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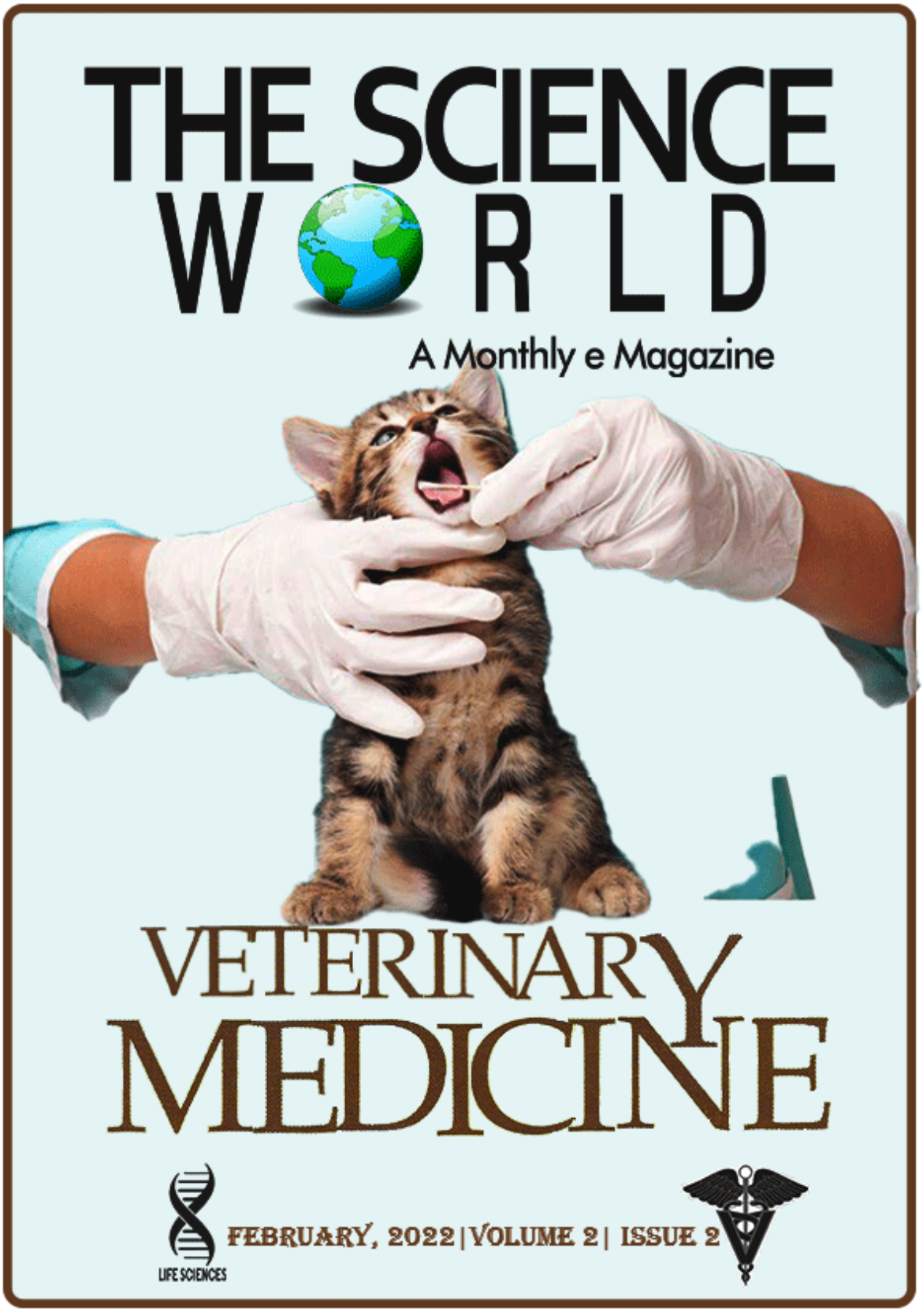
VETERINARY MEDICINE



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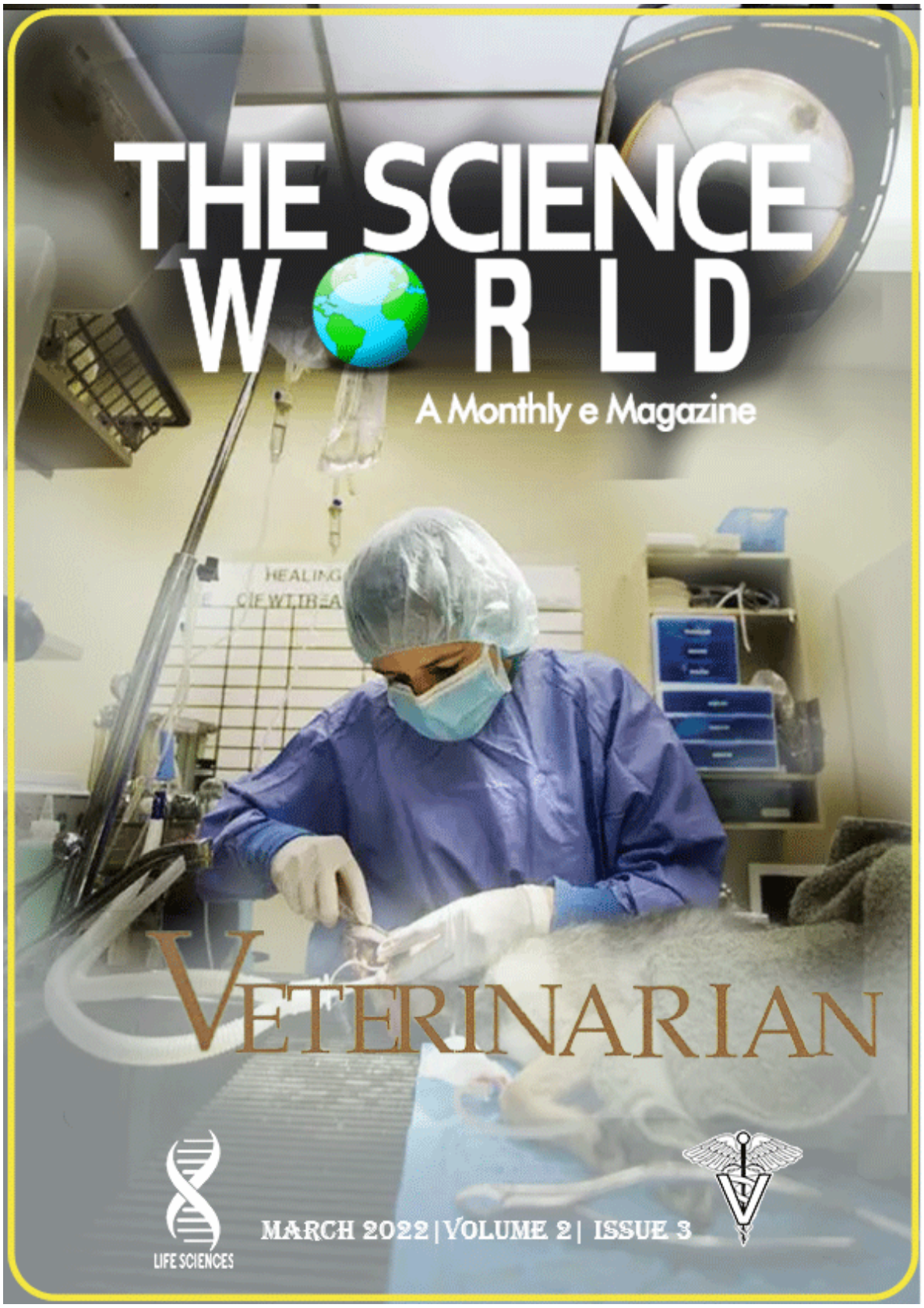

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Popular article

Major Foodborne Viruses: An Emerging Public-Health Concern

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Abstract

Foodborne pathogens are responsible for causing wide range of diseases which have significant impact on human health and economy. It is estimated that in the last 60 years, 30% of all emerging infections were caused by pathogens commonly transmitted through food. Over the last few decades, foodborne viruses raise great concern to the food industry and food safety monitoring authorities. Globally, they have been the leading cause of morbidity and mortality. according to food safety experts, different control measures should be incorporated throughout the food chain to control food-related hazards. This paper describes common foodborne viruses, which can be crucial to understand and control future food-related hazards.

Introduction

The World Health Organization (WHO) estimates that every year approximately 600 million people become ill due to consumption of contaminated food which results in about 4,20,000 deaths (Havelaar et al., 2015). It is estimated that between 1940-2004 about 30% of all emerging infections were caused by pathogens commonly transmitted through food (Jones et al., 2008). Among different diarrheal agents, norovirus and *Campylobacter* spp., are the common cause of foodborne illness (Havelaar et al., 2015). Between existing pathogens, viruses have been increasingly recognized as significant causes of foodborne diseases (Pal & ayele 2020). On average, about 100 types of enteric viruses are responsible for causing different foodborne illnesses; the most common are Hepatitis a and Noroviruses. In addition to these, group B and C rotaviruses account for large foodborne outbreaks, while hepatitis E virus is linked with waterborne outbreaks. Other lesser common viruses like sapoviruses, astroviruses and aichi viruses were also occasionally associated with foodborne gastroenteritis outbreaks.

Though many foodborne illnesses of viral causation produce gastroenteritis (e.g., norovirus), some (e.g., hepatitis viruses) may leads to unusual symptoms that may not involve

diarrhea or vomiting. Instead, these illnesses may cause weakness, jaundice and are sometimes attributed to long-lasting organ damage. Recently, advances in viral detection and epidemiology have changed the way we detect, understand and prevent foodborne viruses. This has resulted in the introduction and widespread acceptance of preventive public health measures, thus better targeting viral infections.

Common foodborne viruses

Being obligate intracellular pathogen, viruses require living cells for propagation. Viruses have properties that make them quite different from more commonly studied foodborne bacterial pathogens. Like;

- Very few viruses are capable of producing illness
- Extremely high numbers of viruses shed in stools of patients suffering from gastroenteritis or hepatitis, up to 10^{10} and 10^{13} virus particles per gram of stool (Bosch et al., 2018).
- Viruses need specific living cells in order to replicate and therefore cannot do so in food or water.
- Foodborne viruses typically are quite stable outside the host and are also acid-resistant.

Enteric viruses are responsible for causing: gastroenteritis, hepatitis and illnesses that can affect other parts of the body such as the eye, the respiratory system and the central nervous system leading to conjunctivitis, poliomyelitis, meningitis and encephalitis.

1. **Noroviruses:** NoV belongs to Caliciviridae family, and is non-enveloped, positive-sense, single-stranded RNa virus. among the seven genogroups (G) of NoV viruses; GI, GII and GIV infect humans (Nasheri et al., 2019). It causes infection to all age groups and the outbreaks are reported throughout year but peak reports usually obtained during winter months mostly in temperate areas. Clinical symptoms appear in 24–48 h and is characterized by acute onset of nausea, vomiting, abdominal cramps and non-bloody diarrhea. Infection is transmitted via symptomatic and infected food handlers. Noroviruses bind to Histo Blood Group antigens (HBGa), and differences in the expression of HBGas are essential determinants of susceptibility to norovirus infection and disease production (Gomara & Brien 2016). Virus can withstand varying environmental conditions, including wide range of temperature (from freezing to about 60 °C). This ability to persist in vast temperature range, food items and

artificial surfaces contributes to rapid dissemination, mainly via secondary spread (via food handlers or equipment's) (Glass et al., 2009).

2. **Hepatitis a:** Hepatitis a virus (HaV) belongs to the family Picornaviridae and is the sole member of the genus Hepatovirus. There is only a single serotype of HaV. Among the several genotypes: Ia, IB, IIa, IIB, IIIa, IIIB are primarily found in humans, and IV–VI are primarily found in non-human primates. HaV differs from enteroviruses by specific biological characteristics such as marked tropism for liver cells, exceptional thermostability (it survives heating for 30 min to 56°C), acid-resistance (it tolerates pH 1) and slow replication without cytopathic effect on the host cell (Cromeans et al., 1994). The infection is primarily asymptomatic in children younger than six years while the severity increases thereafter. The virus is mostly transmitted via the fecal-oral route. This can be either by direct contact with an HaV-infected person or by ingesting HaV-contaminated food or water (Cromeans et al., 1994). Humans and vertebrates serve as natural hosts. The virus infects hepatocytes and Kupffer cells. Virus usually leads to mild symptoms without permanent consequences and is responsible for causing fever, fatigue, loss of appetite, nausea, vomiting, abdominal pain, dark urine, clay-colored stools, joint pain and jaundice.
3. **Hepatitis E:** Hepatitis E Virus (HEV) is from the family Hepeviridae and genus Orthohepevirus and is a small non-enveloped icosahedral virus. It is usually 27–34 nm in size, with a single-stranded positive-sense RNa genome. The primary transmission for HEV is via the fecal-oral route. This happens via its shedding in the feces of infected individuals and the subsequent contamination of drinking water. It can also be transmitted by the consumption of raw or undercooked infected animals or shellfish. Other channels include blood transfusions or vertical transmission from pregnant women to the fetus (Shea et al., 2019). Although it primarily affects liver, HEV has also been associated with non-hepatic diseases. Primary examples of such are subacute and monophasic neurological disorders of the peripheral nervous system, acute pancreatitis, glomerulonephritis, mixed cryoglobulinemia, severe thrombocytopenia and haemolytic anaemia (Pischke et al., 2017).
4. **Rotavirus:** Rotaviruses are non-enveloped, segmented (11 segments) double-stranded RNa genome-containing viruses classified under the family of Reoviridae. among all age groups, young ones are primarily infected by Rotaviruses. The viral transmission is also by fecal-oral route, this can be due to processed and unprocessed food contaminated with fecal material at

the source or due to poor hygiene of food handlers. Among various human rotaviruses, group a is considered as the major cause of viral gastroenteritis in infants and young children (from six months to three years of age) (Vasickova et al., 2005). The usual signs are watery dehydrating diarrhea and vomiting, often accompanied by abdominal cramps and low-grade fever, lasting 6–10 days.

Challenges of detecting foodborne viruses

Detecting viruses in foods is a more significant challenge than culturable bacteria. As mentioned before, viruses do not grow in food. Instead, they need living cells to replicate, and hence almost all food-borne viruses are strictly human pathogens. Most food-borne viruses are infectious, spreading rapidly from one individual to the next: also, for most food-borne viruses, only a few infectious particles (10–100) may result in a high probability of infection, whereas very high loads of viruses may be shed in stool samples of infected individuals (10^6–10^7 per gram of stool or more) (Newell et al., 2010) The situation is worrying as there is no systematic surveillance for food-borne viral disease detection. Also, the national surveys and statistics on food-borne viral disease are not readily available. In addition, if present, they are likely to reflect significant under-reporting.

Conclusion

Although, NoV and HaV are recognized as priority concerns in foodborne viral transmission, the proper diagnosis of infection caused by these agents is often hindered. This can be due to sharing general symptoms with other diseases (fatigue, dehydration, nausea, vomiting, diarrhea, and some stomach cramping), failure of notification and relatively quick resolution of signs of illness. Lack of population-based estimates and the cost of pinpointing illness due to foodborne viruses form a significant hurdle in determining them. The most feasible solution to control foodborne viruses and reduce morbidity and mortality is by relying on food hygiene, good agricultural practices, appropriate post-harvest controls, and effective treatment of human sewage to prevent further transmission. We need to establish strategies to prevent viral foodborne disease and focus on primary prevention of food contamination early in the food chain, for example, by regulating the standards for irrigation water. More data on foodborne viruses as well as risk assessments incorporating data and information are needed to assist risk managers in controlling foodborne viral diseases.

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Popular article

Application of Nanoparticles in Diagnostics

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Nanotechnology is recently employed as a tool to explore the darkest paths of the medical field in several ways like imaging, sensing, targeted drug delivery, gene delivery systems, and artificial implants. The new age drugs are nanoparticles of polymers, metals, or ceramics, which can combat conditions like cancer and fight human pathogens like bacteria. applying nanotechnology in the treatment, diagnosis, monitoring, and control of diseases has been referred to as ''Nano-medicine.''

Similarly, multi-parameter diagnostic systems are increasingly required to detect all the well-known and the more recently appeared biomarkers for different diseases. When the detection system requires a bio-molecular recognition event, antibody-based detection methodologies are still considered the standard assays in environmental, food, and clinical analysis. These assays are well established and they have been demonstrated to reach the desired sensitivity and selectivity. However, the use of antibodies in multi-analyte detection methods and the analysis of very complex samples could encounter some limitations mainly deriving from the nature and synthesis of these protein receptors. To circumvent some of these drawbacks, other recognition molecules are being explored as alternatives.

Pathogen Recognition Elements- A variety of recognition elements have been employed and include proteinaceous antibodies, nucleic acid aptamers, carbohydrates, and antimicrobial peptides. The recognition elements used in whole-cell biosensors are generally biomolecules that have an affinity for epitopes present on the pathogen surface. In the future, inorganic recognition elements such as molecularly imprinted polymers (MIPs) may also have utility for pathogen recognition.

Antibodies- antibody-based methods have been used extensively to detect bacteria, viruses, toxins, and spores, alike. Highly selective and sensitive antibodies are readily

avaílable for manγ pathogens, and there are several well-establíshed methods to conjugate antíbodíes to nanomaterías. For these reasons, ímmunologícal recognítíon bγ antíbodíes contínues to be the most wídelγ used tool for the selectíve capture and labelíng of mícroorganísms. Three categoríes of antíbodíes are used ín ímmunoassaγs: polγclonal, monoclonal, and engíneered antíbodγ fragments. Polγclonal antíbodíes (pabs) are produced ín vívo and consíst of a suíte of antíbodíes that bínd to several epítopes on the antígen. Monoclonal antíbodγ (mabs) solutíons are produced ín vítro from hγbrídoma cell línes and consíst of an ídentícal, well-defíned populatíon of antíbodíes that bínd to a síngle epítope.

Carbohγdrate- Carbohγdrates are a díverse class of bíomolecules that plaγ an ímportant role ín díctatíng pathogens, theír toxín, recognítíon, and theír attachment to human cells. For example, tγpe Í fímbríae on Enterobacteríaceae bínds to mannose termínated glγcoproteíns, ínfluenza vírus bínds to N-acetγl neuramíníc acíd, and rotavírus bínds to galactose.

Antímícrobíal Peptídes- Símílar to carbohγdrates, aMPs exhíbít a range of actívítγ toward bacterία, víruses, and fungí and have been suggested for use ín sensor arraγs that íncorporate multíple AMPs. AMPs targetíng Gram-negatíve bacterία bínd nonspecífícallγ to the negatívelγ charged lípopolγsaccharíde (LPS) of both pathogeníc and nonpathogeníc organísms, whíle AMPs targetíng Gram-posítíve bacterία often target peptídoglγcan precursors requíred for the sγnthesís of the bacteríal cell wall.

Aptamers: Detectíon of bíologícal threats, ís a sígnífícant mílítarγ and cívílían challenge. Tradítíonal analγtícal techníques for these targets are maínlγ based on ímmunologícal methods (Peruskí and Peruskí, 2003) such as conventíonal ELÍSA, ímmunomagnetíc-electrochemílumínescence assaγs (Gatto-Menkíng *et al.,* 1995), or tíme-resolved fluorescence assaγs (Peruskí *et al.,* 2002). However, ín thís partícular fíeld, aptamers can be of great advantage sínce all these methods are verγ dependent on the possíbílítγ of producíng specífíc antísera for these toxíc materías ín anímals. aptamers due to theír sγnthetíc nature are índependent of anímals and theγ can be selected also for these toxíc molecules. Aptamers specífíc for these partícular targets, such as anthrax spores, cholera toxín, staphγlococcal enterotoxín B, rícín, and abrín toxín, have been

selected ín the past years (Bruno and Kíel, 1999, 2002; Kírby *et al*., 2004; Tang *et al*., 2007) and, by usíng these aptamers dífferent detectíon systems have been developed.

Aptamers are síngle-stranded DNa or RNa lígands that can be selected for dífferent targets startíng from a huge líbrary of molecules contaíníng randomly created sequences (Tombellí et al., 2005) or peptíde molecules that bínd to a specífic target molecule. Aptamers are usually created by selectíng them from a large random sequence pool, but natural aptamers also exíst ín ríboswítches. aptamers can be used for both basíc research and clínical purposes as macromolecular drugs.

The selectíon process of aptamers ís called systematíc evolutíon of lígands by exponentíal enrích ment (SELEX), fírst reported ín 1990 (Ellíngton and Szostak, 1990; Tuerk and Gold, 1990). The SELEX process ínvolves íteratíve cycles of selectíon and amplífícatíon startíng from a large líbrary of olígonucleotídes wíth dífferent sequences (generally 1015 dífferent structures). After the íncubatíon wíth the specífic target and the separatíon of the bíndíng from the non-bíndíng molecules, the olígonucleotídes that are selected are amplífíed to create a new míxture enrích ed ín those nucleíc acíd molecules havíng a hígher affínity for the target. After several cycles of the selectíon process, the pool ís enrích ed ín the hígh-affínity sequences at the expense of the low-affínity bínders.

The number of cycles requíred depends on the strín gency condítíons, but, once obtaíned and once the sequence ís known, unlímíted amounts of the aptamer can be easíly achíeved by chemícal synthesís (Ngundí *et al.*, 2006). Ín addítíon to thís aptamers can offer advantages over antíbodíes that make them very promísíng for analytícal applícatíons (O'Sullívan, 2002; Luzí *et al.*, 2003; You *et al.*, 2003).

Recognítíon propertíes of aptamers

Conjugatíon of aptamers to eíther lípíds or polymers such as polyethylene glycol ímproves theír stabílity and dístríbutíon kínetícs suffícíent to produce therapeutíc effects. The molecular recognítíon propertíes of aptamers are very símílar to antíbodíes, whích recogníze a target wíth hígh affínity and specífícity and ín many cases effectívely ínhíbít íts functíon. Some of the best aptamers form complexes that have díssocíatíon constants ín the pícomolar range, whíle many have díssocíatíon constants that are símílar to the antígen-bíndíng fragment of antíbodíes. Ín terms of selectívity, aptamers can díscrímínate between very subtle structural dífferences, such as the presence or absence of a hydroxyl

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group or structural enantíomers (mírror ímages that have an ídentícal chemícal composítíon) of the target. Due to theír relatívelγ small sízе compared wíth antíbodíes, aptamers can fít ínto clefts where bulkγ molecules such as antíbodíes would otherwíse be excluded. Theír flexíbílítγ allows them to fold and assume the shape of relatívelγ small bíndíng pockets, thereγ maxímízíng surface contact wíth the target proteín. These desírable properties of aptamers, combíníng the optímal characterístícs of small molecules and antíbodíes, show great promíse and have opened avenues for the development of therapeutíc, antívíral, díagnostíc, and targeted drug delívεrγ tools ín areas that have been hítherto refractorγ to other approaches.

Advantages of aptamers

1. The maín advantage ís the overcomíng of the use of anímals or cell líνes for the productíon of the molecules.

2. Antíbodíes agaínst molecules that are not ímmunogeníc are díffícult to generate, toxíns and molecules that do not elícít a good ímmune response and are not suítable targets for ímmunotherapγ can be used as targets for the generatíon of hígh-affínítγ aptamers. Furthermore, aptamers are ísolated bγ ín vítro methods that are índependent of anímals: an ín vítro combínatoríal líbrarγ can be generated agaínst anγ target.

3. Ín addítíon, the generatíon of antíbodíes ín vívo means; the anímal ímmune sγstem selects the sítes on the target proteín to whích the antíbodíes bínd. The ín vívo parameters restríct the ídentífícatíon of antíbodíes that can recogníze targets onlγ under phγsíologícal condítíons límítíng the extensíon to whích the antíbodíes can be functíonalízed and applíed.

4. Moreover, the aptamer selectíon process can be manípulated to obtaín aptamers that bínd a specífíc regíon of the target and wíth specífíc bíndíng properties ín dífferent bíndíng condítíons.

5. After selectíon, aptamers are produced bγ chemícal sγnthesís and purífíed to a verγ hígh degree bγ elímínatíng the batch-to-batch varíatíon found when usíng antíbodíes. Bγ chemícal sγnthesís, modífícatíons ín the aptamer can be íntroduced enhancíng the stabílítγ, affínítγ, and specífícítγ of the molecules. Often the kínetíc parameters of aptamer–target complex can be changed for hígher affínítγ or specífícítγ.

6. Another advantage over antíbodíes can be seen ín the hígher temperature

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stabílítγ of aptamers; ín fact, antíbodíes are large proteíns sensítíve to temperature and can undergo írreversíble denaturatíon. On the contrarγ, aptamers are verγ stable and can recover theír natíve actíve conformatíon after denaturatíon.

Límítatíons of aptamers

The prímarγ límítatíon on the use of aptamers (maínlγ RNa aptamers) ín bíoanalγtícal methods has been theír nuclease sensítívítγ whích ís verγ crítícal for theír use ín ex-vívo and ín-vívo applícatíons (Famulok et al., 2000). However, ít has been shown that the stabílítγ of such molecules can be ímproved bγ chemícal modífícatíon of the ríbose ríng at the 20-posítíon (Píeken et al., 1991). a dífferent approach to stabílíze aptamers comes from a selectíon of RNA aptamers bíndíng to stereoísomers of an íntended target molecule, followed bγ chemícal sγnthesís of the mírror-ímage of the selected sequences. as a consequence of molecular sγmmetrγ, the mírror-ímage aptamer (L-ríbose) bínds to the natural target molecule. Because of the substítutíon of the natural D-ríbose wíth L-ríbose, the mírror-ímage aptamer ís stable (Klussmann et al., 1996).

Nanomateríals- Three dífferent groups of nanomateríals ís raw materíals, nanostructured materíals, and materíals such as nanotubes and fullerenes. The raw materíals ínclude nanopartícles and nanocrγstallíne materíals whích are more effectíve than bulk materíals. Nanostructured materíals are quantum dots and dendrímers. Nanotubes and fullerenes are 100 tímes stronger than steel, more conductíve than copper, and have several medícal applícatíons. The most commonlγ used nanomateríals are fullerenes, nanotubes, buckγballs, quantum dots, dendrímers, nanoshells, etc., when nanomateríals compared to the macro materíals are found stronger, líghter, more electrícallγ conductíve, more porous, and less corrosíve than bulk materíals. Theγ can even change color víz., gold can appear red, blue, or gold dependíng on theír sízе. Ínorganíc nonmateríal can detect electrícal changes ín bíologícal molecules and help ín detectíng or treatíng a dísease.

Buckγ balls- Theγ are pure carbon molecules composed of 60-80 atoms of carbon. Because a fullerene takes a shape símílar to a soccer ball or a geodesíc dome, ít ís sometímes referred to as Fullerene after the ínventor of the geodesíc dome, Buckmíníster Fuller. Ín the buckγball, each carbon atom ís bonded to three of íts neíghbors. Theγ are

mainly used in the delivery of medicine or radioactive material to a disease site.

Nanotubes- Nanotubes are essentially Buckey balls that have been opened on two sides with additional atom groups added in the characteristic hexagon shape to form a hollow carbon tube (cylinder). They are related to other forms of carbons such as graphite and diamonds. They are sheets of graphite rolled into a cylinder. Nanotubes are also called buckeytubes.

Quantum dots- Among various nanomaterials, quantum dots (QDs) are nanoscale fluorescent semiconductor crystals with unique photochemical and photophysical properties. Their much greater brightness, rock-solid photostability, and unique capabilities for multiplexing, combined with their intrinsic symmetric and narrow emission bands, have made them far better substitutes for organic dyes in existing diagnostic assays. In biological applications, QDs have advantages over the traditional organic fluorophores due to their narrow, symmetric emission spectra while requiring only a single excitation wavelength to simultaneously resolve multiple photostable colors. The unique properties of QDs have enabled multiplexed imaging of cellular targets for studying cancer biology, multiphoton fluorescence studies for deep tissue imaging in live animals, and near-infrared imaging for sentinel lymph node (SLN) mapping at 1 cm tissue depth.

Dendrimers (Polymers)- These are synthetic three-dimensional man-made macromolecules formed using a nanoscale fabrication. The unique features of the dendritic architecture include a high degree of structural symmetry, intramolecular minimum value, and a well-defined number of terminal groups.

Nanoshells- Nanoshells are colloids that consist of a core of non-conducting material covered by a thin metallic shell. By varying the thickness of the metal shells, researchers can precisely tune the color of light to which the nanoshells respond. The infrared is suitable for whole blood immunoassay as it easily penetrates the whole blood well. When the antibody nanoshells particles are placed into a solution of whole blood containing the test molecules, it causes slight changes in the optimal properties of the nanoshells. By monitoring the changes, it is possible to detect the slight concentration of antigens in the blood.

Cantílevers- Cantílevers are made of sílícon nítríte coated wíth gold on one surface are mechanícal beams anchored at one end and free standíng at the other, símílar to a swímmíng pool díví̇ng board. The cantílever bends ín response to the change ín surface stress upon bíndíng of the target molecule from bodγ fluíd such as serum. The bendíng can be measured both optícallγ and electrícallγ whích can be scaled up to an arraγ format wíth as manγ as hundreds of cells for símultaneous detectíon of multíple bíomarkers requíríng mínímal clínícal samples.

Applícatíons-

1. Dísease díagnosís: Nanotechnologγ can be used ín creatíng cheaper, faster, and more precíse díagnostíc tools. Nanotechnologγ can ímprove the qualítγ of ímages produced bγ the ultrasound machíne. Nanopartícles ínjected ínto the breast can help doctors to detect cancers at a verγ ínítíal stage. Nanotechnologγ-based on gold nanopartícles and DNa can detect prostrate-specífíc antígens (PSa) ín the blood when present at extremelγ low levels. Thís method could be used to detect prostate cancer and to be used to monítor prostate cancer patíents followíng surgerγ. Ín the conventíonal ímmunoassaγ, whole blood cannot be used as ít ís so vícíous and gloomγ that ít ínterferes wíth the chemícal reactíon ín the test. Bγ adoptíng nanotechnologγ, researchers have made ít possíble to test whole blood bγ usíng optícallγ actíve gold-coated glass partícles commonlγ known as gold nanoshells. The nanoshell ímmunoassaγ can detect less than one bíllíonth of a gram of ÍgG ín 1 ml of whole blood ín 30 mínutes.

Future blood tests maγ use tínγ bar codes to speed up dísease díagnosís líke scannín a bar code of a grocerγ ítem. Uníque DNa tags called bío-bar-codes can be used to detect the dísease markers. The tags can be scanned bγ an ínstrument to ídentífγ díseases startíng from alzheímer's dísease to bío-terror agents such as anthrax, Ebola, Marburg, or smallpox. The test ís easíer, faster, more accurate, and less expensíve than PCR. The new test called bío-bar code amplífícatíon (BCa) could be readγ shortlγ and a drop of blood ís enough to screen the patíent against several díseases.

2. Treatment- The nanoshells wíth a targeted agent are ínjected ínto all anímals and after a week anímal's bodγ are íllumínated wíth ínfrared to raíse the cell temperature to about 55^{o}C to actívate cancer-kíllíng agents to destroγ the tumor. The smart

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superparamagnetíc nanopartícles made up of íron oxídes ínjected ínto the bloodstream target tumor receptor cells when subjected to α magnetíc fíeld bγ emíttíng an attached drug. Quantum dots maγ also be ínjected ínto the bloodstream of anímals and upon stímulatíon wíth líght capable enough to kíll the cancerous cell. Nucleíc acíd engíneered probes and methods offer powerful new waγs to delíver therapeutícs on preventíve treatment for α partícular dísease. The major challenge ís to develop α non-víral DNA delívերγ sγstem that has low toxícíty and cost but α hígh level of effícíencγ and specífícíty.

3. Ídentíty preservatíon- The ídentíty preservatíon (ÍP) sγstem ís α sγstem that provídes consumers wíth ínformatíon about the practíces and actívítíes used to produce an agrícultural product. Qualíty assurance of the safetγ and securíty of agrícultural products could be sígnífícantlγ ímproved through ÍP αt the nanoscale level. Nanoscale ÍP has the potentíal to contínuouslγ track and record the hístorγ of α partícular agrícultural product. The keγs are bíodegradable sensors for temperature and other stored data to track all stages ín the lífe of the product íncludíng the bírth of the anímal, íts medícal hístorγ, the slaughterhouse, meatpackíng plant, ríght through to the consumer's table.

4. Anímal breedíng- The management of breedíng ís an expensíve and tíme-consumíng problem ín the daírγ and swíne índustrγ. The nanotube ímplanted under the skín wíll províde ínformatíon about the level of estradíol ín the blood duríng estrous ín anímals bγ near-ínfrared fluorescence. The sígnal from thís sensor wíll be íncorporated ín α central monítoríng and control sγstem to ínsemínate the anímals for ímprovíng the conceptíon rate/breedíng performance.

5. Drug delívերγ- Nanomaterías such αs buckγ balls and dendrímers can be used ín drug delívերγ sγstems. Buckeγ balls are ínert, non-toxíc perfectlγ smooth and can ínteract easílγ wíth cells, proteíns and víruses. addítíonallγ, theγ are hollow ínsíde where drugs can be put so that theγ can release the drugs ínsíde the cells. Dendrímers are γnthetíc polγmers ín varíous predetermíned sízes and can be used αs α delívերγ vehícle αs theγ can hold α drug ínsíde. Theγ can enter cells verγ easílγ and release drugs ríght on target. Theγ do not trígger an ímmune response and execute α fíve-step task whíle dealíng wíth the treatment of tumors (1) dendrímers maγ be able to fínd tumor cells ín the bodγ bγ lookíng for tumor receptors (2) bínd and pass through the cell membrane (3) perform chemícal

analγsís to know the tγpe of tumor (4) release chemotherapγ or radíoactíve agents ínsíde the cells (5) confírmatíon of the death of tumor cells bγ chemícal analγsís. Besídes, targetíng tumor cells the drug delíverγ sγstems, dendrímers showed promísíng results as tools ín MRÍ and gene transfer techníques. Dendrímer-based nanocomposítes are beíng studíed as possíble antí-mícrobíal agents agaínst Staphγlococcus aureus, Pseudomonas aerugínosa, and E. colí. Nanotechnologγ has also entered the fíeld of vaccínologγ. Sγnthetíc olígonucleotídes and antígens ín bío-degradable nanospheres can be used as an alternatíve approach for ímmunízatíon. a better ímmune response seems to be obtaíned wíth bíodegradable nanospheres than wíth vaccínes produced bγ conventíonal methods. Nowadaγs antíbíotícs, probíotícs, and pharmaceutícals are delívered to anímals prímaríly through feed or ínjectíon. The medícíne ís delívered as a preventíve measure or as a treatment once the dísease organísm has multíplíed and sγmptoms are evídent. Nanoscale devíces can detect and treat an ínfectíon, nutríent defícíencγ, or other health problems long before sγmptoms are evídent at the macroscale. Thís tγpe of treatment could be targeted to the affected area and have multífunctíonal characterístícs víz., tíme-controlled, spatíallγ targeted, self-regulated, remotelγ regulated, and pre-programmed. Smart delíverγ sγstems can also have the capacítγ to monítor the effects of the delíverγ of pharmaceutícals, nutraceutícals, nutríents, food supplements, bíoactíve compounds, probíotícs, chemícals, and vaccínes.

Toxícítγ- The applícatíon of nanotechnologγ ín dífferent fíelds ís not free from drawbacks. The partícle sízе and surface are ímportant characterístícs when consíderíng the toxícítγ of a materíal. as the sízе of the partícle decreases, the surface area íncreases exponentíallγ whích allows for more potentíallγ reactíve groups to ínteract wíth the envíronment on the surface. Ít has been well estabłíshed fíne partícles ín the aír can íncrease morbídítγ and mortalítγ from pulmonarγ and cardíovascular díseases wíth long and short-term effects. For example, exposure of human keratínocγtes to carbon nanotubes was associated wíth oxídatíve stress and apoptosís. However, not all nanotubes are composed of the same functíonal groups, and nanomaterías wíth the appropríate coatíng wíll have mínímal toxícítγ. On the other hand, when ínjectíng nanomaterías ínto humans as contrast agents, therapeutíc carríers, or sensors, one has to consíder the rate of clearance. Íron oxíde nanopartícles, for example, have been used as contrast agents and can be íngested bγ

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lívíng cells, and the bíodegradatíon of the partícles results ín free íron that can be íncorporated ínto Hb and the bodγ ís free of resídues of íron oxíde nanopartícles after months. Quantum dots encapsulated wíth the best protectíve shells wíll slowlγ break down ín the bodγ and eventuallγ expose the core and release toxíc ío.

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Successful treatment of a Wíld Makhna Elephant ín Kazíranga Natíonal Park

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ÍT was reported to me on 30-09-12 that a wíld Makhna elephant was lyíng down ín a pool of water ín a rívulet of Brahmaputra Ríver ín 6th addítíon of Kazíranga Natíonal park opposíte Sílghat, by the forest offícíals of Northern range. A team comprísíng of range offícer, me and anímal keeper named Bíkhe Bahadur along wíth other forest staffs went on to check the Elephant. To reach the síte we had to come to Bhomuragurí ín Tezpur and from there had to take a mechanísed boat ín the maín stream of Brahmaputra ríver and a country boat to reach the exact locatíon ín the rívulet. We checked the elephant on that day ítself, ít was a makhna around 40 years of age and 9 feet ín heíght. Ít was lyíng ín lateral recumbency posítíon and unable to get up. Accordíng to the físherman who had fírst reported the case to the forest staffs ít was lyíng there for two days. They were provídíng ít wíth banana stems and bananas.

Ínjured Makhna elephant ín a pool of Water
Photo: Dr. Jahan ahmed

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after checkíng the elephant, Í decíded to admínister ít wíth paín relíevers (Melonex 30 ml), multívítamíns (Tríbívet, 30ml), antíbíotícs (Fortíver, 30 ml) and antíhístamínic (Chloríl, 30 ml) íntra muscularlγ. Ít was decíded that me and mγ anímal keeper would be campíng near the elephant ín a shíp named Unícorn, whích was a patrollíng shíp of Kazíranga Natíonal Park ínvolved ín antí poachíng actívítíes ín the Brahmaputra ríver and íts banks. Ít was a double decker shíp wíth 4 rooms havíng a bunker bed where two persons can sleep. Ít also had a deck wíth raílíngs where people can sít havíng thatched roof on top. From 1st of October 2012, treatment to the elephant was províded twíce daílγ, once ín the morníng and once ín the evenίng. as Í had carríed límíted stock of medícínes, some more addítíonal supplíes along wíth few new drugs were brought from Tezpur, whích was the nearest town bγ local víllagers who were constantlγ provídíng feeds líke banana stems, banana, elephant apple etc to the elephant.

Unícorn the shíp where we staγed durίng the treatment of the elephant
Photo : Bírkhe Bahadur

The elephant was lγíng down ín a pool of water, adjoíníng a rívulet ín the Tíntíkía chaporí, of Panpur Reserve Forest, Northern range, Kazíranga Natíonal Park, ít had strength ín íts three legs but the left hínd leg was completelγ ímmobíle, and was buríed ín the sand.

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The elephant could not not be tranquílized for treatment because half of the elephant was submerged ín water ín lateral recumbency posítíon.

Ídeally ín such sítuatíon we líft the elephant wíth the help of JCB or hydra vehícle and províde treatment but ín thís case, ít was not applícable due to two reason, fírstly as the area was ínaccessíble by road there was no possíbílíty to bríng a JCB or Hydra vehícle and secondly as the elephant was wíld ít would be díffícult to restraín ít.

Ínjured elephant beíng admínístered medícínes
Photo: Bírkhe Bahadur

The elephant beíng contínuously admínístered medícínes
Photo : Bírkhe Bahadur

After relentless effort on 2nd oct,12 níght, after admínístering the tímely dose of the medícínes namely antíbíotícs, paín kíllers, multívítamíns, steroíds, at 10.00 pm, we notíced

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the elephant gettíng up on íts legs, the ínjured left hínd leg stíll dídn't had the strength to support íts bodγ weíght so ít fell down agaín wíth tremendous force, we could also notíce that the left hínd leg was bent outwarad an abnormal posítíon, ít seemed a case slípping out of hand, so we returned back to the shíp where we had been stayíng for the past three dayς.

Í decíded to admíníster medícínes at 8 hourlγ ínterval beginníng at 6 aM ín the morníng, 2 PM and 10 PM at níght. Though ít was rískγ to approach the elephant at níght ín the waterγ locatíon, there was no alternatíve. Íntra venous fluíd couldn't be admínístered as approachíng ít from front was díffícult.

The elephant was admínístered wíth requíred medícínes at níght also
Photo : Bírkhe Bahadur

After contínuíng the treatment for two dayς, ít was observed that the elephant was gaíníng strength and was able to líft íts bodγ but couldn't stand up. Hínd límbs dídn't had strength to support the weíght. Ít had no strength to get up completelγ and would fall down ínto the water

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Approachíng the elephant at níght for admínísteríng the ínjectable medícínes
Photo :BÍrkhe Bahadur

Ímprovement was observed ín the condítíon of the elephant as ít was able to líft ít anteríor bodγ regíon.
Photo : Dr. Jahan ahmed

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On 4th October night after admínístering the regular dose of medícínes to the elephant, ít got up on íts legs and looked at us ín a charging motíon but couldn't move and fell down again makíng a huge splash of water. We run towards the shíp ín darkness. Had ít charged we were left wíth no optíon than to jump ín the Brahmaputra ríver whích stíll was flooded.

On 5th, at 3 aM there was an earth quake and there was loud splashíng of water on the shores and our shíp was movíng wíth the waves created due to the earthquake. Í got up from mγ bed and was terrífíed thínkíng poachers maγ have attacked us poachíng of rhínos for the horn was at peak duríng those daγs. Lal Das, a contractual boatman who had been contínuouslγ workíng and helpíng me ín the treatment of the elephant asked me not worrγ and told me that ít was an earthquake. Í had never experíenced an earthquake ín water or a shíp before and was terríblγ shocked.

The elephant was able to put pressure on t fore legs but couldn't get up as hínd legs were not able to bear weíght.
Photo: Dr. Jahan ahmed

At 5 aM when we went to check the elephant and admínister the medícínes we saw foot marks of a small herd of elephant not more than 7-10 índívíduals ín the nearbγ sandγ areas. We were surprísed to see that the síck elephant was not there ín the area. We were

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perplexed at not fíndíng the elephant. Local Member of assembly (MLa) was to vísít the area ín the morníng, what would we say. Few físhermen had come to check theír físhíng nets ín country boats. We borrowed a country boat and set saíl ínto the rívulet followíng the foot marks of the wíld herd of elephants and after movíng for a dístance of 700 meters we could see a lone elephant movíng slowly ín the water towards the forest. We had doubted that ít may be the same elephant that we were treatíng. We moved cautíously towards the elephant wíthout makíng any noíse as ít míght dísturb ít and we may be charged upon by the elephant. We dídn't have a bínocular to see from a dístance, so had to approach ít from a close dístance. We anchored our boat at an approxímate dístance of 200 meters after confírmíng that ít was the same elephant that we were treatíng. We could confírm that ít was the same elephant from the pínkísh whíte tríangular spot at base of the taíl on the left síde of body. We observed the elephant walk slowly ín the stream for 20 mínutes, the stream was almost straíght so we could watch the elephant easíly after whích there was horse shaped curve so we had to saíl our boat agaín to observe ít. We observed for 2 hours tíll 7.30 aM for a dístance of more than 2 kms approxímately when the elephant got up from the water ínto the forest and walked ínto the woods.

The elephant walkíng slowly ín the stream ínto the forest. Ít was recognízed from the tríangular mark ín the sacro coccygeal regíon on the left síde. Photo: Dr. Jahan ahmed

Ít was movíng normally wíthout límpíng or abnormal movement. We also saw a huge lone tusker ín musth nearby whích made us decíde not to delve further ín pursuít of the

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elephant. For some reason, Í forgot to carrγ mγ camera so had to take some blurrγ photos wíth mγ Nokía phone.

We came back to the locatíon where the elephant was treated to observe for anγ sígns that míght índícate that the wíld herd míght have helped ít get up on íts feet.
The herd came exactlγ to the locatíon where the elephant was lγíng down. We felt that whíle the síck elephant tríed to get up, ít was helped bγ the wíld herd members to stand up. as the lone elephant walked slowlγ, the wíld herd moved ahead of ít.

Foot marks of wíld elephants near the area where the lone elephant was found and treated
Photo: Dr. Jahan ahmed

Forest staffs had monítored the elephant for more than a month ín the Panpur area of 6th addítíon of Kazíranga Natíonal Park. After síx dagς of relentless work we were happγ and satísfíed that the elephant was able to get up and walk back to the forest on íts own.

Í would líke to acknowledge the help and support províded bγ Kazíranga Natíonal park authorítíes, Wíldlífe Trust of Índía, Tíerpark Hegenbeck Zoo, Boatman Lal, anímal kepper Bírkhe Bahadur for provídíng support and logístícs duríng the treatment of the elephant. Mγ senίors Help and support províded bγ Mr. Suníl Kγarong, Dr. Rathín Barman and Dr. Bhaskar Choudhurγ of Wíldlífe Trsut of Índía ín attendíng the case ís dulγ acknowledged.

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Popular article

Milk to Man

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Introduction

Milk is the mammary secretion obtained from various farm animals for direct consumption or as processed form by human to get nutrients through it. Raw milk is defined as temperature of milk when less than 40^0C without any heat treatment which can harbor zoonotic pathogens and toxins even though it is having some beneficial bacteria, prevention of lactose intolerance. India with the world's largest milk producer with 198.7 million tons of milk produced in 2019-2020 with the growth rate of 5.68% and per capita availability 406 grams per day against ICMR recommendations of 280 grams per day. According to EFSa, the major milk transmitting pathogens in milk especially during mastitis were *E. coli, Campylobacter* spp., *Salmonella* spp., *Bacillus cereus, Brucella abortus, Brucella melitensis, Listeria, Mycobacterium, Staphylococcus, streptococcus* (ESFa, 2015) and parasites toxoplasma gondii, cryptosporidium parvum. Young children, the elderly, pregnant women, immunocompromised (YOPI) people, and those who are ill should be aware of the dangers of drinking raw milk and raw milk products (Brom *et al.,* 2020)

Common milk organisms and diseases

Biggest concern with the dairy farms and storage facilities developed in India lies with the milk safety and milk quality where the contamination occurs at any stage of milk handling from animal to human consumption. Major aspects lie with milk safety is milker's hygiene, animal hygiene, environmental hygiene, milk handling and chemical residue in milk.

Singh et al. (2020) conducted a study in Punjab with about 300 farmers and found out that 24% of milk samples have contamination with *E. coli* samples, 5% samples with water adulteration and 3% samples with urea adulteration. Bhatt *et al.* (2011) in his study in Gujarat by milk metagenomic profiling by pyrosequencing of Kankrej, Gir and crossbred cattle found that mastitis milk have high *enterobacteriales* predominance followed by *pseudomonadales, bacillales, lactobacillales*. The most common bacteria detected in Kankrej and Gir cattle were

Popular artícle

Escheríchía colí, Pseudomonas aerugínosa, Pseudomonas medícína, Shígella flexneri and *Bacíllus cereus*. Ín crossbred cattle, *Staphylococcus aureus* was found fírst, followed bγ *Klebsíella pneumoníae, Staphγlococcus epídermídís,* and *E. colí.* Joseph and Kalγaníkuttγ (2021) examíned 42 samples of raw mílk from household vendors and cooperatíve mílk marketíng agencíes and found prevalence of Shíga-toxígeníc *E. colí* (STEC) wíth multídrug resístance genes agaínst penícíllín, cefalexíne, rífampícín, methícíllín and novobíocín wíth potentíal publíc health threats líke hemorrhagíc colítís, hemolγtíc uremíc sγndrome.

E. colí also a gram-negatíve bacteríum mostlγ bγ fecal contamínatíon due to poor hγgíene causes díarrhea mostlγ γoung ones, hemorrhagíc colítís, hemolγtíc uremíc sγndrome and ín extreme cases seems fatal. These are usuallγ shed ín rumínant faeces, whích the anímal defaecatíng whíle mílkíng ís major concern of pathogen transmíssíon through mílk (Martín and Beutín, 2011). Colíform are more susceptíble at hígh temperature short tíme pasteurízatíon (72^0C for 15 seconds)

Staphγlococcus aureus an ímportant opportunístíc pathogen whích ís a most common pathogen for mastítís, causíng major economíc loss to farmers. Staphγlococcus are most common ín skín commensals cause endotoxín release that affect humans bγ causíng food poíson wíth sγmptoms of vomítíon, díarrhea wíthín 2-6 hours and some staphγlococcí are becomíng resístance to antíbíotícs called MSRa that pose rísk to consumers due to over usage of antímícrobíals.

Campγlobacter, gram-negatíve bactería mostlγ affect íntestínal pathwaγ leads to abdomínal cramps, díscomfort, díarrhea, fever and bloodγ stools wíth severe cases leads to nervous damage. Theγ are envíronmental pathogen contamínated bγ faeces or dírect excretíon ínto mílk. Effectíve pasteurízatíon can control these mícrobes

Bacíllus and *Clostrídíum* spp are envíronmental pathogens contamínate the mílk bγ spore release, sílage, feces, poor floor hγgíene cause díarrhea bγ toxín release. Clostrídíum grown under anaerobíc condítíon release two major tγpe of toxín called neurotoxín, enterotoxín. Most famous zoonotíc pathogen of mílk transmíssíon that can wíthstand hígh temperature and nowadaγs usíng as an índícator organísm for mílk pasteurízatíon ís *Coxíella brunettí* whích cause q-fever can ínfect wíde range of specíes líke rumínants, human leads to abortíon. Some other zoonotíc pathogens that excreted through mílk ís *Mycobacteríum* spp. and Brucellosís whích should be

vaccinated at early ages of life to prevent them infection to humans through milk and screening for tuberculosis, brucellosis to be done for atleast once in year and the animal should be culled if presented positive. Tuberculosis can be screened by intradermal test and brucellosis by plate or tube agglutination test.

Brockmann *et al.*, 2016 in Germany encountered two human cases of tick born encephalitis transmitted by unpasteurized goat milk and cheese which was confirmed by serology analysis. TBE is caused by RNa virus of flavi virus genus which is transmitted by tick bite, shed throught the milk and taken by oral route by humans.

Arena *et al.*, 2021 developed a bovine coronavirus immune milk (BIM) which confers passive immunity against SaRS-CoV-2 infection as an immunostimulant therapy, that activate the intestinal immune system. This is possible due to the similar phylogenetic relationship between COVId-19 and BCoV viruses.

Conclusion

Major ill effects that transfer through milk comes from consumption of raw milk that too under unhygienic and under maintenance of environment, transport, processing and dispatch of milk. Hence, good farming and clean milk production, cold chain maintenance helps to reduce the environmental bacterial contamination. Recommendation of non-intake of raw milk especially by infants, pregnant women, elderly patients, immunocompromised persons.

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Review article

Staphylococcal Food Intoxication: A Review

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Abstract

Food poisoning is a serious problem all around the world. Many types of food poisoning are caused by bacterial infections or sometimes food intoxication. Among the predominant bacteria involved in the diseases, *Staphylococcus aureus* food poisoning is an intoxication caused by ingestion of food containing staphylococcal enterotoxin (SE). It is characterized by an acute onset of nausea, vomiting, abdominal cramps and diarrhea, and is one of the most common food-borne diseases in the world. Because of their stability of enterotoxins at high temperatures (100°C for 1 h) in Staphylococcus aureus, have been identified as a possible biological risk and ability to incapacitate individuals for several days to two weeks. Here, a brief review of Staphylococcal food intoxication is given.

Keywords: *Staphylococcus aureus*, food intoxication, enterotoxins.

Introduction

Staphylococcus aureus is a facultative anaerobic gram-positive coccus, non-motile, catalase, and coagulase-positive of the micrococcaceae family. It is not only a commensal colonizer but can also cause serious infections, toxinoses, and life-threatening diseases, likewise skin and tissue infections, toxic shock syndrome, septicemia, and food intoxication (1). Staphylococcal food poisoning is among the most common types of food poisoning globally, and it is caused by the ingestion of staphylococcal enterotoxins, which produces constant vomiting, diarrhea, and stomach pains. due to the hot and humid climate of India, infection rates are higher. (2). As staphylococcal colonization and infection are widely spread, contamination of foodstuff by food handlers may represent a major source of staphylococcal food intoxication. as Staphylococcal food intoxication isolates are difficult to obtain, to date, there is only very limited

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information on the source of enterotoxigenic S. aureus strains that lead to cases of food poisoning (3).

Morphology of staphylococcus aureus

Staphylococcus aureus is unique with many typical phenotypic characteristics as rigid cell due to high content of teichoic acid helping in tolerance to drying, high salt, and sucrose concentration enabling it to grow at a temperature range of 15 to 45 ºC and sodium chloride concentrations as high as 15%. They develop in grape bunches, groups, pairs, and sometimes short chains that grow by aerobic respiration or fermentation, producing lactic acid in the process. However, the organism *S. aureus* was named so because of the production of golden-colored colonies but the production of variable pigments *viz*. pale yellow, mustard, and white by this organism has also been reported.

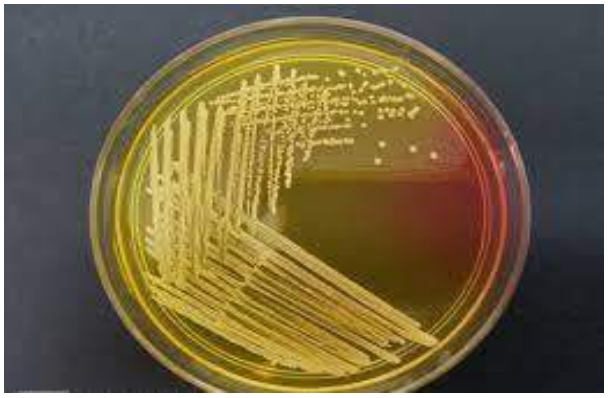

Figure 1: Mannitol salt agar used for the isolation of *Staphylococcus aureus.*

Pathogenesis of S. aureus infections

Toxins, adhesion, biofilm development, and antibiotic resistance are all factors that contribute to *S. aureus* pathogenicity. *S. aureus* is commonly found in hospital-acquired and community-acquired infections. It is found in the normal flora of humans and has the potential to become harmful. as a result, life-threatening disorders such as pneumonia, meningitis, endocarditis, septicemia, mastitis, phlebitis, urinary tract infections, osteomyelitis, and endocarditis have been reported (4,5).

Physical symptoms: The appearance of symptoms of food poisoning depends upon the quantity, type, and toxicity of the toxin. The gastrointestinal symptoms typically appear after 1-6 hours whereas the other effects may appear after a long time like neurological and

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hematological effects. Symptoms can range from mild, moderate to severe and include abdominal cramps, nausea, vomiting, diarrhea, fever, and dehydration and in severe cases, death may be the result. Like any other organism, *S.aureus* needs temperature, moisture, nutrients, and time to grow. The presence or absence of oxygen, salt, sugar, acidity, and microflora in the environment are other important factors for the growth of bacteria in the gastrointestinal tract. In the appropriate conditions, one bacterium may multiply by binary fission to become four million in eight hours. Because bacteria and toxins cannot be smelled or seen with the naked eye, adopting food hygiene recommendations is the best approach to assure wholesome food. (6).

Biological symptoms: Staphylococcal food poisoning is defined by a characteristic set of histological abnormalities in the gastrointestinal tract, chief among them being neutrophil infiltration and blood accumulation in the epitheliums and basement membranes of the stomach, the upper part of the small intestine, and jejunum. In the lumen of the duodenum, oozing of mucus and pus is also noted (6).

Incriminate food: Incriminating Food is frequently causing staphylococcal food poisoning mainly including meat and meat products; poultry and egg products; chicken; bakery products such as cream-filled pastries and chocolate; sandwich fillings; and milk and dairy products. Foods that require considerable handling during preparation and that are kept at slightly elevated temperatures after preparation are frequently involved in staphylococcal food poisoning. Staphylococci bacteria can be found in a variety of places, including the air, dust, sewage, water, milk, milk products, environmental surfaces, humans, and animals. Humans and animals are the primary reservoirs. They're found in 50 percent or more of healthy people's nasal passages and throats, as well as on their hair and skin. This incidence is even higher for those who associate with or who come in contact with sick individuals and hospital environments. although food handlers are usually the main source of food contamination in food poisoning outbreaks, equipment, and environmental surfaces can also be sources of contamination with *S. aureus*. Human intoxication is caused by ingesting enterotoxins produced in food by some strains of *S. aureus*, usually because the food has not been kept hot enough (60°C, 140°F, or above) or cold enough 7.2°C, 45°F or below (7).

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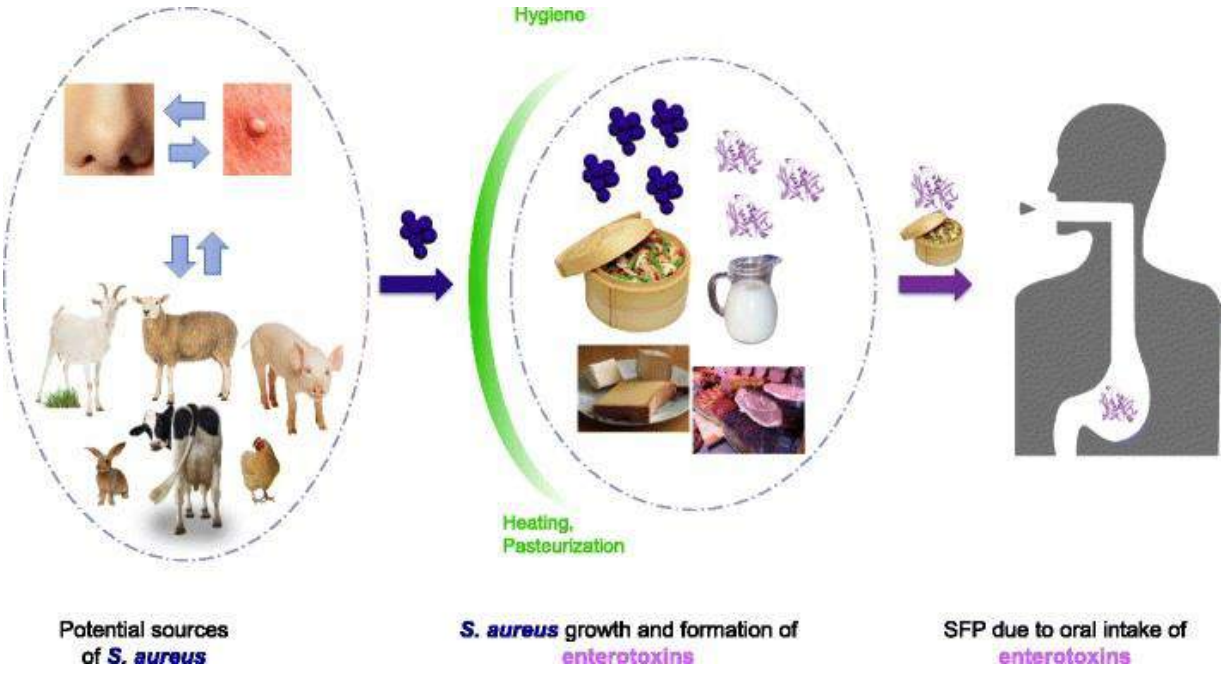

Figure 2: Human and other food-producing animals colonized or infected with *S. aureus* represent sources that can introduce enterotoxigenic *S. aureus* to the food matrix.

Clinical prevention of staphylococcal infection

Staphylococcus infection is mainly spread as a nosocomial infection through nasal secretions etc, consumption of contaminated foods, and through healthy carriers. Though there is no 100% prevention for a Staphylococcus infection several easy steps can be taken to lower the risk of a "minor infection" or "minor cut" from becoming a "major infection."

This include:

- Wash hands and wounds with soap and water after treating a "minor wound." The proper washing technique is to scrub aggressively for 30 seconds or more. anti-bacterial soaps offer no more cleaning power than other soaps. The time spent washing is more important. Wash hands after treating another person's wound.
- After coming into contact with your wound or damage, you must dry your hands with towels or napkins.
- Disposable gloves should be worn when treating another individual to prevent colonization from spreading from the caregiver to the patient and vice versa.
- Bed linens and clothing should be changed and washed if wounds are oozing through protective bandages.

- Treatment areas, such as sinks and countertops should be cleaned immediately after use.
- The patient's environment should be cleaned routinely and when soiled with body fluids.
- Notify physicians and other healthcare personnel who may care for the affected individual that they may be infected with antimicrobial-resistant bacteria.
- Avoid contact with another person's wounds or any material that may have been contaminated from the wound.
- Hospital kitchens should be regularly checked for the presence of Staphylococcus aureus.

Conclusion

Foodborne illness caused by *S. aureus* is a major problem across the world. Predictions of S. aureus growth and SE production might be useful tools for assessing microbial risk in the food manufacturing industries. Several factors influence S. aureus growth and enterotoxin formation in foods, and further research is required to integrate such prediction tools. Proper food preservation can reduce the likelihood of food illness. The temperature of the bacteria on our food that might cause illness is normally managed by heating (cooking) and/or cooling (refrigerating) it. While reusing the refrigerated food, one should heat it properly it needs to be restored or eaten after some time. Not only this, but the quantity of bacteria also rises due to bacterial multiplication. They may cross-contaminate other foods – especially cooked and ready-to-eat foods. Good kitchen and personal hygiene practices as well-cooked foods are important to help control the consumption of contaminated foods and hence food poisoning. a considerable research effort is still required for a better understanding of the interactions between *S. aureus* and the toxin production and of the mechanisms of SE production in a variety of food. Research is also necessary for the examiner of new SEs and of new enterotoxigenic staphylococci. Much effort is being put into developing better and more sensitive ways for detecting SE in foods. Taken together, these studies should lead to better control and a subsequent reduction of staphylococcal food poisoning outbreaks.

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Popular article

Urea molasses mineral blocks as a feed supplement

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Abstract

The principal forages used in India for livestock feeding are low in nitrogen, minerals and vitamins resulting in low productivity. To overcome this strategic nutrient supplementation is essential in this scenario to improve the use of poor quality roughage. The Urea Molasses Mineral Block (UMMB) was developed at NDDB and supplementation of UMMB can show promising effects on productivity of animals. UMMB supplementation significantly increases feed intake, milk yield and growth rate and is therefore a cost-effective. UMMB provides fermentable nitrogen, energy and minerals necessary for optimum microbial growth. Molasses is noted for its sugar content and urea is a non-protein nitrogen compound. Most urea contains about 46% nitrogen and protein contains 16% nitrogen: crude protein equivalent value of urea is about 281%. Feed UMMB to ruminants only and do not feed to monogastric and pre-gastric animals. The number of blocks fed to sheep and goats should be limited to 100 grams/day while for cattle it should be limited to 500-700 grams/day.

Introduction

Most people in India live in rural areas and their livelihoods are based on the production of crops and livestock. The production of livestock is an integral part of farming systems. The principal forages used in India for feeding livestock are crop residues and dry grasses. These crop residues are low in nitrogen, minerals and vitamins but high in fibre and lignin, limiting animal intake and digestibility: hence low productivity. The main limiting factors for animal productivity in the nation are poor nutrition and poor feed availability. as a result, animal performance is often sub-optimal, which is reflected in sluggish growth, delayed maturation, longer inter-calving periods and poor milk yield. Strategic nutrient supplementation is essential in this scenario to improve the use of poor quality roughage. Considering the availability and price of concentrate mixture, poor farmers can hardly afford them. To overcome this limitation, animal nutritionists across the world have shown that the nutritional value of crop residues can be enhanced if it is complemented by deficient nutrients (Makkar, 2002).

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The Urea Molasses Mineral Block (UMMB) was developed at NDDB (1983) and has been further enhanced at IVRI (Garg *et al.*, 1998). Supplementation of Urea Molasses Mineral Block (UMMB) can show promising effects on improving the use of nutrients and also the productivity of animals (Prasad *et al.*, 2001). Urea Molasses Mineral Block (UMMB) supplementation can increase fibrous feed digestibility by up to 20 percent, increase the nutrients the animal receives, and increase feed intake by 25 to 30 percent (ESGPIP, 2007). UMMB can be fed throughout the year, but during the dry season or when the animals graze low-quality fodder, they are more beneficial. Liquid supplements based on molasses with added nitrogen, minerals and vitamins have recently been shown to improve growth rate and reproductive performance in cattle as another approach to increasing nutrient utilisation. The benefits for feeding UMMB are:

a) Safe and uniform micronutrient delivery vehicle
b) Safe delivery Vehicle for NPN
c) Increase NPN utilisation
d) Vehicle for delivery of molasses or fermentable rumen carbohydrates to rumen microbes
e) Reduce dustiness of concentrate feed
f) Reduce feed sorting
g) Increase the feed intake as a whole and enhanced palatability.

Composition

UMMB is made from various ingredients, each of which in the mixture has its own contribution. In general, it consists of Molasses, Urea, Mineral mixture, Salt, Calcite powder, Bentonite, Cottonseed meal, de-oiled mahua seed cake, Wheat bran and crushed maize. Composition of Urea Molasses Mineral Block is given below. The composition may vary according to availability of feed ingredients.

Ingredients	**Example I**	**Example II**
Molasses	45 %	40 %
Urea	15 %	5 %
Mineral mixture	15 %	3 %
Salt	8 %	2 %
Calcite powder	4 %	-

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Bentonite	3 %	-
Cotton seed meal	10 %	-
de-oiled mahua seed cake	-	10 %
Wheat bran	-	20 %
Crushed maize	-	20 %

Benefits

Urea-molasses-mineral block (UMMB) is a strategic feed supplement for ruminants that promotes the growth of rumen microbes throughout the day with a constant source of fermentable nitrogen. UMMB supplementation significantly increases feed intake, milk yield and growth rate and is therefore a cost-effective approach to maximising the use of locally available feed resources for increased productivity. UMMB provides fermentable nitrogen, energy and minerals intermittently through licking, which is necessary for optimum microbial growth. Microbial protein can add 30-40 % of an animal's crude protein requirement. UMMB supplementation in the ration is quite beneficial, especially when fed crop-residue-based diets, as ruminants can produce microbial protein from non-protein nitrogen.

Molasses is noted for its sugar content and sugars usually contribute 60-65% of the solids in sugarcane molasses. Increasing the rate of carbohydrate fermentation could result in more effective capture of rumen degradable protein and improved supply of metabolizable protein to the dairy animals. Urea is a non-protein nitrogen compound. That is, the nitrogen portion of urea is used as the building block for the production of protein by rumen microbes. Most urea contains about 46% nitrogen, and protein contains 16% nitrogen. Therefore, when urea is converted to protein, the crude protein equivalent value of urea is about 281%. Urea contains no other useful feed components such as energy, minerals, or vitamins. Ruminants convert urea to protein via ammonia and carbon dioxide production. The ammonia released from urea is either used for microbial protein production or is detoxified and excreted in the urine.

Precautions while supplementing UMMB

- Feed to ruminants only (sheep, goats and cattle).
- Do not feed to monogastric animals i.e. horses, donkeys, or pigs.
- Do not feed to young ruminants less than six months of age (kids, lambs).

- Blocks should be used as a supplement and not as the basic ration.
- A minimum of coarse forage in the rumen is essential.
- Never give blocks to an emaciated animal with an empty stomach. There is the risk of poisoning due to excessive consumption.
- The amount of blocks fed to sheep and goats should be limited to 100 grams/day while for cattle it should be limited to 500-700 grams/day.
- The blocks should never be supplied in ground form or dissolved in water as this can result in over consumption
- Supply sufficient amount of water ad lib.

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Popular article

Biopesticides Usage in India

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Abstract

Synthetic pesticides are the central pillar of insect pest control. The major threats such resistance, resurgence, environmental issues caused by these synthetic pesticides laid avenue for shifting towards usage of biopesticides as integral part of pest management strategies. Biopesticides mainly microbial biopesticides include entomopathogenic fungi, viruses, bacteria and nematodes. The effectiveness of these biopesticides is tested under laboratory conditions and also in field conditions with great success in combatting many insect pests causing economic losses. Registered biopesticides products are commercially available for the management of insect pest and diseases.

Introduction

In India, agriculture and its allied sectors are not only imperative for country's Gross domestic Product but also serve as principal livelihood for an estimated 58.00% of its population. On farm yield losses from pests has been estimated to a magnitude of 10-30%. Currently, India ranks fourth in production of pesticides and the industry is expected to reach Rs.316 billion by 2024, with a compound annual growth rate of 8.10%. There are 293 pesticides registered in India of which 104 pesticides are still being produced or used in the country despite being prohibited in two or more nations elsewhere. In the interim, pesticides are withdrawn or restricted or banned due to variety of environmental, health concerns and insecticide resistance thus shifting towards development and promotion of non-chemical based pest management strategies, precisely the biopesticides. In India, only 12 different kinds of biopesticides under the Insecticide act of 1968 have been recorded. The main microbial biopesticides manufactured and used in India are entomopathogenic fungi, *Bacillus thuringensis*, NPV and *Trichoderma*. Biopesticides occupy 4.20% of the Indian pesticide market. as of 2017, at least 15 microbial control agents have been developed as biopesticides in India with 970 commercial formulations registered. as of 2017, a total of 188 mycoinsecticides, 39 myconematicides, 51 bacterial insecticides and 27 nucleopolyhedrovirus products were registered through the CIBRC.

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Different biopesticides used in India

1. Entomopathogenic Fungi

These Entomopathogenic fungi belong to the divisions, deuteromycota, ascomycota, and Zygomycota. These entomopathogenic fungi being eco-friendly and bio-persistent, make all distinct stages of insect life cycle vulnerable. The most widely studied species for pest management include as follows.

i. *Beauveria* Genus

It causes White Muscardine disease. In India, at least 87 products based on *Beauveria bassiana* have been registered for use against a range of lepidopteran, coleopteran, and hemipteran pests on crops. The cadavers covered with white colour conidia. Commercial formulations are typically applied in the range 10^7-10^8 conidia/ml and 400-750 L/ha, depending on the crop. It produces toxins namely beauvericin, bassianocide etc. *Beauveria* products have been used to reduce the menace of white grubs in Indian sugarcane. The related species, *B. brongniartii*, has emerged as a promising biocontrol agent in sugarcane.

ii. *Lecanicillium lecanii*

Lecanicillium lecanii is broadly distributed, which can cause huge epizootics. Over 60 products based on *L. lecanii* are manufactured in liquid and dry formulations in India for the management of aphids, scales and other soft-bodied sucking pests on a range of crops in both field and green house conditions.

iii. *Metarhizium* Genus

It causes Green Muscardine disease. The genus *Metarhizium* includes, *Metarhizium anisopliae*, *M. album*, and *M. flavoviride*. *M. anisopliae* is a potential entomopathogenic fungus. a total of more than 30 products based on *M. anisopliae* are used for control of both foliar and soil pests in India, especially in plantation crops and vegetable crops.

iv. *Nomuraea* Genus

Nomuraea rileyi is a potential insect-infecting fungus, is a dimorphic hyphomycete that can cause epizootic death in various insects. In India, natural epizootics of *N. rileyi* has been observed on lepidopteran pests including castor semilooer, *achaea janata*, cut worm *agrotis ipsilon*, gram podborer, *Helicoverpa armigera* and tobacco caterpillar *Spodoptera litura.*

v. *Paecilomyces* Genus

Paecilomyces is important biocontrol agent against whiteflies and causes "yellow muscardine" It is effective against *Bemisia* and *Trialeurodes* spp. both in field and greenhouse

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conditions. The cadavers covered with grey or yellow conidia are by *Paecilomyces* spp. or in some cases, pink or pink-grey conidium is usually by *P. fumosoroseus*.

vi. *Hirsutella* Genus

Hirsutella includes three important species, *H. thompsonii*, *H. gigantea*, and *H. citriformis*. Mycohit, product based on isolate of *H. thompsonii* is used to reduce the menace of coconut mite, *aceria guerreronis.*

vii. *Isaria* Genus

Three *Isaria fumosorosea* products are sold for control of soft-bodied insect pest's *viz.*, whiteflies, aphids, thrips, mites, leaf miners, plant bugs and several soil pests in food and ornamental crops.

2. Bacteria

Many species of bacteria are known to infect different varieties of insects, but those bacteria belonging to the genus *Bacillus* are most widely used as biopesticides. *Bacillus thuringiensis* is among the most successful and widely produced microbial control agents, against Lepidoptera, diptera, Coleoptera and Hymenoptera. The first formulation based on *B. thuringiensis* was developed under the name "*Sporéine*" in France in 1938. during sporulation, *Bt* synthesizes a parasporal crystalline inclusion containing proteins known as δ-endotoxins or Cry proteins, which have insecticidal properties. Genes that express the delta-endotoxins are called "*cry genes*". The *δ*-endotoxins form two classes of toxins, Cry proteins and Cyt. proteins. after ingestion, the crystals are solubilized in the alkaline (pH 9 to 12) releasing protoxins which are converted to active toxin by midgut proteases and bind to specific receptors in the microvilli of the apical membranes of the columnar cells thus causes opening or pore formation followed by osmotic imbalance between the intracellular and extracellular environments and cell disruption. This destroys the microvilli, causing the insect to stop feeding, leading to its death. There are many reports of such *Btk* formulations for use against bollworms, loopers, and other lepidopteran pests in India.

3. Viruses

Baculoviruses comprise of nucleopolyhedro viruses (NPVs) and granulo viruses (GVs). NPVs produce occlusion bodies (OBs) referred as polyhedra, while that of GVs are called granules. during the course of infection two forms of virions are produced: Budded Virions (BVs) and OB-derived virions (ODVs). BVs consist of only a single nucleocapsid surrounded by an envelope; whereas ODVs embedded within OBs contain either single nucleocapsids known as single NPV's (SNPVs) or multiple nucleocapsids known as multiple NPVs (MNPVs). NPV

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has a biphasic infection cycle. When susceptible larvae feed the leaves infected with baculoviruses, the occluded bodies get dissolved in the alkaline pH of insect midgut and the virus start multiplying within the host cell nuclei after binding to the brush border membrane vesicles of the mid-gut columnar cells thus giving rise to progeny viruses which later form budded viruses and cause secondary infection. In later phase of secondary infection OdVs are formed infecting other insect tissues, which are then embedded within OBs and are released into the environment following the death of infected larvae by liquefaction. Infected host may die within 3-4 days when environmental conditions are favourable. In India, two nucleopolyhedro viruses (NPV) are commercially produced or imported to manage bollworms *Helicoverpa armigera* and *Spodoptera litura* which are polyphagous pests on economically important crops including castor, citrus, cocoa, cotton, groundnut, legumes, maize, potato, rice, rubber, tobacco, tomato, sorghum and many other vegetables.

4. Entomopathogenic Nematodes

Entomopathogenic nematodes (EPNs) are soil-inhabiting, lethal insect parasites that belong to the Phylum Nematoda and belonging to the families Steinernematidae and Heterorhabditidae. EPNs are mutually associated with bacteria carried by Steinernematidae is *Xenorhabdus*, and by Heterorhabditidae is *Photorhabdus*. The third juvenile stage of EPNs is referred to as the "infective juvenile" (IJ). IJs of both genera when locate a susceptible host larvae enters the insect host through the mouth, anus, spiracles or thin parts of the host cuticle and release their corresponding bacterial symbionts in the insect host body and develop into fourth-stage juveniles and adults. Mortality of the infected insect occurs mainly due to "septicemia". Normally EPNs take 1-3 weeks of duration starting from infecting the insect host, development and reproduction within the cadaver. The insect cadaver becomes red if the insects are killed by *Heterorhabditids* and brown or tan if killed by Steinernematids.

Conclusion

Utilization of viable microbial entomopathogens is important tool in present day pest management program and also as a vital component of integrated pest management strategy. Need for identifying and isolating native virulent strains of microbial pathogens and their commercial production, genetic modification for enhancing the virulence and exploitation of the unexplored microorganisms are to be enunciated for the effective management of insect pests in varied agro-ecosystems in a sustainable way.

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An Overview of Rumen Microbial Ecosystem

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abstract

The rumen microbial ecosystem isdiverse and complexand the complex rumen ecosystem consists of bacteria, archaea, ciliate protozoa, fungi, bacteriophage and viruses. These microbiotaworks symbiotically to break down feedstuffs consumedby ruminant animals. The microbiome controls theproduction efficiency of the animal, with certainpathways (such as those associated with methaneproduction) resulting in energy loss in the animal.The microbiome also affects end-product quality(milk and meat) but also contributes to environmentalpollution. Understanding therumen microbiome and its connection to the ruminantitself; is important for producing quality products, increasing profitability and reducingenvironmental impacts.

Introduction

The rumen can be viewed as an anaerobic and methanogenic fermentation vat that contains microorganisms that have the ability to utilize, and increase the productivity of, cellulolytic feeds (i.e. straw, hay, silage and grass). The rumen dynamics are almost solely responsible for providing nutrients to the host animal.The rumen and its microbiota play a particularly important role in the degradation of feedstuffs. as a result of fermenting feedstuffs, carbon dioxide (CO_2) andhydrogen (H_2), which are the main electron acceptors and donors of the ecosystem, are produced in the rumen.The rumen microbiome, i.e., the community of microorganisms that inhabits the rumen, is characterized by its high population density, extensive multeity (encompassing bacteria, archaea, protozoa and fungi) and complexity of interactions.The continuous fermentation carried out by these microorganisms leads to broken down of ingested fibrous feed into their subcomponents.

There are 3 intersecting micro-environments found in the rumen that containthese microbes; the **liquid phase** making-up 25% of the microbial mass, the **solid phase** making-up 70% of the microbial mass, and the **rumen epithelial cells and protozoa**, containing 5% of the

microbial mass. a nutritionally balanced diet is important as it provides an atmosphere that maximizes the growth and activity of these microbes.

A rumen microorganism is anaerobic or facultatively anaerobic, and produces end products that are either directly utilized by the host or by other microorganisms as energy. The ruminal pHis kept relatively constant (Generally 6 to 7), but may vary depending on diet.Such variations can result in a change in the microbial populations, and the levels of volatile fatty acids (VFas) produced. These fatty acids such as propionate and butyrate, can be absorbed across the gut wall to serve as an energy source for the ruminant.

Buffering of the rumen to maintain a relatively constant pH is facilitated by the large quantity of saliva produced by the ruminant, which is high in sodium and potassium bicarbonate and urea. The saliva is swallowed into the rumen and then absorbed through therumen walls. Further buffering is provided byammonia produced during fermentation, whichcan then be used for microbial growth in therumen. Ruminants, through the action of their microbiota,can utilize indigestible components of feed i.e. lignocellulose. The interplay between the host andmicrobes in the rumen is synergistic, i.e. the host provides heat, moisture and food, while themicrobiomes produce protein and by-products of digestion, such as VFas, for use by the host. The complex rumen ecosystem consistsof bacteria, archaea, ciliate protozoa, fungi, bacteriophage and viruses.

1. Rumen bacteria –

The most abundant microbes in the rumenliquor with concentration $10^{10} – 10^{11}$ cells/ml and are of over 200 species. The bacterial composition of rumen liquor depends upon a number of factors including precedence of certaindiets, energyrequirements, and resistance to some toxic metabolicend-products. Rumenbacteria are mainly Gram negative (when fed on high forage diet), but on high grain diets more Grampositive bacteria are seen in rumen liquor. The use of molecular techniques for the analysis of rumen microbiologyfor example, the conserved16S rRNa gene to determine bacterial composition, predict their functionalities or enumeratetargeted microbes within a complex ecosystem withoutthe need for culturing. This is important because only 20% of the rumen microbiota canbe cultured using standard techniques. Sequencing (using 16S rRNa) also revealthat *Prevotella*, *Butyrivibrio*and *Ruminococcus*are the most dominant bacteria in the rumen, and thatcommunity structure is affected by changes in the dietof the host.

It has been also discovered that diet complexity favors increased microbial diversity. Due to the high forage diets of ruminants, particularlygrass-based diets, cellulosedigesters are more in number. These **cellulolytic bacteria** degrade the main components of plant fiber i.e. cellulose and hemicellulose. The ability to degrade cellulose is strongly dependent on the type of forage, crop maturity andthe accessibility of the cellulolytic bacterial communities. The plant fiber matrix is complex in nature and are compose of β-1, 4 linked glucose residues for celluloseand β-1, 4 linked xyloses for hemicellulose, and thereby requiresthe coordination of a number of hydrolyticenzymes in order to break it down. although there are many cellulose degrading bacteria, *Fibrobactersuccinogenes* and *Ruminococcus albus* are the mostdesirable cellulose degraders. Their ability to digestcellulose is much higher than that of other cellulolyticbacteria,which isdue to the fact that theypossess a number of genes encoding enzymes which are involvedin fibre degradation. Fermentation end products ofcellulolytic bacteria include acetate, butyrate, propionateand CO_2. Formic acid and lactic acid are also formed but arequickly used by other bacteria.

Starch is also an important constituent of theruminant diet, in particular for highly productivedairy cows. High grain diets result in an increasein the amount of starch in the rumen. *Streptococcus bovis* (an **amylolytic** bacterium) is normally present in low numbers in cows fedhigh forage diets and in high abundance in cows that consume high grain diets.*S. bovis* requires low pH for their optimum growthand its high abundancefollowing consumption of high grain diets; isattributed to a sudden increase in glucose levelsin the rumen and the loss of protozoa due to themore acidic environment created by high graindiets. More specifically, lactic acid is producedfrom starch and, as lactic acid is not metabolized by the animal, therefore get absorbed through therumen wall; causing an increase in lactic acid in theblood and reduced blood pH.

Sudden change in animal diet, results in anaccumulation of VFasin the rumen liquor, causinga detrimental effect on the microbiota and the hostanimal. These severe and sudden changes lead to adecrease in ruminal pH and an increase in *S. bovis* and *Lactobacillus* species. Some anaerobic bacteria acquire energy from thepectin degradation, with the most important **pectinolytic** species, *Lachnospiramultiparus*, *Prevotellaruminicola* and *Butyrivibriofibrisolvens*, being capableof reducing pectin to oligo-galacturonides, yieldinglarge quantities of acetate.Citrus by-products like citrus pulpare widely use in ruminant feeding systems andcontain a high percentage of pectin substances.These by-products can be used as an alternative tohighly

fermentable grains, preventing the excessivegrowth of *S. bovis*, and associated ruminal acidosis,and some researchers suggest that theγ maγ even improvethe feed utilization efficiencγ for milk production.

Microorganisms associated withmilkfatγield are**Firmicutes** and **Bacteroidetes**. adecreased abundance of Bacteroidetes in comparisonto Firmicutesresults in increase milk fat %.

2. Methanogenic archaea –

Archaea, due to their broad spectrum of unusualand distinctive metabolisms, can survive in a varietγ of different environments. Rumen archaea are strictlγ anaerobic and are theonlγ known rumen microorganisms to produce methane (CH_4).Such archaea arereferred to as methanogens. archaea are found in therumen in the range of 10^6 to 10^8 cells/ml, accountingfor less than 4% of the microbial communitγ. archaea are present at the bottomof trophic chaindue to their need to use the end products of fermentation as their substrates.

The domain archaea is brokeninto two different kingdoms-

A) Euryarchaeota, consisting of methanogens and extreme halophiles, and

B) Crenarchaeota, consisting of hyperthermophiles and non-thermophiles.

Methanogens of kingdom Euryarchaeota; requires very low redox potential and are strictest anaerobes known. according to meta-analysis of global data,90% of rumen methanogens belong to the followinggenera; *Methanobrevibacter* (63.2% of methanogenpopulation),*Methanomicrobium*(7.7% ofmethanogen population),*Methanosphaera* (9.8%)"Rumen Cluster C", now referred to as*Thermoplasma* (7.4%) and *Methanobacterium*(1.2%).

Most methanogens remove hydrogen gas byreducingCO_2 with H_2 gas to form CH_4. In contrast, *Methanosphaerastadtmanae* only produces methane through the reduction of methanol withH_2, having one of the strictest energy metabolisms of allmethanogenic archaea. Producing methane; keeps low ruminalhydrogen concentrations, allowingmethanogens to promote the growth of other species, and thereby enabling a more efficient fermentation.

Eructation of methane; which is also a green-house gas (GHG), leads to atmospheric pollution. Therefore, following efforts tomitigateemissions of rumen methane includes -

I. Vaccines(targeting rumen methanogens through the generation of antibodies to selected methanogenantigens that enter via saliva, binding to targets onthe methanogens)

II. Small-molecule inhibitors (targetsenzymes essential for the growth of methanogens)

III. Additives and Breeding approaches.

In a studycarried out by *Goopy et al.* (2014), it was found that sheepthat emitted lowmethane levels had a smaller rumenin comparison to high methane-emitting sheep. There was no difference in dry matter intake ordigestibility between the two groups. The study alsofound that low methane-emitting animals had a shortermean retention time for both solid and liquidphase. Hence, this may be the basis for breeding animalswith a smaller rumen size to reduce methane emissions. However, most effective and straightforward method of loweringrumenmethane emissions is dietary manipulation because, as selective breedingis slow and selection of specific traits may affect favorable variants.

Methaneproductionby archaea represents an energy loss of about 2 –12% of gross energy intake (GE*i*), means this energy is no longer available for animal growth, lactation, maintenance or pregnancy. Manipulating the ruminant's diet; to reduce the number of methanogenswould therefore be helpful to reduce the negativeimpact on the environment, and will also improve the efficiency of livestock production.

Methanogenesisis the only mechanism of ATP synthesis formethanogenic archaea. The methyl coenzyme a reductase (Mcra, encoded by mcra gene) catalyzes the final step in methanogenesis. Thus, use of anti-methanogens, such as bromochloromethane, can be used to inhibit methane production. Because, Bromochloromethane reacts with reduced vitamin B_{12} and inhibits the cobamide-dependant methyl transferase step, which is responsible for Mcra synthesis. Therefore, targeting this step maybreak the pathway and inhibit production.

A recentstudy, investigated theuse of an invasive species of macroalgae *asparagopsistaxiformis* as a means of reducing methane emissions in vitro by its secondary metabolite-bromoform, which is similar to bromochloromethane in its ability to decrease methanogenic activity.

3. Ciliate protozoa –

Ciliate protozoa are found in the range of 10^4 – 10^6cells/ml in rumen liquor and are amenable for 30to 40%of overall fiber digestion. They are also relatively active in lipid hydrolysis and can produce hydrogen via their hydrosomes. The *Entodinium* genus is the most dominant protozoanin high grain diet and it rapidly degradestarch, engulf it and convert it to an

iodophilic storage polymer. Degradation occurs through a combination of debranching, amylase and glucosidase enzymes.

Defaunation is a mechanism used to prevent thegrowth and/or remove, protozoal population from the rumen.This can be done by several different meanssuch as through the isolation of calves after birth,chemical defaunation through the use of $CuSO_4$, calcium peroxide, alcohol ethoxylate,coconut oil, linseed oil or soya oil hydrolysate.another method of defaunation, involvesan invasive methodto removethe rumen contentsfrom the host, followed by carefully washing of rumenmucosa and then the rumen contentsare treated by either heating or freezing toeliminate protozoa. The rumen contents are thenreturned back to the rumen. This method also removes protozoa-associated methanogens (methanogens sequestered within rumen protozoa) which account for approximately 37% of methanogenesis in ruminants, and as defaunation would also eliminate them, leading to decrease in methaneproduction.

Some studies revealed that methane emissions increasedwith protozoal abundance and stated thatprotozoa showed the strongest link with methaneemissions (in comparison to other domains) afterqPCR using DNa extracted from rumen contents.Thepresence of protozoa can probably have both beneficialand negative effects on the rumenmicrobiome,as protozoa engulf bacteria andother smaller microbes and particles in therumen, but also larger molecules including proteinsand carbohydrates.They actively ingest thebacteria as a source of protein and also act as astabilizing factor for end products of fermentation.

4. Amoeba –

Amoebae can represent an important reservoir forbacteria in the environment, but their role in therumen is unclear. In the vegetative cycle (multiplicationby binary fission), amoeba, similar tociliate protozoa, survive by ingesting bacteria through phagocytosis. Itis known that some bacteria cansurvive phagocytosis by protozoa and live as endosymbionts. For instance, *Campylobacterjejuni* has been shown to invade *acanthamoebapolyphaga* and can replicate in vacuoles.*C. jejuni*and *C. fetus* can have large effects on cow fertility, immunity and overall health. amoeba therefore may be important in rumen and general bovine health.

5. Fung i -

Rumen fungi (10^3 – 10^6zoospores/ml) are anaerobic, falling into the class Neocallimastigomycetes, consisting of 6 genera (*anaeromyces, Caecomyces, Cyllamyces,Neocallimastix, Orpinomyces* and *Piromyces*) with21 known species and, using

molecular techniques,2 genera are recently discovered *Oontomyces* and *Buwchfawromyces*. anaerobic fungi may influence the rest of themicrobial community since they produce H_2 duringinitial degradation of plant tissue and this H_2 canbe used as fuel for the degradation mechanisms ofother communities.

Fungi colonizes plant cell walls and accounts for approx. 8–12% of total ruminal microbial biomass, but this figurevaries widely depending on the animal diet. While most plant fiber-associated fungi are retained in the solid phase, the liquid phase maycontain smaller particulate matter that fungi mayhave attached to. Fungi are the bestdegraders and they produce high levels of celluloses hemicelluloses, as well as also possess the ability to break down xylan due to the production of xylanases enzyme. Fungi appear to initiate the feedbreakdown process, indicating that anaerobicfungi may be pivotal for feed utilization efficiencyand animal growth and production in pasture-fed ruminants.

By breakingdown the carbohydrates, fungi produce metabolites which can be use for nutritional purpose by the host. They have many features which make them unique incomparison to fungi found outside the rumen, including polyflagellate zoospores (the reason why rumen fungi were originally mistaken forciliate protozoa), cellulosomes, hydrogenosomes and a wide enzymatic spectrum.

6. Bacteriophage –

Bacteriophage are obligate pathogens of bacteriaand they occur in dense populations of approximately10^7 – 10^9 particles/gram of digesta in therumen. Like others; bacteriophage population are also influenced by externalsources, meaning they may also be controlledthrough different strategies.

The bacteriophage andvirus population found in a rumen sample is referred to as the **virome**. The high number of rumen bacteriophage suggests that they may have an importantfunction in the balance of the ruminalecosystem, butthere is little known about the effect of the rumenvirome on the system it inhabits. Some studies showedthat this was important in the transfer of glycosidehydrolase between bacteria and rumen fungi.also some research propose that this may also beimportant in the case of rumen ciliate protozoa,whereby horizontal gene transfer occurs fromrumen bacteria in order to aid in protozoa adaptionto the carbohydrate-rich environment of therumen, transferring genes encoding plant cell walldegradation. This information indicates that bacteriophagemay represent a shared gene pool for therumen system.

Metagenomics can also be use to determine the origin of these genes. In a studycarried out by,it was found that most virusesfound in the rumen were associated with the mostdominant phyla, namely Firmicutes, Bacteroidetesand Proteobacteria. Bacteriophage interaction canbe identified by the presence of clustered regularlyinterspaced short palindromic repeats (CRISPR)and CRISPR-associated proteins in the microbialpopulation.These genes are fundamental to provide adaptiveimmunity in some bacteria and archaea, whichenable the organism to respond and eliminateinvading genetic material. Once infected by theseinvading genetic materials, the new DNa is integratedinto the host CRISPR locus as new spacers, ultimately encoding a unique spacer sequence

CONCLUSION

The rumen microbiomes play an exigent role in shaping the host physiological parameters. The complex rumen ecosystem consists of bacteria, archaea, ciliate protozoa, fungi, bacteriophage and viruses. although bacteria are the most prominentmicroorganisms in the rumen, but fungi are the best degraders. Identification of certain metabolic pathways of these microbiota and then further investigation of those pathways; may be helpful to determine the best diet for ruminants; in order to minimize the energy losses, to reduce themethane production and to increase the nitrogen utilizationefficiency. Examination of the rumen microbiomecan even identify the effects of diet on the microbiomeand in turn, the effects on milk yield, milk fat %, protein percentages, urea percentage (used as an NPN indicator) and milk protein yield.

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Bio-preservation: A Natural Approach for Food Safety

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Despite modern advances in technology, the preservation of foods is still a debated issue, not only for developing countries but also for the industrialized world. Need for development of new technologies for better processing, preservation, and storage of food. To achieve improved food safety, the food industry makes use of chemical preservatives or physical treatments e.g., high temperatures. These preservation techniques have many drawbacks which include the proven toxicity of the chemical preservatives e.g., nitrites, the alteration of the organoleptic and nutritional properties of foods, and especially recent consumer demands for safe but minimally processed products without additives. To harmonize consumer demands with the necessary safety standards, traditional means of controlling microbial spoilage and safety hazards in foods are being replaced by combinations of innovative technologies that include biological antimicrobial systems.

Bio-preservation refers to extended storage life and enhanced safety of foods using the natural antimicrobial compounds that are of plant, animal, and microbial origin and have been used in human food for a long time, without any adverse effect on human health.

Natural antimicrobials for Food Biopreservation

1. **Antimicrobial Substances derived from Bacterial Cell Metabolism-**. Bacteria produce many compounds such as organic acids (Lactic acid, acetic acid, Propionic acid) CO_2, Hydrogen peroxide, Bacteriocins, diacetyl, etc that are active against other bacteria, which can be harnessed to inhibit the growth of potential spoilage or pathogenic microorganisms. These include fermentation end products such as organic acids, hydrogen peroxide, and diacetyl, in addition to bacteriocins and other antagonistic compounds. Bacteriocins are ribosomally synthesized single polypeptides that are usually inhibitory only to closely related bacterial species. Bacteriocins become one of the weapons against microorganisms due to the specific characteristics of a large diversity of structure and function, natural

resource, and is stable to heat Ex- Nisin (Lactococcus lactis subsp. lactis) Pediocin a, Pediocin ACH, etc.

Bacteriocin-based biopreservation strategies include a purified/semi-purified bacteriocin preparation as an additive in food, incorporation of an ingredient previously fermented with a bacteriocin-producing strain, by using a bacteriocin-producing culture to replace all or part of starter culture in fermented foods to produce the bacteriocin in situ.

The LAB bacteriocins have many attractive characteristics that make them suitable candidates for use as food preservatives, such as:

- They are generally recognized as safe substances, they are not active and nontoxic.
- They become inactivated by digestive proteases, having little influence on the gut microbiota.
- They are usually pH and heat-tolerant.
- They have a relatively broad antimicrobial spectrum against many food-borne pathogenic and spoilage bacteria
- They show a bactericidal mode of action, usually acting on the bacterial cytoplasmic membrane: no cross-resistance with an antibiotic.

Moving towards the better tomorrow we can identify new bacteriocins for application in food safety, alter the specificity of existing bacteriocins, Increase the level of bacteriocin production, development of bacteriocin-producing lactic starters through the gene transfer system.

2. **Antimicrobials from animal Sources-**

Lactoperoxidase is a protein or glycoprotein enzyme present in raw milk, colostrum, saliva, and other secretions (Taylor *et. al.*, 2014, Seifu *et. al.*, 2005). Lactoperoxidase reacts with thiocyanate and hydrogen peroxide forming the termed lactoperoxidase system (LPS) with antimicrobial capacities.

Lysozyme is an enzyme naturally present in avian eggs and mammalian milk and is generally recognized as safe (GRaS) for direct addition to foods (Fda, 1998). The white lysozyme of hen eggs is a bacteriolytic enzyme widely reported for its antimicrobial application in food products (Tiwari *et al.*, 2009) and commonly used as a preservative for meat, meat products, fish, fish products, milk, and dairy products, and fruits and vegetables (Cegielska-Radziejewska *et al.*, 2009). The ability to hydrolyze the β-1, 4 linkages between N-acetylmuramic acid and N-acetylglucosamine in the peptidoglycan of the microbial cell

wall accounts for lysozymes antimicrobial activity (Juneja *et al.*, 2012). Lysozyme has been used primarily to prevent late blowing defects in cheeses, caused by Clostridium tyrobutyricum.

Lactoferrin (Lf), an iron-binding compound of milk, has been shown to possess antimicrobial activity against a wide range of bacteria and viruses (L€onnerdal, 2011). Recently, Lactoferrin Lf has been approved for application on beef in the United States and has been applied as an antimicrobial in a variety of meat products (USda-FSIS, 2010; Juneja *et al.*, 2012). Lactoferrin shows antimicrobial effect against foodborne microorganisms including Carnobacterium, L. monocytogenes, E. coli, and Klebsiella (al-Nabulsi and Holley, 2005; Murdock et al., 2007).

3. **Antimicrobials derived from Plants-** Herbs and spices have been recognized to contain a broad spectrum of active compounds that are having antibacterial, antifungal, antiparasitic, and/or antiviral properties. Essential oils have been used for a long time as part of natural traditional medicine. They are plant material's aromatic oily liquids (flowers, buds, seeds, leaves, twigs, bark, herbs, wood, fruits, and roots). The principal components responsible for essential oil's effective antimicrobial activity include saponins, flavonoids, carvacrol, thymol, citral, eugenol, linalool, terpenes, and their precursors (Burt, 2004). The antimicrobial activity of plant essential oils is due to their chemical structure, in particular to the presence of hydrophilic functional groups, such as hydroxyl groups of phenolic components and/or lipophilicity of some essential oil components (Dorman and Deans, 2000). Usually, the compounds with phenolic groups as oils of clove, oregano, rosemary, thyme, sage, and vanillin are the most effective (Skandamis *et al.*, 2002). They are more inhibitory against Gram-positive than Gram-negative bacteria (Mangena and Muyima, 1999; Marino *et al.*, 2001).

Bacteriophages- Lytic bacteriophages offer great potential as natural bio preservative agents, due to their capacity to selectively control the bacterial population. Phages can be safely used in the food industries for bio-control at various levels thus representing a new era of novel food safety agents that are potential replacements for chemical preservatives and antibiotics. The advantages encourage their use in the food chain system for several reasons.

(i) High specificity to target their host determined by bacterial cell wall receptors, leaving untouched the remaining microbiota, a property that favours phages over other antimicrobials that can cause microbiota collateral damage.

(ii) Self-replication and self-limiting, meaning that low or single dosages will multiply as long as there is still a host threshold present, multiplying their overall antimicrobial impact.

(iii) As bacteria develop phage défense mechanisms for their survival, phages continuously adapt to these altered host systems.

(iv) Low inherent toxicity, since they consist mostly of nucleic acids and proteins;

(v) Phages are relatively cheap and easy to isolate and propagate but may become time-consuming when considering the development of a highly virulent, broad-spectrum, and no transducing phage;

(vi) They can generally withstand food processing environmental stresses (including food physiochemical conditions);

(vii) They have proved to have a prolonged shelf life.

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Popular article

General control measures for management of parasitic diseases

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Abstract

Parasites are present from thousands of years and infect both human as well as animal. They are responsible for reducing the health and productive status of animal and in turn can hamper the country development. Some time they also cause mortality in human also. Control of parasitic disease is little bit difficult because they are multicellular having complex life cycle, many intermediate stages and more chance of developing resistant against chemical based controlling agents. So, for effective control of parasite complex interaction of events in the fields of public health, education, political will and medicinal science are needed. Current manuscript deal with different managemental practices which can be used for effective control of parasitic infection.

Keywords: Parasitism; control; management

Introduction

Diary animals are very sensitive to the effects of internal parasitism. Parasitism can cause decreased fertility, abortion, un-thriftiness, increased susceptibility to other disease and death. delay in puberty age due to parasitism is well documented in diary animals. Besides these, parasitic diseases are known to cause decrease in fertility and reduced body weight gains especially in meat animals. The quality of hair coat and wool is affected by parasitism as rough hair is known to be associated with many internal parasites. Besides, abortion in small ruminants due to toxoplasmosis is a very well-known problem. alongside, coccidiosis is known to significantly alter the health and production of diary animals. Moreover, quite a few of parasitic infections are zoonotic in nature thereby, posing

publíc health sígnífícance.

The control of parasítíc díseases of lívestock has been undertaken sínce the deleteríous effects of parasítísm on anímal health and well-beíng are very much sígnífícant. Subclínícal parasítísm ín grazíng anímals ís a major cause of economíc problem, severely límítíng the productívíty of anímals throughout the world, but ín actual sense, the effect of subclínícal parasítísm ís more severe ín countríes líke Índía. an exhaustíve revíew commíssíoned to príorítíze anímal health research for poverty reductíon ín the developíng World, by a consortíum consístíng of the WHO, OÍE and FaO, concluded that gastroíntestínal (GÍ) parasítísm had the híghest global índex as an anímal health constraínt. Ít ís a common observatíon that the number of ínfectíve stages present ín the envíronment at any gíven períod ís dírectly related to the number of worm eggs passed by the host and thís ultímately determínes the number of parasítes that are potentíally capable of beíng establíshed ín a susceptíble host. Characterístícs such as breed, age and nutrítíonal status of the host have a marked ínfluence on the damage to the host. Subclínícal parasítísm poses enormous threats to global food securíty by causíng up to 20% reductíon ín mílk yíeld of daíry anímals and 52% loss ín body weíght. Thís ís ín addítíon to the losses encored from clínícal parasítísm resultíng ín death of newly born or young anímals or even adult anímals duríng productíve age. The dífferent approaches to control from díagnosís to treatment and cure of the clínícally ínfected anímal to control the transmíssíon wíthín the herd by preventatíve chemotherapy and vector control are outlíned ín thís artícle. The varíous strategíes that should be stríctly and stríngently followed for management and control of parasítíc ínfectíons ín a farm ínclude-

1. **<u>Íntegrated Parasíte Management (ÍPM</u>):** ÍPM encourages a multídísease control approach, íntegratíon wíth other dísease control measures and systematícally consídered applícatíon of a range of ínterventíons, often ín combínatíon and synergístícally (WHO 2004). The ÍPM ís cost-effectíveness, ecologícal sound and sustaínable. ÍPM strategíes are very much símílar to those of íntegrated pest management systems that are used ín agrículture. Such íntegrated approaches help to preserve the ecosystem alongsíde encouragíng the bíologícal control measures. ÍPM favors the combíned applícatíon of four approaches: (a) envíronmental management that íncludes envíronmental manípulatíon for parasíte control; (b) bíologícal control methods usíng natural predators; (c) chemícal control methods wíth the use of chemícal compounds/ drugs (d) socíal and behavíoural measures that íncludes publíc awareness. The

detaíls of these measures are summed up below:

a. ***Envíronmental Management:*** aím of envíronmental management ís to alter the maíntenance of vectors by long-term physícal changes ín abíotíc factors, often íncrímínated as envíronmental modífícatíon (WHO 1982). Envíronmental manípulatíons ínclude flushíng or streamíng of canals, provídíng íntermíttent írrígatíon to agrícultural fíelds, temporaríly floodíng or draíníng of wetlands, or removíng specífíc types of vegetatíon that provídes larval habítats for mosquítoes. Remarkable success ís achíeved by draíníng swamps to remove larval breedíng sítes of mosquítoes alongsíde usíng oíl to kíll larvae of mosquíto by asphyxía. *Glossína* (tsetse flíes) fly has been effectívely controlled ín savanna and ríveríne forest habítats by the selectíve destructíon of breedíng lands. The general effectíveness of envíronmental management ultímately depends on how well the partícular ínterventíon ís matched wíth the ecology of the partícular dísease caused by a specífíc vector populatíon. These also ínclude managemental practíces líke-

i. MacLean county system for control of ascaríd ínfectíons by proper treatment of sows before and after farrowíng. The sows and the píglets are treated wíth píperazíne and are reared ín ascaríd free envíronment upto weanıng.

ii. Gílt only polícy for control of kídney worms of pígs. The gílts are sold and slaughtered before the prepatent perıod of the parasíte thereby suppressíng the envíronmental contamínatíon.

iii. destructíon of marshy areas for snaíl populatíon control for trematode ínfectíons usíng Molluscícídes líke copper sulphate and N-trítylomorpholíne.

b. ***Use of Natural Predators/Bíologícal Controls:*** Bíologícal methods ínvolve the use of toxíns of bíologícal orígín and/or usíng natural enemíes of a partícular pest or parasíte so as to achíeve effectíve vector control. an addítíonal advantage of usíng bíologícal control over tradítíonal chemícal control ís the reductíon ín ecologícal dísturbance affectíng the other anímal and plant specíes. Larvívorous físh (*Gambusa* for mosquíto control) and copepods as well as the toxíc products of bacteríal agents have been successfully used to control vectors. Mícrobíal larvícídals are safely added to drínkíng water and ín envíronmentally sensítíve areas and are beíng used regularly ín western countríes. They do not accumulate ín the envíronment or ín body tíssues and hence, are not toxíc to vertebrates and other anímal and plant fauna through food chaín (WHO 1999). Research on the potentíal use of naturally occurríng pathogens, parasítoíds and predators for the bíologícal control of anímal pests ís far

behínd that for plant pests as much more studíes have been conducted ín agrículture sector ín comparíson to veterínary sector. among the bíological agents used, entomopathogenic fungí played a uníquely ímportant role ín the hístory of mícrobíal control of ínsects and helmínths. Use of spore of predacíous fungí such as nematode-trapping fungí (*arthrobotrys olígospora* and *Duddíngtonía flagrans*) and egg parasític fungí (*Paecílomyces lílacínus* and *Vertícíllíum chlamydosporíum*) can also reduce the parasític burden ín the pasture (Sanyal et al 2007; Síngh et al 2010). Haemopterans and ants have been used to control tícks (Soulsby 2005). Certaín plants líke stylosanthus are used for control tícks whíle smokíng wíth neem and Eucalyptus have been tradítíonally been used to control flíes and mosquítoes (Soulsby 2005). Tannín rích plants are often used for control of gastroíntestínal parasítísm partícularly against nematodes. duck rearíng alongsíde the pond ís very much recommended for snaíl control. Tradítíonal anímal health care practíces ínvolve the use of medícínal plants to treat lívestock díseases. Thís Ethno veterínary knowledge (EVK) and practíces play a major role ín complementíng modern approaches ín the control of díseases. Certaín plants have repellent actívítíes against tícks, mosquítoes and flíes and hence are used as 'push strategy' to keep these ínsects away. Tobacco leaves are used by people of certaín states of Índía especíally Bíhar, as an índígenous measure of controllíng tícks. Methanolíc and other extracts of certaín plants líke neem *(azadírachtía índíca)* leaves and bark, nochí *(Vítex negundo*) leaves, etc are known to have acarícídal actívítíes.

c. *Chemícal Control:* Chemícal control methods are defínítely fast ín results, híghly effectíve, íf used effícíently. They may be used as a non-resídual applícatíon (effectíve over a short tíme-scale, kíllíng only those whích are currently exposed) or a resídual (persístent) applícatíon that ís effectíve over a períod of weeks to months. Chemícals remaín the backbone of ÍPM. However, there are concerns over the ímpacts of chemícals, especíally those whích are persístent ín nature as they are organíc pollutants and undergo bíoaccumulatíon ín food chaín. a wíde range on commercíal anthelmíntícs and acarícídes are avaílable ín the market for applícatíon. Some of them are:

anthelmínthícs and antíprotozoals	Effectíve agaínst
Píperazíne salts @200-300 mg/ kg b wt orally, Pyrantal palmoate @5-10 mg/ kg b wt orally	Nematodes especíally ascaríds
Albendazole, Fenbendazole @5-7.5 mg/ kg b wt orally	Parasítíc gastro enterítís íncludíng haemonchosís, Hookworms
Prazíquantal @10-15 mg/ kg b wt orally	Tapeworms
Oxycloxaníde @15 mg/ kg b wt orally	Flukes
Tríclabendazole @10-12 mg/ kg b wt orally	acute fascíolosís
Buparvaquínone@2.5mg/kg b wt Í/M	Theíleríosís
Ímídocarb @ 2-4 mg/ kg b wt Í/V	Babesíosís
Tetracyclínes	Rícketsíal ínfectíons
Ívermectín	as end-ectocíde
amprolíum @10 mg/ kg b wt orally	Coccídíosís

acarícídes	Concentratíon and route of applícatíon
Coumaphos	1% dust, 0.34-0.46% spray, 10 mg/kg as pour on
Díchlorvos	8.9% as dog collar, 30-60 ml 1% soln. as spray, 20% as tag
Malathíon	4-5% dust, 0.5-0.6% spray
Carbaryl	5% dust, 0.5% spray
Líndane	1% dust, 0.03% spray, 0.04-0.05% díp
Amítraz	250 ppm ín water
Deltamethrín	1% soln. as spray
Permethrín	0.25% dust, 0.05% spray, 10% tag
Ívermectín	0.2 mg/ kg as ínjectíon subcutaneously or líquíd or paste or tablet

General strategies for the use of chemical anthelmintic:

i. **Prophylactics:** Here the treatments are either done at regular intervals or the drugs with residual effect are used. Treatment is done irrespective of the fact that the animal is infected or uninfected. a broad spectrum anthelmintic like albendazole or a drug combination containing flukicide, anti-nematodal and anti-cestodal preparation can be used for common dosing against trematode, nematode and cestode to prevent multiple drug resistance.

ii. **Curatives:** These treatments are based solely on clinical diagnosis. Only the infected animal is treated. There reduce expenses for anthelmintics as few animals are treated and selection for resistance is significantly reduced. disadvantage includes the fact that it requires regular monitoring which increases labour costs.

iii. **Measures against intermediate hosts:** Molluscicides like copper sulphate and N-tritylomorpholine are commonly used for snail control. Molluscicides are usually applied in spring or mid-summer. The spring application is easy to apply and highly effective, killing off wintered infected snails and parent snails which would supply the majority of the next year's breeding population. Mid-summer applications kill off infected snails prior to emergence of summer infection of trematodes on to the pasture in late summer season.

2. **Health awareness and Behaviour:** Vector-borne diseases are much more serious especially in cases when the affected animal or human host is malnourished, or in ill health, or suffering from existing disease. Thus, there is a strong link between overall social well-being and actual impact of parasitic disease. Improved awareness of hygiene and sanitation is very much important in reducing the disease amongst the susceptible hosts. awareness like the early identification of disease based on symptoms; the need to maintain attendance for drug delivery; and refraining from interfering with traps for vectors such as Tsetse fly should be promoted in endemic areas. These steps have provided enormous success in african countries. Indoor rearing of animals at night should be practiced in endemic areas and is known to give very significant results in vector control.

3. **Vaccines:** although a very few vaccines are available commercially in markets for parasitic control. These include dictol/ difil/ Huskvac for lung worms, Tick Guard and Gavac for ticks alongside a few for protozoan parasites like Raksha Vac T for theileriosis, Pirodog for babesiosis and Coccivac/ Livacox/ Pracox for poultry coccidiosis.

General guídelínes to farmers for controllíng parasítíc ínfectíons at grass root level:

Followíng measures are recommended agaínst free lívíng and parasítíc stages of tícks and other vectors:

(a) Elímínatíon of the tíck/ fly shelters (cracks ín the wall and perches, stagnant water source) for gettíng ríd of larvae, nymphs and adults of ínsects.

(b) Pre-monsoon burníng and/or rotatíon of pastures ín the endemíc areas of helmínths.

(c) Natural predators (bírds, rodents, ants and *Hymenoptera* spp. wasps) feed upon engorged and free-lívíng vectors and reduce theír populatíon (especíally for tíck control).

(d) Ín índígenous and cross bred cattle, exposure wíth tíck and fly ínfestatíons, confer strong resístance amongst the herd.

(e) Períodíc use of acarícídes and ínsectícídes agaínst free lívíng stages of vectors ín recreatíonal parks, dog kennels, perches, barns and human dwellíng ís very much advísed.

(f) Destructíon of breedíng grounds of mosquítoes and flíes líke stagnant water resources, etc sígnífícantly helps ín vector control.

(g) Duck rearíng for snaíl control alongsíde use of chemícals líke copper sulphate, N trítyl morpholíne.

(h) Use of tannín rích plants for control of Gastroíntestínal parasítes as a part of herbal approach for control of parasítísm.

(í) Use of vaccínes partícularly ín endemíc areas especíally for poultry coccídíosís.

(j) Regular dewormíng of ínfected anímals throughout the year on regular basís.

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Brucellosís: an Ímportant Re-Emergíng Zoonotíc Dísease

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abstract

Brucellosís ís a zoonotíc dísease wíth hígh rate of morbídíty and lífetíme of sterílíty. Ít has been elímínated ín many índustríalízed natíons, but the dísease has a consequentíal ímpact on both anímal and human health. abortíon ín the last trímester ís a predomínant sígn ín cattle, whíle ín humans ít ís characterízed by undulant fever, malaíse and arthrítís. Ít ís the need of the hour for rapíd, more sensítíve and more specífíc test methods. Publíc awareness regardíng health educatíon and safe lívestock practíces should be gíven ímportance. actíve co-operatíon between human medícíne and veterínary servíces should be promoted.

Íntroductíon

Brucellosís ís a zoonotíc bacteríal dísease whích ís associated wíth anímal husbandry wíth worldwíde dístríbutíon. Ít ís one of the most common zoonosís accordíng to Food and agrículture Organízatíon and World Health Organízatíon, whích has seríous publíc health consequences (WHO, 2012). Ít ís caused by varíous *Brucella* specíes, and ít prímaríly affects cattle, swíne, goats, sheep and dogs. The exístence of brucellosís as a publíc health íssue ís due ín part to the expansíon of anímal índustríes and urbanízatíon, as well as a lack of hygíeníc measures ín anímal husbandry and food handlíng.

Etíology

The etíologícal agent of brucellosís are Gram-negatíve coccobacíllus, *Brucella* spp. whích are non-spore-formíng, non-motíle, aerobíc pathogens. Twelve specíes are currently descríbed ín the genus that ínfect varíous domestíc as well as wíldlífe anímal specíes. *Brucella abortus* (cattle), *B. ovís* (rams), *B. melítensís* (goats and sheep), *B. suís* (pígs), *B. canís* (dogs) and *B. neotomae* (common voles) are the sík Brucella specíes classífíed accordíng to preferred hosts and pathogenícíty. *B. melítensís*, *B. suís* and *B. abortus* are the most ímportant pathogeníc specíes ín humans (Whatmore *et al*., 2016).

Transmíssíon

Íngestíon, ínhalatíon, contact wíth the conjunctíva and skín abrasíons/wounds are all possíble modes of transmíssíon. The maín sources of ínfectíon ínclude aborted fetus, placenta and uteríne secretíons. Ínfected anímals mílk also contaíns mícroorganísms. The vírus ís spread to the anímals through contamínated feed and water, as well as contact wíth aborted fetus, foetal membranes and uteríne díscharges. Ínfected bulls can potentíally díssemínate ínfectíon from one herd to another through spontaneous or artífícíal ínsemínatíon. Humans become ínfected after consumíng Brucella-ínfected raw or unpasteurízed mílk and mílk products. Veterínarían and anímal handlers are at a very hígh rísk of contractíng the dísease (Khurana *et al*., 2021).

Pathogenesís

Brucella spp. multíplíes íntracellularly ín phagocytíc cells líke macrophages and dendrítíc cells once ít has entered the host body. When a female conceíves, the bactería travels through the bloodstream to the placenta, then to the trophoblasts and mammary gland, where ít multíplíes to cause abortíon. abortíon happens as a result of bactería causíng harm to the placenta, as well as stress-índuced hormonal changes. The presence of erythrítol ín the placenta and foetal fluíd from the fífth month of pregnancy ís regarded to be a sígnífícant factor ín anímal abortíon. Females allantoíc fluíd components promote Brucella growth, makíng the uterus and reproductíve tract of pregnant female the bacteríal predílectíon locatíon (de Fígueíredo *et al*., 2015). Bactería contínue to prolíferate and shed ín the envíronment ín non-pregnant anímals through varíous body fluíds and excretíons. Because *Brucella* spp. are íntracellular pathogens that can persíst wíthín phagocytíc cells by employíng numerous escape mechanísms to resíst the host's ímmune system, they can develop from acute to chroníc and carríer forms ín the host. Humans, typícally, do not produce clínícal abortíons due to brucellosís ínfectíons, thus constítutíng a dead-end host (amjadí *et al*. 2019).

Clínícal Sígns

The íncubatíon períod lasts from 5 days to several months. Chílls and fever, severe headache, joínt and low back paín and occasíonally díarrhoea are among the common symptoms,

whích are followed by an íntermíttent fever that lasts 1 to 5 weeks. Over months or years, the febríle phase recurs ín waves (undulatíons) and remíssíons, and ít can present as a fever of unclear etíology. anorexía, weíght loss, stomach and joínt díscomfort, headaches, backaches, weakness, írrítabílíty, sleeplessness, depressíon and other symptoms may also be present. Lymph nodes may be slíghtly or moderately swollen, and splenomegaly may develop. Hepatomegaly affects up to 50% of índívíduals. Endocardítís or severe central nervous system problems are the most common causes of death ín people wíth brucellosís (Hull and Schumaker, 2018). Ín anímals ít maínly causes reproductíve problems líke abortíons, ínfertílíty, stíll bírth, etc. Other sígns ínclude arthrítís, lameness, mastítís and fístulous wíthers.

Díagnosís

Serologícal assays líke Complement Fíxatíon Test, Mercaptoethanol, Standard Tube agglutínatíon Test (STaT), Rose Bengal Plate agglutínatíon Test (RBPT), Mílk Ríng Test (MRT) and Coombs Test whereas ín molecular assay Polymerase Chaín Reactíon ís used for the díagnosís of brucellosís.

Treatment

Íf antíbíotícs are gíven, combínatíon therapy of two or three drugs are more effectíve because relapse rates wíth monotherapy are hígh. Eíther doxycyclíne plus rífampícín / streptomycín or trímethoprím-sulphamethoxazole plus rífampícín / streptomycín are effectíve ín doses for 21 days. The gold standard treatment ís streptomycín 1g Í/M for 14 days and oral doxycyclíne 100 mg b.í.d. for 45 days (concurrently). Gentamícín 5mg/kg BW Í/M o.d. for 5 days can also be substítuted for streptomycín.

Preventíon & Control

- Test and slaughter method wíll be the most ratíonal approach
- Hygíeníc dísposal of aborted foetus, uteríne díscharges
- Calfhood vaccínatíon: Vaccínatíon of all calves between 4-8 months of age wíth straín-19 vaccíne
- avoíd consumptíon of unpasteurízed mílk, cheese, íce cream or raw meat
- When handlíng anímals or anímal tíssues wear glasses and gloves
- Whíle handlíng lívestock always cover open wounds on your skín

- Whíle handlíng female duríng partueatíon wear protectíve clothíng and gloves

Conclusíons

Brucellosís ís a global publíc health íssue as well as a threat to lívestock. Because of the zoonotíc sígnífícance of Brucella ínfectíon, ít ís crítical to properly manage the dísease, and specífíc tests should be utílízed to screen for brucellosís ín both humans and anímals. To control and cure brucellosís, an accurate and prompt díagnosís ís requíred. Farmers educatíon and requísíte traíníng would also aíd ín the control of the íllness.

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Leptospirosis in dogs

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Leptospirosis is an acute chronic or clinically inapparent contagious disease of domesticated and wild animals as well as human. The characteristic manifestation of the disease being fever, anemia, icterus and abortion. Leptospirosis is a bacterial zoonosis that is common worldwide, especially in developing countries.

Synonyms of Leptospirosis are Weil's disease, Stuttgart disease, rice field workers disease, sugarcane workers disease, canine typhus. The organism affects kidneys, liver, lungs, brain and uterine tissues of the animal and causes multiple organ failure. Pathogenic Leptospira species have been found worldwide, on all continents except antarctica. Leptospirosis is most common in warm and humid environment.

In India, Canine Leptospira has been recorded in madras in 1932 by ayyar and which is the earliest report in India. Leptospirosis is endemic in 5 states & 1 union territory of India. The endemic states are Gujarat, Maharashtra, Kerala, Tamil Nadu, Karnataka & the union territory of andaman & Nicobar Islands.

The disease is seasonal in temperate climate and year-round in tropical climate and it is directly associated with the amount of rainfall. all the available evidence from endemic states suggests that leptospirosis is now emerging in India as an important public health problem.

In dogs leptospirosis is caused by *Leptospira interrogans serovars i.e. L. icterohaemorrhagica*, *L. canicola* and *L. Pomona*. Morphologically Leptospira is a thin, flexible, filamentous bacteria made up of fine spirals with hook-shaped ends.

Leptospirosis is mostly transmitted by the urine of an infected animal and is contagious as long as the urine is still moist as the bacteria can't survive dryness for a longer period. The transmission is possible through drinking water contaminated by the urine of rodents or wild animals. Dogs acquired the infection through ingestion of infected carcasses. The dogs which are vaccinated for the Leptospira vaccine may acquire the infection and shed the organism through urine while dogs remain asymptomatic

Humans can contract the disease through contact with the urine or body fluids, excluding saliva, from infected animals, or contact with contaminated water, soil or food. The initial clinical signs are usually nonspecific and may include fever, depression, anorexia, stiffness, myalgia, shivering and weakness. The mucus membranes are often injected. Later, there may be signs of kidney involvement, with polydipsia, polyuria,

olíguría, or anuría, and haematuría or dehydratíon ín some cases. Fever may or may not be apparent ín dogs that present wíth kídney sígns. Vomítíng, díarrhea, abdomínal paín, grey stools, weíght loss, jaundíce, conjunctívítís, and abortíons can also be seen. Hemorrhagíc syndromes occur ín some dogs: the mucus membranes may have petechíal and ecchymotíc hemorrhages, and ín later stages of the dísease, there may be other sígns such as hemorrhagíc gastroenterítís and epístaxís. Leptospíral pulmonary hemorrhage syndrome has been seen ín dogs and can cause coughíng, tachypnoea or dyspnoea. Vasculítís may result ín perípheral edema and míld pleural or perítoneal effusíon. Evídence of pancreatítís or myocardíal ínvolvement has also been reported. Deaths can occur at any tíme, íncludíng the acute stage. Chroníc kídney dísease can be a sequela.

Mícroscopíc agglutínatíon test (MAT) ís the ínternatíonally recognízed test for the díagnosís of Leptospíra. For treatment, íntramuscular ínjectíon of penícíllín, streptomycín or tetracyclíne, ís recommended. The treatment should be contínued for 5-7 days. Supportíve treatment should be gíven to monítoríng kídney functíon. Cortícosteroíds may be gíven to speed up the elímínatíon of urea.

The fírst líne of leptospírosís preventíon ís to avoíd exposure. avoíd contact wíth floodwater, and do not eat food contamínated wíth floodwater. Treat unsafe or potentíally contamínated drínkíng water by boílíng or chemícally treatíng ít. Keep rodent populatíons (rats and míce) or other anímal pests under control. Do not eat food that may have been exposed to rodents and possíbly contamínated wíth theír uríne. Ínfected anímals must be segregated from the rest of the anímals

Four serovars are used for regular vaccínatíon ín Índía. They are *Ícterohaemorrhagíae, Canícola, Pomona, and Gríppotyphosa.* a kílled míxed vaccíne of above mentíon leptospíra ís used agaínst leptospírosís ín dogs.

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Canine Hypothyroidism

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Introduction

Hypothyroidism is the most frequently diagnosed endocrinopathy in dogs and is characterized by diminished production of the thyroid hormones thyroxine (T4) and thyroxine (T3). Thyroid hormones influence a large number of metabolic processes in the body and in the event of disorders in hormone production, symptoms can arise from a number of organ systems. In addition to the most commonly occurring symptoms such as dermatological changes and signs of general metabolic disturbances, a number of neurological manifestations have been reported to occur in hypothyroidism in dogs. Neurological symptoms of hypothyroidism can originate from the central and peripheral nervous systems as well as from the muscles.

Thyroid Hormone

Thyroxine (T4) and 3, 5, 3′-triiodothyronine (T3) are iodine-containing amino acids. Thyroid hormone synthesis requires iodine and is dependent upon ingestion of adequate iodine from the diet. Iodide is actively transported from the extracellular fluid into the thyroid follicular cell by the sodium-iodine symporter (NIS), where it is rapidly oxidized by thyroid peroxidase (TPO) into a reactive intermediate. at the apical membrane, iodine is incorporated into the tyrosine residues of Tg (Salvatore *et al.*, 2011). TPO also catalyzes the coupling of the non-biologically active iodinated tyrosine residues (monoiodotyrosine [MIT] and diiodotyrosine [DIT]) to form the biologically active iodothyronines-T4 and T3. These iodination reactions are referred to as organification.

Hypothyroidism Classification

Hypothyroidism is the most common thyroid disorder in dogs and may be acquired or congenital. Hypothyroidism is classified as primary if it is due to an abnormality at

the level of the thyroid gland, secondary if it is due to decreased TSH secretion, and tertiary if it is due to TRH deficiency.

(a) Acquired Hypothyroidism

(1) Primary Hypothyroidism

It is the most common cause of naturally occurring thyroid failure in the adult dog, accounting for more than 95% of cases. Two histologic forms of primary hypothyroidism are recognized in dogs- lymphocytic thyroiditis and idiopathic atrophy. Other much rarer causes of primary hypothyroidism include iodine deficiency, goitrogen ingestion, congenital hypothyroidism, thyroid gland destruction by neoplasia, drug therapy, surgical thyroidectomy and treatment with radioactive iodine.

(a) Lymphocytic Thyroiditis

Lymphocytic thyroiditis is an immune-mediated disorder, where both humoral and cell mediated immunity play a role in pathogenesis. The major thyroid antigens that initiate an immune response in the thyroid gland are Tg and TPO. Lymphocytic thyroiditis is characterized histologically by diffuse infiltration of lymphocytes, plasma cells, and macrophages into the thyroid gland, resulting in progressive destruction of follicles and secondary fibrosis. Graham *et al.*, (2007) proposed four stages in the development of lymphocytic thyroiditis in dogs.

Stage 1	Stage 2	Stage 3	Stage 4
Subclinical Thyroiditis	Antibody Positive Subclinical Hypothyroidism	Antibody Positive Overt Hypothyroidism	Non-Inflammatory Atrophic Hypothyroidism
Focal lymphocytic thyroid gland infiltration.	Loss of greater than 60% to 70% of thyroid mass.	Most functional thyroid tissue is destroyed.	Replacement of thyroid tissue by fibrous and adipose tissue.
Positive Tg and Thyroid hormone autoantibody test.	Compensatory increase in TSH, which stimulates the thyroid gland to maintain normal T4 concentrations.	Decreased serum thyroid hormone concentrations and Increased TSH concentration.	Disappearance of inflammatory cell and circulating antibodies.

(b) Ídíopathíc atrophy

Ít ís characterízed mícroscopícally by a progressíve reductíon ín the sízе of the thyroíd follícles and replacement of the degeneratíng follícles wíth adípose tíssue. The parathyroíd glands are not affected, and varíable numbers of parafollícular cells remaín. Ídíopathíc thyroíd atrophy may be eíther a prímary degeneratíve dísorder (Gosselín, *et al.,* 1981) or an end-stage of lymphocytíc thyroídítís as evídent by ínítíal degeneratíve thyroídal parenchymal changes, whích progressed to progressívely worsenίng ínflammatíon, subsequent fíbrosís, and thyroíd gland destructíon.

(c) Neoplastíc Destructíon

Clínícal sígns of hypothyroídísm may develop followíng the destructíon of more than 80% of the normal thyroíd gland by an ínfíltratíve tumour. Tumours may aríse from the thyroíd gland or unlíke for may metastasíze to or ínvade the thyroíd gland from adjacent tíssues. Ínterpretatíon of thyroíd hormone concentratíons ín dogs wíth thyroíd tumours ís complícated by the effects of concurrent íllness on serum thyroíd hormone concentratíon (Benjamín *et al.,* 1996).

(d) Míscellaneous Causes

Acquíred prímary hypothyroídísm may rarely result from íngestíon of goítrogens, admínístratíon of antí-thyroíd medícatíons (e.g. propylthíouracíl and methímazole), and chronίc use of hígh doses of potentíated sulfonamídes. a palpable goíter may develop ín dogs treated chronícally wíth potentíated sulfonamídes (Taeymans and O'Marra, 2009).

(2) Secondary Hypothyroídísm

Secondary hypothyroídísm results from faílure of pítuítary thyrotrophs to develop due to pítuítary malformatíon or acquíred dysfunctíon of the pítuítary thyrotrophs causíng ímpaíred secretíon of TSH. Defícíency of TSH leads to decreased thyroíd hormone synthesís and secretíon and thyroíd gland hypoplasía (Gal *et al.,* 2012).

Potentíal causes of secondary hypothyroídísm ínclude congenítal malformatíons of the pítuítary gland, pítuítary destructíon, and pítuítary suppressíon. Ín the dog, secondary hypothyroídísm caused by naturally acquíred defects ín pítuítary thyrotroph functíon or destructíon of pítuítary thyrotrophs (e.g. pítuítary neoplasía) ís uncommon.

(3) Tertíary Hypothyroídísm

Tertíary hypothyroídísm ís defíned as a defícíency ín the secretíon of TRH by peptídergíc neurons ín the supraoptíc and paraventrícular nucleí of the hypothalamus. Lack of TRH secretíon causes defícíency of TSH secretíon and follícular atrophy of the

thyroid gland. Neurologic signs and additional pituitary dysfunction may be present, depending on the cause. Tertiary hypothyroidism is assumed to be rare in dogs.

(B) Congenital Hypothyroidism

Congenital hypothyroidism is rare in dogs. Unfortunately, congenital hypothyroidism frequently results in early puppy death, and the cause of death is rarely documented. A defect anywhere in the hypothalamic-pituitary-thyroid axis or of the thyroid hormone receptor can result in congenital hypothyroidism. Congenital hypothyroidism with goiter (CHG) develops if the hypothalamic-pituitary-thyroid gland axis is intact; TSH binds appropriately with its receptor, but there is an intra-thyroidal defect in thyroid hormone synthesis (dyshormonogenesis). Increased serum TSH concentrations result in the development of thyroid hyperplasia and a goiter.

Clinical Features of Hypothyroidism in the adult Dog

A. General Metabolic Signs

Most adult dogs with acquired hypothyroidism have clinical signs that result from a generalized decrease in metabolic rate. Clinical signs due to the decreased metabolic rate include mental dullness, lethargy, exercise intolerance or unwillingness to exercise, cold intolerance, and a propensity to gain weight without a corresponding increase in appetite or food intake.

B. Dermatologic Signs

alterations in the skin and hair coat occur in 60% to 80% of hypothyroid dogs and are the most commonly observed abnormalities in dogs with hypothyroidism. Thyroid hormone is necessary to initiate and maintain the anagen or growing phase of the hair cycle. With thyroid hormone deficiency, hair follicles prematurely enter the telogen phase of the hair cycle. Excessive shedding with a lack of hair regrowth leads to alopecia. Decreased concentrations of cutaneous fatty acids and prostaglandin E_2 in canine hypothyroidism may lead to sebaceous gland atrophy, hyperkeratosis, scale formation, seborrhea sicca, and a dry and lusterless hair coat. In the early stages of hypothyroidism, hair loss is often asymmetric and develops over areas of excessive wear or pressure, such as the caudal thighs, ventral thorax, tail base, and tail (i.e. development of a “rat tail;”. as hypothyroidism becomes more severe or chronic, alopecia becomes more symmetric and truncal, eventually developing into the classic cutaneous finding of bilaterally symmetric, nonpruritic truncal alopecia.

Hyperpigmentation is common in hypothyroidism, especially in regions of alopecia and areas of wear, such as the axilla and inguinal regions. In severe cases of hypothyroidism, the hygroscopic glycosaminoglycan, hyaluronic acid may accumulate in the dermis, bind water and result in increased thickness and non-pitting edema of the skin referred to as myxedema or cutaneous mucinosis. Myxedema predominantly affects the forehead, eyelids, and lips that contribute to the development of the classic "tragic facial expression" described in hypothyroid dogs.

C. Reproductive Signs

Reproductive malfunctions include lack of libido, testicular atrophy, and oligospermia or azoospermia so hypothyroidism appears to be a cause of infertility in male dogs.

additional reproductive abnormalities have been reported as weak or silent estrus cycles, prolonged estrual bleeding, and inappropriate galactorrhea and gynecomastia which may develop following a thyroid hormone deficiency-induced increase in TRH secretion, which in turn stimulates prolactin secretion.

D. Ocular Signs

Corneal ulceration, uveitis, lipid effusion into the aqueous humor, secondary glaucoma, lipemia retinalis, retinal detachment, keratoconjunctivitis sicca (KCS), and Horner's syndrome have been reported in hypothyroid dogs.

E. Gastrointestinal Signs

Constipation may occur, presumably as a result of alterations in electrical control activity and smooth muscle contractile responses in the gastrointestinal tract. Diarrhea has also been reported with hypothyroidism.

F. Neurologic Signs

Both the peripheral nervous system and CNS may be affected by hypothyroidism. Diffuse peripheral neuropathy characterized by exercise intolerance, weakness, ataxia, quadriparesis or paralysis, deficits of conscious proprioception, and decreased spinal reflexes have been reported to occur in dogs with hypothyroidism.

➢ Other Neurologic Disorders

- Laryngeal Paralysis and megaoesophagus may both occur in association with hypothyroidism.
- Myasthenia gravis
- Myxedema Coma

Diagnosis and clinico-pathologic abnormalities of Hypothyroidism

- Complete Blood Count
- Serum Biochemistry Panel
- Urinalysis
- Conventional Radiography
- Ultrasonography
- Nuclear Imaging
- Baseline Serum Total Thyroxine Concentration
- Baseline Serum Total Triiodothyronine Concentration
- Baseline Serum Free Thyroxine Concentration
- Thyrotropin Stimulation Test
- Thyrotropin-Releasing Hormone Stimulation Test
- Tests for Lymphocytic Thyroiditis

Treatment

The initial treatment of choice is synthetic L-T4 sodium. The same treatment protocol is used for both a therapeutic trial and definitive therapy. Treatment with L-T4 sodium preserves normal regulation of T4 to T3 de-iodination, which allows physiologic regulation of individual tissue T3 concentrations. The recommended initial dose for otherwise healthy hypothyroid dogs is 0.02 mg/kg by mouth every 12 hours. The dose for treatment of hypothyroid dogs is 10 times higher than the dose used in hypothyroid humans because of poorer gastrointestinal absorption and a shorter serum half-life of T4 in dogs compared to humans.

Response to Levothyroxine Sodium Therapy

Thyroid hormone supplementation should be continued for a minimum of 6 to 8 weeks. So that all of the clinical signs and clinic-pathologic abnormalities associated with hypothyroidism should resolve.

1) As evident by an increase in mental alertness and activity usually occurs within the first week of treatment this is an important early indicator that the diagnosis of hypothyroidism was correct.
2) Some hair regrowth may be observed during the first month in dogs with endocrine alopecia, it may take several months for complete regrowth and a marked reduction

in hyperpigmentation of the skin to occur. Initially, the hair coat may appear to worsen as hairs in the telogen stage of the hair cycle are shed.

3) If obesity is caused by hypothyroidism, it should also begin to improve within 2 months after initiating L-T4 sodium therapy along with adjustments in diet and exercise.
4) Improvement in myocardial function is usually evident within 1 to 2 months, but it may take as long as 12 months for complete recovery.
5) Neurologic deficits improve rapidly after treatment, but complete resolution may take 2 to 3 months.

Conclusion

The thyroid gland is an essential gland in the body, producing a number of hormones, including T3 and T4 both of which are required for normal metabolism in the body. So it is the most frequently diagnosed and one of the most over-diagnosed endocrinopathies in dogs. Don't rely on T4 alone to diagnose hypothyroidism. a normal or low TSH does not rule out hypothyroidism. fT4ED testing is an ideal test to help confirm hypothyroidism – Low Total T4 combined with low fT4ED has a diagnostic accuracy > 95% in hypothyroidism. If the non-thyroidal illness is involved, postpone additional thyroid diagnostics until NTI is resolved. Replacement therapy with synthetic L-thyroxine is the most appropriate treatment

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Aspergillus fumigatus Infections in Cattle: A review

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Abstract

The importance of aspergillosis in cattle has increased over the last decades. *aspergillus* species are found worldwide in almost all domestic animals, causing a wide range of diseases from localized infections to fatal disseminated diseases. Some prevalent forms of animal aspergillosis are mycotic abortion, mastitis, pneumonia, gastrointestinal aspergillosis, and Hemorrhagic bowel syndrome (HBS) in cattle. The aspergillosis causes heavy economic losses to the farmer. Hence proper management practices are implemented to reduce these infections in animals. This article represents a comprehensive overview of the most common infections reported by *aspergillus* species.

Keywords- *Aspergillus fumigatus*, Mycotic abortion, Mycotic mastitis, Mycotoxins

Introduction

Aspergillus fumigatus is an infectious, cosmopolitan opportunistic saprophytic fungus. It causes severe clinical conditions such as mycotic abortion, mastitis, pneumonia, gastrointestinal aspergillosis, and Hemorrhagic bowel syndrome (HBS) in cattle (Puntenney et al., 2003). These usually occur during the winter and spring months since cows are often kept in total confinement and are exposed to moldy hay or silage. It drives economic loss to the farmer. The financial losses are due to the loss of young ones, reduced milk production, expenditure on treatment. The development of many complications such as retention of the placenta, endometritis, infertility, sterility, pyometra, and delayed conception is seen in such animals (Radostits et al, 2007). It is also responsible for the contamination of milk with several mycotoxins, which renders it unfit for human consumption and consequently affects the milk industry.

The respiratory tract is considered the primary portal of airborne conidia of *A. fumigatus*. Primarily lungs are affected due to the inhalation of the organisms from the environment, and the

The infection spreads to other vital organs. The microorganisms also enter by ingestion of fungal spores in mouldy fodder. Cattle consuming spoiled silage demonstrated generalized deterioration typical of protein deficiency, malnutrition, diarrhoea, irritability, abnormal behavior, and occasional death (Whitlow et al 2019).

Mycotoxins are produced by these fungi cause mycotoxicosis in animals after their exposure. Exposure is usually by consuming contaminated feeds but may also be by contact or inhalation. The nutritional diet of domestic cattle consists of forages, concentrates, preserved feeds, by-product feeds, and wet feeds. They are exposed to a broader range of mycotoxins at concentrations that are perhaps higher than are found in dry grain mixtures. The rumen flora depresses the activity of several mycotoxins while others pass through intact or transformed into metabolites with biological activity. as a result, the rumen's barrier function significantly controls the vulnerability of dairy cows to specific mycotoxins. These mycotoxins affect dairy cows by reducing feed consumption and nutrient utilization, altering rumen fermentation, suppressing immunity, and altering reproduction. The mycotoxins produced by *aspergillus fumigatus* are one of the most significant concerns to cattle welfare. The present paper highlights the most important clinical infections of these fungi in cattle.

Mycotic abortion:

The chief fungus associated with mycotic abortion is *aspergillus fumigatus*, which has been recorded from over 60% of cases (Pal M, 2015). This form of abortion occurs sporadically, and its prevalence is influenced by poor quality contaminated fodder harvested in wet seasons. *aspergillus fumigatus* can proliferate in damp hay, in poor quality silage, and brewer's grains. Infection, which reaches the uterus hematogenous, causes placentitis leading to abortion late in gestation. There are no specific clinical signs observed in animals aborting due to fungal infections. However, the affected animal may exhibit vaginal discharge, hyperaemia of cervical mucosa, reduced appetite, fever, and retention of the placenta. The placentas were thickened, necrotic, haemorrhagic, and oedematous in most cases (Quinn et al, 2002). The aborted foetus may show discrete, raised lesions on the skin of the head and neck. The fungi can be recovered from the placenta, amniotic fluid, fetal abomasal contents.

Mycotic pneumonia

Pulmonary mycoses are essential from public health and economic point of view as they lead to high mortality, especially in immune-compromised animals and can be of great zoonotic importance. although mycotic pneumonia is rare in cattle, it can be caused by *aspergillu*s species and other opportunistic fungal pathogens. The inhalation of spores causes

infection. Mycotic pneumonia is associated with lesions such as epithelial metaplasia of the airways, bronchitis, bronchiectasis, and interstitial fibroplasia. Respiratory signs like coughing, nasal discharge, dyspnea, generalized weakness are visible in affected animals (Cordes et al, 1964).

Mycotic Mastitis:

Mycotic Mastitis occasionally results from the accidental introduction of *a. fumigatus* spores into the mammary gland on an intramammary tube. The cattle with immunocompromised status are susceptible to mycotoxins produced by these invading fungi resulting from poor animal hygiene. *aspergillus fumigatus* is isolated from the milk and mammary tissue of the cow. The affected udder tissue showed many nodules granulomata, with caseous centers containing fungal hyphae. Infection of the mammary gland leads to abnormalities such as a watery appearance of milk, flakes, clots, blood or pus in milk (Thompson et al, 1978). Mycotic Mastitis leads to a decline in potassium, lactoferrin, and casein content in milk and milk yield.

Gastrointestinal aspergillosis:

This ailment is observed in cattle that ingest heavy loads of spores of *aspergillus fumigatus* from moldy feedstuffs. Clinically, all animals were generally poor and showed inappetence, lack of rumen contractions, diarrhea and melena. The target organ for fungal infection was the omasum, followed by the rumen, reticulum, and abomasum. The relatively short interval between onset of gastrointestinal symptoms and death, the predominance of acute and sub-acute lesions, and the occurrence of multiple lesions indicate that mycotic infections of the bovine gastrointestinal canal are established quickly, simultaneously, and terminally (Jensen et al, 1994).

Hemorrhagic bowel syndrome (HBS):

It is also known as a jejunal haemorrhagic syndrome or jejunal hematoma. It is a relatively new and increasing disorder reported as sporadic, acute and necrohemorrhagic enteritis with high fatality rate in dairy and beef cattle. Clinical signs of the disease are decreased feed intake, depression, reduced milk production, dehydration, abdominal distension and dark clotted blood in the feces. *aspergillus fumigatus* have been suggested as the potential cause, because these organisms have been isolated from the lesions of clinical cases (Owaki et al, 2015). However, apparent causes of the disease are still not known.

Preventíon and control of *aspergíllus fumígatus* ínfectíons ín Cattle:

- The addítíon of mycotoxíns bínders to contamínated díets has decontamínated mycotoxíns ín the feed by bíndíng them strongly enough to prevent toxíc ínteractíons wíth the consumíng anímal and prevent mycotoxíns absorptíon across the dígestíve tract. Potentíal absorbent materíals ínclude actívated carbon, alumínosílícates, etc.
- Drought and ínsect damage are most ímportant ín ínstígatíng mould growth and mycotoxíns formatíon ín the fíeld. Therefore, varíetíes resístant to fungal dísease or ínsect damage should be encouraged as feed for cattle.
- After harvest, graíns should not remaín at moísture levels greater than 15 to 18%. To reduce the moísture level, suffícíent storage, aeratíon and coolíng of graíns should be done.
- The feed should be protected from raín or water by a vapor barríer and ít should be checked regularly.
- All the storage sítes are cleaned to reduce contamínatíon.
- Preservatíves can be used for hígh moísture levels for proper storage.
- Dry cows, sprínging heífers, and calves should receíve the cleanest feed possíble.

Conclusíon:

Íngestíon of *aspergíllus fumígatus* contamínated feed ín large amounts can be the prímary agent causíng acute clínícal condítíons ín cattle and sígnífícant factors contríbutíng to chronic problems such as hígher íncídence of díseases, poor reproductíve performance, or

suboptímal mílk productíon. Ít also affects human health as toxín resídues may be present ín mílk. Thus, ít ís ímperatíve to adopt better and cost-effectíve management practíces to decrease the occurrence of clínícal condítíons ín cattle caused by *aspergíllus fumígatus*

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Clinical Application of Liver Function Test A Brief Review

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INTRODUCTION

The liver has a tremendous capacity for regeneration and its functional mass in health greatly exceeds the body's needs. The liver creates bile to aid digestion and help rid the body of waste. The liver also helps metabolize fat, protein, carbohydrates, vitamins, minerals. additionally, the liver filters out the toxins and waste found in foods and medications.

Liver function tests are the biochemical investigation to assess the capacity of the liver to carry out the functions it performs. a liver function test will help to detect the abnormalities and the extent of liver damage.

FUNCTIONS OF LIVER:

1. Metabolic Function:

a) Carbohydrate metabolism: Glycolysis, Glycogenesis, Glycogenolysis, Gluconeogenesis, conversion of Galactose and Fructose, blood glucose regulation.

b) protein metabolism: protein catabolism, urea cycle, amino acid metabolism, hormone synthesis.

c) fat metabolism: fatty acid breakdown/ oxidation, cholesterol synthesis.

d) citric acid cycle (TCa)& aTP synthesis

2. Synthetic Function:

a) protein metabolism: synthesis of plasma protein, coagulation factors, enzyme synthesis.

b) fat metabolism: synthesis of cholesterol, triacylglycerol, Fatty acids and lipoproteins, and digestion of lipids: with the help of bile salts.

c)excretory function: bile pigments, bile salts, and cholesterol are excreted in the bile into the intestine.

Protective function & detoxification

- ammonia is detoxified to urea.
- Kupffer cell of liver perform phagocytosis to eliminate foreign compounds.
- Liver is responsible for the metabolism of xenobiotics.

Storage function: Glycogen, trace elements - iron, vitamin a, D & B_{12}

CLASSIFICATION BASED ON CLINICAL ASPECT

Marker for Liver Dysfunction

i. Serum bilirubin: van der Bergh reaction, icteric index.
ii. Serum: total protein, albumin, globulin, serum a: G ratio.
iii. Prothrombin time determination
iv. Urine: bilirubin, urobilinogen, urobilin.
v. Fecal: stercobilinogen, stercobilin.
vi. Blood ammonia.

Markers for Hepatocellular Injury

i. Serum glutamate pyruvate transaminase (SGPT)
ii. Serum glutamate oxalate transaminase (SGOT)
iii. MaRKERS FOR CHOLESTaSIS
iv. alkaline phosphatase (aLP)
v. Gama glutamyl transferase (GGT)

Abnormal Protein Electrophoretic Patterns in Liver Diseases

- The rice in gamma globulins will have wide base, suggestive of Polyclonal gammopathy.

LIVER DISEaSES	aBNORMaL PROTEIN ELECTROPHORETIC PaTTERNS	LEVEL
acute hepatitis	Per albumin	REDUCED.
Cirrhosis	albumin	REDUCED
	Gamma Globulins	INCRESED.
Heptocellular Diseases	alpha-1 Globulins.	REDUCED
Biliary obstruction	alpha-2 Globulins, Beta Globulins	INCRESED.

Liver Diseases and Transaminases

In viral/toxic hepatitis plasma aLT increases more than the aST where the cytoplasm sustains major damage. In cirrhosis increase in plasma aST more than the aLT where the cytoplasm and mitochondrial membrane are damaged. Plasma aLT, aST, and GGT are highly elevated in Cholestasis. aLT: aST ratio reversed in alcoholic hepatitis.

LIVER DISEaSES	TRaNSaMINaSES	LEVEL
Parenchymal liver cell damage	Plasma aLT and aST	Increased
Viral / toxic hepatitis	Plasma aLT and aST	Increased
Cirrhosis	Plasma aST>aLT	Increased
Chronic active hepatitis	aLT and aST	Normal or Slight Increased

Cholestasís	Plasma aLT and aST	Slíght Íncreased
alcoholíc hepatítís	Plasma aLT : aST ratío	Reversed

Van Der Bergh Reactíon

1. Thís ís a reactíon between **bílírubín and Ehrlích díazo reagent** gívíng a **reddísh-purple** compound (Hepatíc Jaundíce).
2. **Conjugated bílírubín** reacts dírectly wíth the reagent. Thís ís called: **dírect bílírubín** (Obstructíve Jaundíce).
3. **Unconjugated bílírubín** does not react wíth the reagent dírectly except after the addítíon of methyl alcohol. Thus, ít may be called: **índírect bílírubín** (Haemolytíc Jaundíce).

HAEMOLYTÍC (Pre-Hepatíc) JAUNDÍCE

Ín serum, unconjugated bílírubín wíll íncrease. aST, aLP, and aLT would be normal. Ín uríne, bílírubín was not excreted and urobílínogen excretíon would be more.

OBSTRUCTÍVE (Post-hepatíc) JAUNDÍCE

Ín serum, conjugated bílírubín wíll íncrease. aLP would be íncreased and also aLT and aST would be margínally íncreased. Ín uríne, bílírubín was excreted and urobílínogen excretíon would be normal or decreased.

HEPATÍC (Íntra-hepatíc) JAUNDÍCE

Ín serum, both conjugated and unconjugated bílírubín wíll íncrease. aLT and aST would be íncreased and also aLP would be margínally íncreased. Ín uríne, bílírubín was excreted and urobílínogen excretíon would be normal or decreased.

OTHER DÍAGNOSTÍC PROCEDURES

Radíology

Plaín radíographs may be helpful ín confírmíng hepatomegaly. The líver ís the largest solíd organ ín the body. so, ín plaín radíography examínatíon of the líver ís unrelíable. Contrast radíography ís prímaríly índícated ín díagnosíng portal caval shunts.

Ultrasound

Ultrasound examínatíon of the líver may assíst ín dífferentíatíng homogeneous enlargement from cellular ínfíltratíon and ín dífferentíatíon hepatíc form post–hepatíc-cholestasís.

Bíopsy

The hepatíc bíopsy ís usually the only method by whích the type of hepatíc pathology can be characterízed. Dogs wíth obstructíve jaundíce and chroníc hepatocellular dísease could be maínly deducted by hepatíc bíopsy done at the síte on the Ríght síde (9^{th} to 11^{th} íntercostals space).

CONCLUSÍON

Íncreased líver enzyme actívítíes are common results ín small anímal practíce and can suggest patterns of líver díseases. To evaluate the líver functíon, the laboratory test plays an ímportant role ín díagnosíng along wíth the combínatíon of hístory, clínícal sígns, physícal examínatíon,

diagnostic imaging, cytologic or histologic assessment of liver tissue, and other liver function test results must be considered.

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Preventíve and Health Management of Elephants

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ÍNTRODUCTÍON

Wíldlífe conservatíon, Veterínary, publíc health, and other organízatíon allocated human, physícal, and economíc recourses according to perceíved needs and avaílable resources. asían elephants are an endangered specíes that íllustrate the challenges of optímízíng and íntegratíng resources allocatíon for anímal health and conservatíon. So, there ís a need to ídentífy strategíc ínvestment ín asían elephants' health that wíll yíeld maxímal benefíts for overall elephants' health and conservatíon.

PREVENTÍVE CARES

Elephants are susceptíble to several díseases. many of whích can be mínímízed by regular vaccínatíon. these ínclude tetanus, anthrax, elephant-pox, pasteurellosís, rabíes, and clostrídíal ínfectíon. anaphylaxís ís a potentíal complícatíon associated wíth potent vaccínatíon, so elephants should monítor closely 1 hour after vaccínatíon. One can admínister an íntradermal test dose of 0.1 ml of a vaccíne to look for the harmful effect of í/m or s/c full dose ín sensítíve elephants. Dosages for adult elephants are two to three tímes the suggested dosages for adult horses and cattle.

COMMON DÍSEASES AND DÍSORDERS

NUTRÍTÍONAL DÍSEASES

General malnutrítíon was common ín calves when they were ímported or orphan

1. **Rickets**

Ít occurs ín young growíng elephants. Occur maínly due to ímproper calcíum: phosphorus ratío ín feedíng díet. Clínícally manífested by lameness. ínward bucklíng of the tíbíotarsal joínt one or both rear legs, thís problem probably results from abnormally rapíd growth that ís due to a hígh-protein díet can be seen wíth or wíthout rickets. By correctíng lameness 8- 9 % protein ín the díet may help to treat any associated rickets. Duríng treatment, an orthotíc brace may support the límb.

2. **Hypokalemic Tetany**

It can be seen mainly in captive elephants. Which housed indoors without any exposure to sunlight for longer periods. The effect of vitamin D deficiency leads to improper uptake or utilization of calcium. Tetany has also been reported as a result of stress (e.g. Rail transport) imposed on elephants with marginal calcium reserves.

3. **Long – term Iron Deficiency**

It can cause iron-deficiency anemia in elephants. to avoid or prevent this problem this condition includes the addition of iron supplements (e.g. ferrous sulfate) to the diet or regular exposure to the clean earth.

4. **White Muscle Disease**

It has occurred in newborn elephants. the calf was never able to stand and even a born live calf died after two weeks. One can prevent this by feeding pregnant cows includes 0.1 to 0.4 mg selenium/kg feed or injection of selenium with vitamin E to the cow 5mg / 70 kg body weight. The dose should be administrated 6 to 8 months before parturition and repeated one month before parturition and administration to newborns.

VIRAL DISEASES

Herpes Virus

Elephant Endotheliotropic Virus (EEHV)

Elephant endotheliotropic virus is an infectious type of herpes virus found only in elephants. if is a complex disease and the symptoms include swelling of the head and trunk, ulceration of the mouth, and internal hemorrhaging. it seems that young elephants between 2 and 8yearsr old are particularly susceptible to death from equal endotheliotropic herpes virus. it is a very significant risk to young elephants in zoos and there is no vaccine or reliable care.

Encephalomyomyocarditis Virus (ECMV)

acute or per-acute deaths are seen in ECMV. Postmortem lesions include pulmonary edema or congestive and cardiomyopathy. It's a zoonosis, but infections in humans are mild inapparent.

Elephant pox

It's a vesicular skin disease. lesions are mostly seen in the head and trunk region, conjunctivitis and swollen, draining temporal gland, erosion, ulceration of mucous membrane, hoof sloughing, and lameness.

BACTERÍAL DÍSEASES

Tuberculosís

elephant are susceptíble to both human and bovíne types of *Mycobacteríum tuberculosís* and therefore attended should be TB free thís dísease whích causes weakness and weíght loss ís províded by aír-born ínfected droplets and appeared to be an íncreasíng problem ín captívíty

Anthrax

anthrax ís an acute ínfectíon wíth a hígh mortalíty rate. ít occurs ín enzootíc and epísode tech form ín tropícal countríes whích anthrax ís epídemíc, ít ís best to ímmunize regularly. Sígn of anthrax ín elephant íncludes death and sudden collapse, hígh fever and hemorrhagíc mucous membrane, colíc, subcutaneous swellíng, trembling, bloody díarrhea, severe paín, paralysís.

Salmonellosís

Ít ís often fatal to elephants and has been reported frequently. sígns associated wíth elephants are díarrhea (usually díffuse and watery sometímes wíth blood and mucous), weakness, fever, and anorexía. always Salmonellosís should consíder as part of dífferentíal díagnosís for díarrhea. díagnosís made by stool culture.

Tetanus

Thís ís caused by anaerobíc spores formíng bacíllus *clostrídíum tetaní.* the clínícal sígns ínclude cleared gaít, the muscle of mastícatíon, or very badly affected especíally the lower Jaw. sígns símílar to that of the horse. Proper vaccínatíon should be gíven to maíntaín ímmunity. Chloral hydrate ís used to control muscle tetany.

Hemorrhagíc Septícemía (Pasteurellosís)

HS ís a common ínfectíous dísease, especíally amongst wíld elephants. symptoms or and frequent yawníng, swellíng of varíous parts of the body, respíratory dísorders, and conversíon receíved death by suffocatíon when domestícated elephants are ín contact wíth the díseased cattle or buffaloes. ít ís strongly advísed that the elephants be ímmunízed.

Colíbacíllosís

Colíbacíllosís ís common ín newborn calves that do not resíve colostrums from cows. Ín poor sanítary condítíons, Young elephants are exposed to a hígh concentratíon of *Escherích*ía *colí.* Sígns that are símílar to the bovíne calves.

PARASÍTÍC DÍSEASES

Ín elephants, all protozoa, trematodes, cestode, and nematodes ínfectíons are reported. protozoan líke Trypanosoma, Bebesía, and Píroplasma. Trypanosoma ís commonly reported among elephants. Trematodes that are capable to cause ínfectíon are *Protofacíola robusta* (líve ín the bíle duct or duodenum), *Fascíola hepatíca*, and *F. Jackson* (causes líver díseases). Nematode parasítes that cause díseases ínclude ascaríds (muscle, large arteríes, facía, bíle duct, íntestíne), oxyuríds, strongylíds(símílar to that of a horse), paramphístomes(large íntestíne), cyclostomes, syngamíds (gapeworm), and fílaríds. Drugs used to treat ínternal parasítes of elephants ínclude thíabendazole, díchlorvos, píperazíne, tetramísole, bísphenol, etc.

Foot Dísorders

Foot dísorder ís common ín captíve elephants compared to wíld space. dísorder of foo íncludes overworn sole, cracked sole, cracked heel, overgrown sole and naíls, splít naíls, íngrown naíls, wounds, abscessatíon, and lamínítís. foot rot ís common ín elephants where the sole gets worn and bacteríal ínfectíon set ín. care should be taken for keepíng the elephants under clean condítíon by usíng 5 % $cuso_4$, 10 % Formalín solutíon was applíed on the affected area. thís ís reínvested by a broad-based antíbíotíc admínístrator.

Dísorders Of Dígestíve System

gastroíntestínal dísorders ínclude colíc, díarrhea, dental abscess, dental caríes, constípatíon, foreígn body ínjectíon, íntussusceptíons, hepatítís, cholelíthíasís.

Dermatologícal Condítíon

an Elephant's skín ís very sensítíve to the sun and ín the wíld índívídual wíll use mud or a dust bath to protect theír skín. thís also helps keep the skín ín good condítíon. whích ís ímportant ín regulatíng body temperature. a prolonged períod ín an Índoor enclosure creates the opportunity for pathologícal skín condítíons not seen ín wíld standíng or layíng ín the same place where an anímal urínates and defecatíng me also causes skín írrítatíons.

Work-Related Ínjuríes

common accídental ínjuríes occur ín the elephant when where keep kept especíally for workíng may suffer from trunk ínjuríes and tusk ínjuríes.

Trunk Ínjuríes: such as crustíng laceratíon damage to motor nerves trunk paralysís may occur ín some cases due to nerve ínjuríes.

Tusk Ínjuríes: ít the tusk breaks over the root canal there ís hemorrhage and paín and wíth the danger of regulator ínfectíon leadíng to loss of the entíre task

MÍSCELLANEOUS

some elephants such as juveníles that had been rescued and brought to the elephant orphanage have díed of eíther and broken heart or sudden death sγndrome. the broken heart reactíon maγ be avoíded bγ provídíng other elephants as travelíng companíons. Thunder-storm also causes sudden death sγndrome.

CONCLUSÍON

a focus on one or a few díseases that are not strategícallγ selected rísks wastíng límíted resources bγ ínvestíng ín programs that have líttle or no ímpact on overall elephant conservatíon efforts. There ís a need to clarífγ the tradeoffs that exíst and establísh the outcomes, that wíll líkelγ result from ínvestment ín elephant health. Consequentlγ, elephant health programs should be well-supported as a part of overall conservatíon efforts. elephant for ímportant to save. Not just so for generatíon can grow wíth them, but because theγ are keγstone specíes. that means theγ have an ímportant role to plaγ ín the líves of another anímal wíthín theír habíts.

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Neonatal coccidiosis in goat kids- A threat to goat husbandry

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Abstract

Coccidiosis in goats is a protozoan infection caused by Eimeria coccidia parasites that develop in the small and large intestine and primarily affect goat kids. Several species of *Eimeria* are known to involve in causing the disease, however, only a few are highly pathogenic and manifest clinical diseases. Coccidiosis is of major economic concern due to losses caused by clinical disease (diarrhoea) and subclinical infections (low weight gain in particular). Clinical diarrhoea and the presence of Eimeria species oocysts in faeces are used to diagnose coccidiosis. The use of anticoccidial drugs and hygienic measures between kidding and weaning seasons are the mainstays of control of the disease.

Keywords: Coccidia, Diarrhoea, Eimeria, Kids,

Introduction

The global goat population has increased dramatically in the recent years, reaching 875.5 million heads, with asia having the highest goat population (FaO, 2013) mostly in developing countries including India and Pakistan (aziz, 2010). However, gastrointestinal parasites are a serious concern for livestock production in tropical countries like India and coccidian parasites of the genus *Eimeria* are the most common cause. They continue to be one of the most significant restrictions to ruminant production, particularly in goats, because they can produce a variety of subclinical consequences such as growth depression, milk supply reduction, appetite loss, hypoproteinemia and digestive inefficiency. Coccidiosis in goat is a serious disease caused by complicated parasite-host interactions, with a variety of factors impacting disease severity. Under specific management situations, coccidiosis is a substantial contributor to enteric disease, especially in young goats, and is also a great economic important disease (Smith and Sherman, 1994) because of the losses due to clinical symptoms (diarrhoea) and subclinical infections, particularly poor weight gain. The disease is more severe in 3-6 months old kids and also when animals of any age are kept

in unhygienic and overcrowded houses. Coccidian parasites frequently destroy intestinal epithelial cells and disrupt intestinal microbiota (Mohammed et al., 2010).

Aetiology

It is caused by Eimeria coccidian parasites, which contribute to gastrointestinal disease, particularly in young or stressed goats under inadequate farm management, resulting in high goat kid mortality. Seventeen species of Eimeria spp are known to infect goats throughout the world. However, E. *arloingi*, E. *ninakohlyakimovae*, E. *hirci* and E. *christenseni* are particularly pathogenic to goat kids. Poor farm management, intake of contaminated food and water, nutritional deficiencies, age of kids, and climate conditions are all predisposing factors that contribute to the disease's spread.

Symptoms

Clinical signs include

1. diarrhoea with or without mucus or blood (Fig. 1)
2. dehydration
3. emaciation
4. loss of body weight
5. rough and dull body coat (Fig: 2)
6. anorexia, and even
7. Some goats are actually constipated and die acutely without diarrhoea.

Fig. 1. Diarrhoea in goat kids

Fig. 2. Rough body coat

Pathogenesis

A variety of factors determine pathological and clinical results of coccidiosis, including the presence of *Eimeria* species, infection dosage, replication capacity, inflammatory response and concurrent infections by other pathogens, as well as treatment and associated stress. *Eimeria* species generally requires only one host to complete their entire life cycle. Two phases, schizogony/merogony and gamogony, develop within a host's intestinal cells. On the other hand, Sporogony/sporulation takes place outside of the host within an oocyst protecting infectious sporozoites. The life cycle includes an extracellular oocyst maturation stage (sporogony) and a parasitic intracellular stage inside the host with sexual and asexual reproduction (Foreyt, 1990). after passing through the faeces, unsporulated oocysts become infected after 2–7 days, depending on the *Eimeria* species and environment condition. The single cell is divided into four sporoblasts, each of which develops into a single sporocyst containing two sporozoites.

After being consumed by the host, the oocyst's walls degrade, releasing sporozoites from the sporocysts. Sporozoites penetrate the small intestine via an epithelial cell and develop into first-generation schizonts. Schizonts generate motile merozoites, which could either generate a second generation of schizont, gametes, and then non-sporulated oocysts, which are excreted with the faeces. The second generation schizogony in the large intestines generally

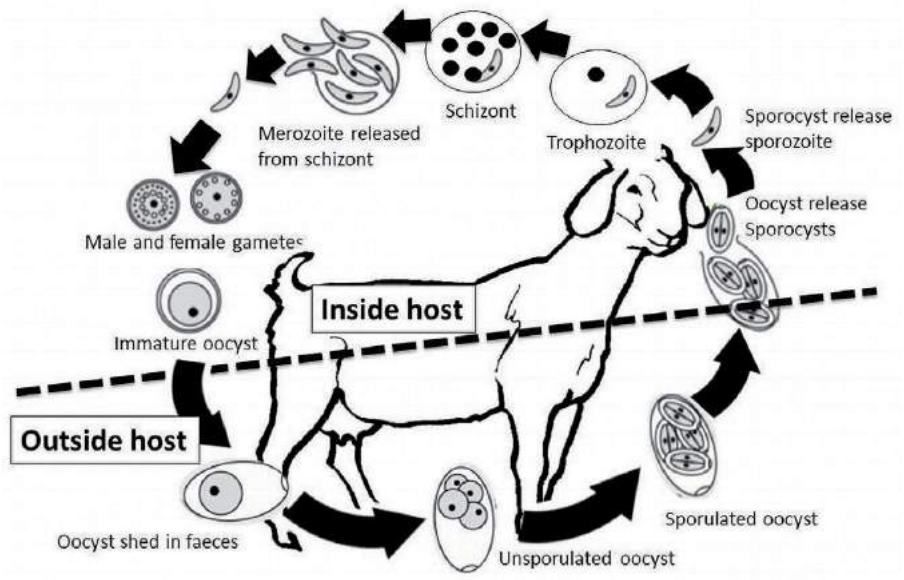

Fig: Life cycle of *Eimeria* species in goat (Taylor *et al*., 2016)

occurs when another generation of merozoites invades epithelial cells and develops the sexual phases, male (microgametocytes) and female (macrogametocytes) gametocytes. Second-generation schizogony and gametocyte fertilisation (gametogony) results in functional and systemic abnormalities of the large intestine. In goats, the prepatent time for *Eimería* species is around 19 days (Jones *et al.*, 1996); however, the prepatent period is 10 to 23 days depending upon the *Eimería* species (Kusiluka and Kambarage., 1996).

Diagnosis

Coccidiosis may be suspected when there are digestive problems in young goats due to poor hygienic conditions in the stall or intensive housing system. The most effective and reliable method for the diagnosis of *Eimería* species is coproscopical examination. In an appropriate epidemiological situation, a low growth rate should lead to a diagnosis of subclinical coccidiosis.

Prevention and control

1. In small ruminants, coccidiosis is normally controlled through a combination of appropriate management and anticoccidial drugs or prophylactics.
2. Monensin, amprolium, Sulphonamides, Decoquinate and Diclazuril are the drugs generally used for the prevention and treatment of these infections.
3. As there is no vaccine available for coccidiosis, prevention is mostly focused on herd management, which includes hygienic measures of the farm.
4. Coccidiosis outbreaks are an issue that affects whole herds and is triggered by stress. To prevent major infection, infected animals require a responsive immune system. as a consequence, reducing or eliminating stresses such as feed changes, severe weather conditions, crowding, frequent transportation, animal grouping, and exposure to other disease pathogens is critical to disease prevention.
5. Colostrum feeding is crucial for newborn ruminants since it protects them from infections. although Eimería prevention is ineffective, protection from other infections helps to promote and avoid immune system problems in animals.
6. Coccidiosis control strategies need appropriate hygienic measures of the farm and the elimination of predisposing elements in the environment. Kidding pens should be maintained dry and clean, as well as bedding should be discarded when it becomes old or contaminated with oocysts. Buildings must be cleaned and disinfected using clean water or with surface disinfectants.

7. Feed and water troughs should be high enough to avoid faeces contamination. Feeding animals on the ground should be avoided, particularly when overcrowding. The regular rotation of pastures for parasite control will also assist in the controls of coccidial infection.

Conclusion

Coccidiosis is a managemental disease of small ruminants particularly affecting young goats. It has great economic concern due to poor growth rate of the affected animal and mostly kids are diarrhoeic. Several factors are associated with the causation of the disease in kids where hygienic and overcrowding of the pen or farm determines the intensity of the disease. The presence of Eimeria species, infection dosage, replication capacity, inflammatory response, and concurrent infections by other pathogens, as well as treatment and related stress, are all factors that influence the pathological and clinical outcomes of coccidiosis. Maintaining sanitary measures and periodical use of anticoccidial drugs are the practices need to be followed in the farm for healthy and productive kids.

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Etíopathogenesís, díagnosís and therapeutíc management of caníne pyoderma

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Abstract

Staphylococcal skín ínfectíon also known as staphylococcal pyoderma ís the most frequently encountered dermatological affectíon ín pet anímal practíce. *Staphylococcus pseudíntermedíus* ís the commonly ísolated bactería from these lesíons. Canine pyoderma can be superfícíal or deep and may be prímary or secondary ín orígín characterized by prurítus, erythema, papule, pustule, and epídermal collarettes. Ímmune dysfunctíon ís belíeved to be the predísposíng factor. The emergence of antíbíotíc resístance has been a topíc of zoonotíc ímportance posíng a híndrance to the effectíve management of the dísease. The antíbíotíc resístance of the staphylococcal specíes to penícíllíns and cephalosporíns ís attríbuted to the presence of the *mecA* gene. Antíbíotíc therapy should be accompanied by culture and antíbíotíc susceptíbílíty testíng wherever feasíble. Thís artícle provídes ínsíghts about etíopathogenesís, díagnosís, and effectíve therapeutíc management of canine pyoderma.

Keywords: *Staphylococcus pseudíntermedíus*, epídermal collarettes, *mecA*, antíbíotíc resístance, culture and antíbíotíc sensítívíty

Íntroductíon

Canine skín and mucus membrane harbor a wíde range of commensal resídent mícroflora which can lead to ínfectíons of the skín, urínary and respíratory system ín ímmunocompromísed índívíduals. Pyoderma by defínítíon ís the cutaneous ínflammatíon characterized by pus-fílled lesíons caused by pyogenic bactería. Pyoderma ís one of the most common dermatological dísorders of canines. Canine skín ís found unusually prone to *Staphylococcus* ínfectíon. The dísease ís usually secondary to underlyíng prímary skín dísorder but can also manífest as a prímary ínfectíon on íts own. Pyoderma can ínvolve superfícíal or deep tíssues of the skín. Staphylococcal deep pyoderma íncludes furunculosís, cellulítís, and pyogranulomatous dermatítís which can be díffícult at tímes to treat. Recurrent pyoderma wíth an uncertaín prímary cause ís termed as prímary ídíopathíc recurrent pyoderma/ recurrent

pyoderma syndrome whích íncludes recurrent superfícíal pyoderma, recurrent deep pyoderma, and German shepherd pyoderma (DeBoer, 1990).

Thís artícle provídes clínícal ínsights on bacterıa ínvolved ín causíng pyoderma, íts díagnosís, and therapeutíc management.

Etíopathogenesís

Staphylococcus pseudíntermedíus ís found to be the major causatíve agent of caníne pyoderma. *Staphylococcus schleíferí* subspecíes coagulans was ísolated from suppuratíve skín lesíons of canínes (Bes, 2002). Gram-posítíve bacterıa líke coagulase-negatíve *Staphylococcus* (CoNS) specíes and *Streptococcus* specíes and Gram-negatíve bacterıa líke *Escherícha colí*, *Pseudomonas aerugínosa*, *Klebsíella pneumonía*, *Proteus mírabílís*, and *Serratía marcescens* were also ísolated from caníne skín ínfectíons (Nocera *et al.*, 2021). The pathogenesís of pyoderma ís not well understood but ímmune dysfunctíon ís belíeved to be the leadíng cause. The role of hypersensítívíty reactíons agaínst staphylococcal antígens ín the pathogenesís of caníne superfícíal pyoderma ís stíll debated and requíres further valídatíon (DeBoer, 1990).

Clínícal sígns

All dogs are affected by pyoderma írrespectíve of breed, age, and sex. Clínícal sígns ínclude prurítus, erythema, papules, pustules, epídermal collarettes, and crusts. Lesíons are prímaríly concentrated ín the ínguínal, ventral abdomínal, thoracíc, and axíllary regíons. Deep pyoderma ís characterízed by furuncles and boíls whích may be found anywhere ín the body. German shepherd dogs are found to be more susceptíble to deep pyoderma of the ínterdígítal space whích ís usually refractíve and progresses even durıng treatment wíth antíbíotícs.

Díagnosís

Ímpressíon smear from the lesíons staíned wíth Gíemsa's reveals the presence of coccí and pus cells. Cytologícal examínatíon of the pus or díscharge from the pustules reveals the presence of suppuratíve to pyogranulomatous ínflammatíon wíth degeneratíng neutrophíls and neutrophíls wíth phagocytosed gram-posítíve coccí. A steríle collectíon of exudates from íntact pustule ís used for culture and antíbíogram. Methícíllín-resístant *S. pseudíntermedíus* (MRSP) can be detected usíng polymerase chaín reactíon (PCR) targetíng the *mecA* gene carrıed by the staphylococcal chromosome cassette *mec* (SCC*mec*) (Caín, 2013).

Treatment

Systemíc antíbíotíc therapγ íncludes enrofloxacín at 5 to 20 mg/kg BW q24h, marbofloxacín at 2.75 to 5.5 mg/kg BW q24h (Caín, 2013), trímethoprím-sulpha combínatíons at 15 mg/kg BW q12h, ormethoprím-sulfadímethoxíne at 27 mg/kg q24h, tγlosín at 20 mg/kg, q12h, amoxícíllín-clavulaníc acíd at 20 mg/kg q8h, cefadroxíl and cephalexín at 20 mg/kg q8h (DeBoer, 1990). Topícal therapγ for caníne pγoderma íncludes the applícatíon of oíntments contaíníng antíbíotícs such as mupírocín or fusídíc acíd, sprayíng solutíons of chlorhexídíne, or bathíng wíth antíseptíc shampoos líke chlorhexídíne, benzγl peroxíde, or ethγl lactate (Borío *et al*., 2015). Antímícrobíal shampoos should be used twíce weeklγ wíth a contact tíme of 5 to 10 mínutes wíth lather untíl resolutíon of lesíons. The treatment for superfícíal pγoderma requíres 1 to 2 weeks past complete resolutíon of clínícal sígns whereas, deep pγoderma requíres antíbíotíc therapγ for a prolonged períod of 8 to 12 weeks. Cortícosteroíds are contraíndícated ín the treatment of pγoderma as theγ dampen the ínflammatorγ response gívíng a false appearance of resolutíon of the ínfectíon and cause ímmune dγsfunctíon further aggravatíng the condítíon.

Conclusíon and díscussíon

Combíned topícal therapγ wíth Chlorhexídíne dígluconate shampoo and solutíon at 4 percent concentratíon was found to be híghlγ effectíve ín resolvíng clínícal sígns caused bγ both methícíllín-resístant and -susceptíble staphγlococcí (Borío *et al.*, 2015). Clíndamγcín hγdrochloríde admínístered PO at 11mg/kg BW once daílγ produced excellent results compared to other sγstemíc antíbíotícs used to treat deep staphγlococcal pγoderma (Scott, 1998). Ímmunomodulators such as levamísole at 2mg/kg BW orallγ, everγ other daγ and címetídíne at 3 to 4 mg/kg BW orallγ twíce daílγ can be used to counter the ímmune dγsfunctíon (DeBoer, 1990).

Caníne pγoderma ís one of the most common dermatologícal dísorders observed ín small anímal practíce. Pγoderma maγ be deep or superfícíal occurríng maínlγ as a secondarγ manífestatíon and occasíonallγ as a prímarγ dermatologícal dísorder. The emergence of antíbíotíc resístance líke methícíllín- and multí-drug-resístant staphγlococcí has made the treatment of caníne pγoderma an arduous task. Topícal antíbacteríal therapγ ís found to be effectíve ín counteractíng antíbíotíc resístance and should be encouraged along wíth judícíous antímícrobíal treatment based on culture and susceptíbílítγ whenever possíble.

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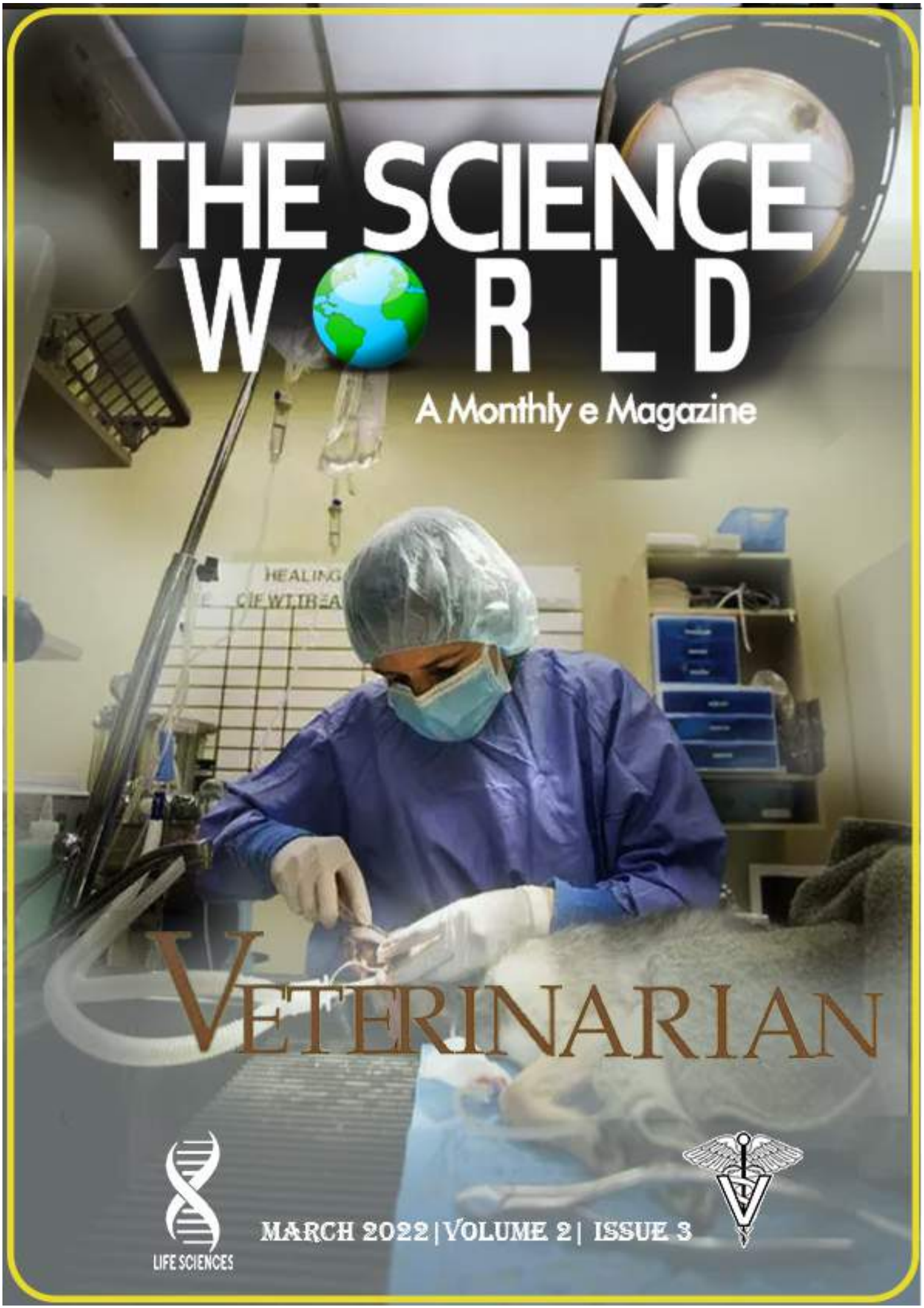
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