mustard etc

Recent Advances

- ✓ CIRG, Makhdoom: Researches are ongoing for the strategic supplementation of concentrate mixture @ 1.2 % of the body weight for better growth and meat quality of Barbari goats.Identification of anti-methanogenic feed resources for goat production system. They developed higher bio-mass producing fodder system (Guar+ Lobia + Sunhamp) for goats under rain fed conditions and *Morus alba* based cost-effective agro-forestry system for sustainable goat husbandry in semi-arid and rain-fed areas. Modern goat appliances are being made to reduce feed and water wastage. Area specific mineral mixture and cost-effective milk replacers for kids are given.They developed a suitable milk replacer for pre weaning kids. They developed complete pelleted feed, feed blocks and designing of low cost pelleting machine that is being adopted by commercial goat farmers for intensive goat rearing.

- ✓ **Hydroponic maize & barley fodder :** Gebremedhin.W.K., 2015 have found that there is increase in body weight gain, feed conversion efficience and overall profit of the goat farm by feeding hydroponic maize and barley fodder to small ruminants.inferior quality roughages are being supplemented along with green hydroponic fodder. S.P. Dhawale (2017). found that 25 percent replacement of concentrate mixture with hydroponically grown maize fodder is economical for rearing of growing goats.

- ✓ **Azolla feeding:** Chandra *et al*.,2018 found that the Inclusion of 25% azolla in ration of goats proved better as it increased return per day and increase milk production per litre. Azolla contains 25-35% protein, 10-15% minerals, 7-10% aa, bio-active substances & bio-polymers , low in fats & carbohydrates. It Can be easily harvested with a scoop net, or grown in enclosed, floating rings which can be pulled to the edge for easy harvest

- ✓ **CSWRI, Avikanagar:** Use of nutrigenomics in physical and chemical nutrition, rumen bio-films and its role in therapeutic nutrition had been studied by the scientist of CSWRI, Avikanager.Probiotic microorganisms from different wild and domestic animals and birds and rumen microorganisms and biomarkers for micronutrient status in animals will be identified, isolated and characterized. These studies are ongoing to supplement the sheep along with the poor quality roughage.

Conclusion

Use of modern techniques and through strategic feeding supplementation cost of the feeding of ruminants could be economized and may lead to higher output with low input.

References

Prasad, Jagdish. (2016) Goat, sheep and pig production and management. Kalyani publisher, Ludhiana.

Chandrashekhar, D. *et al*., (2011). National seminar on sheep and goat production, Nammakkal. pp: 3-8.

Gebrimedhin, W.K. (2015). Nutritional benefit and economic value of feeding hydroponically grown maize and barley fodder for KonkanKanyal goats**.** *Journal of Agriculture and Veterinary Science.* 8(7). pp: 24-*30.*

Dhawale, S.P. (2017). Effect of replacement of concentrate mixture by maize hydroponic fodder on performance of goat. MAFSU, Nagpur