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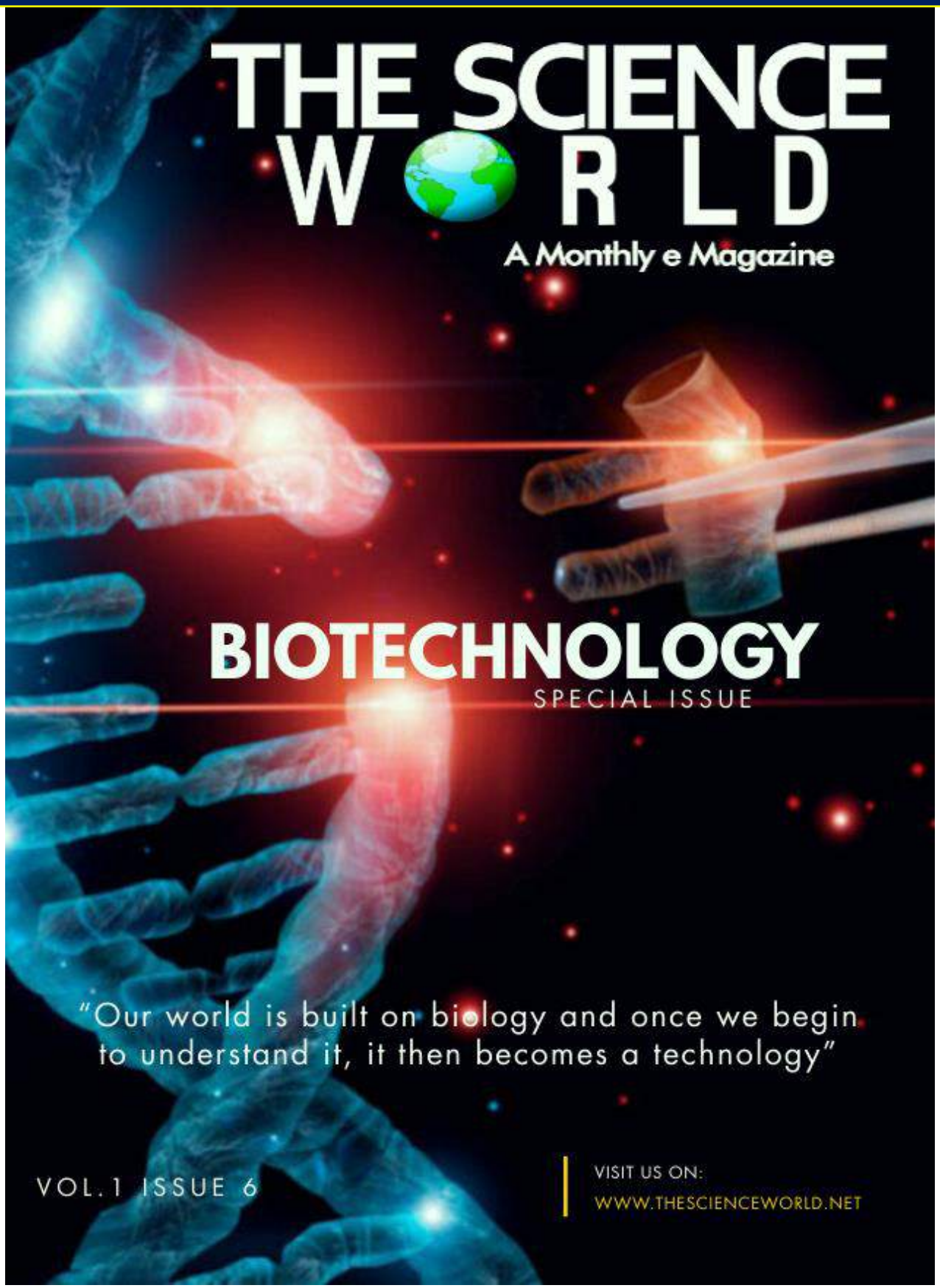

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Popular Article

Accentuating One Health perspectives of Covid-19

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Abstract

The "One Health" concept is a well-known idea; nevertheless, it has remained on the periphery of most practical wellbeing programs rather than being the primary focus. Although worldwide researchers and legislators have agreed on this idea, the shift from vision to the actual application has been sluggish. The Covid-19 outbreak has wreaked havoc on the global economy and continues to endanger human lives throughout the globe. The unfamiliarity of the concepts of the One Health approach in the present health care system has proven to be our health policy's weak spot. Therefore, understanding the broader perspectives of Covid 19 requires knowledge of the human-animal-environment interface. Furthermore, during this pandemic, it is now critical to address mental health concerns, since Covid 19 is becoming a stress-inducing pill daily.

Keywords: One health, COVID-19, Pandemic, Zoonosis

Introduction

Globally, the ongoing pandemic of Covid-19 is now a major health crisis because of its highly contagious and jiffy nature, with an escalating number of positive cases and deaths. Several countries are now vying to produce an efficient vaccine against Covid-19 since its genomic characterization and phylogenetic analysis was carried out. Aside from the dreadful data and human gloom, the coronavirus-driven politico-socioeconomic loss of several countries necessitates a reconsideration of the "One Health" concept, which was established many years ago as an all-encompassing process that included the direct influence

of ecological epidemiology on anthropological as well as animal health. It is widely now acknowledged that to achieve a healthy condition, people must recognize the critical contribution of coexisting species (like animals and plants), because we share the same habitat and ecosystem, revealing an inextricable link between environmental factors and human and animal health. As a result of this, the idea of 'One Health, One Medicine' emerged, which is regarded as a meeting point for veterinarians and human health. "One health" refers to the collaborative efforts of various disciplines working on a local, national, and global scale to promote maximum health for people, animals, and the environment. This technique is governed by several cliques, including public health experts, leaders of government and non-profit health organizations, economists, and ecologists. These international specialists must examine and scrutinize policies that are required for the prevention of possible epidemics. In these times, when the entire globe is fighting a pandemic and experiencing unparalleled economic collapse, the shift from the narrow idea of "health" to the larger concept of "One Health" is critical for improving public health results. By recognizing the intricate link between the environment and health, we must work hard and invest in establishing altruistic environmental and health policies for the benefit of all species.

Human and animal convergence

A plethora of infectious illnesses are categorized as zoonotic since they can impact a large number of human populations. The threat of the emergence and spread of new highly infectious illnesses such as SARS, Middle East Respiratory Syndrome (MERS), and the current COVID-19 pandemic is now being reported and is thought to be caused by a combination of factors such as population bloom, overseas travel, world trade, climate change, biodiversity loss, irregular human lifestyle, as well as pathogenic variations and mutations. In the twenty-first century, we have seen the emergence of zoonotic coronavirus infections, like Severe acute respiratory syndrome CoV (SARS-CoV) from China in 2003, the Middle East respiratory syndrome CoV (MERS-CoV) from Saudi Arabia in 2012, and the COVID-19 pandemic that is surfacing as a new threat to humanity, which has currently troubled millions and killed thousands of people in over 220 nations and territories globally. The most recent COVID-19 outbreak was caused by SARS-CoV-2 in Wuhan, China, and it is likely to have spread from bats to humans via an undiscovered intermediate animal host, with snakes or pangolins being of particular concern. Early epidemiological research has also revealed a probable link to animal-human transmission, while genomic and phylogenetic investigations have revealed a link between SARS-CoV-2 and CoVs isolated from bats. Coronaviruses, which are well-known for their capacity to leap between species, may also be transferred from one animal

species to another. Figure 1 depicts the probable role of animals in SARS-CoV-2 transmission, putative intermediate hosts, natural and experimental animal infection.

Since the Wuhan market in China not only trades freshly killed wild animals but also supplies living animals for human consumption, it has been hypothesized that the initial introduction of Covid-19 into the human population occurred either through direct contact with an infected animal in Wuhan or through eating raw meat from wild animals. Another hypothesis is that the virus arrived through the illicit trafficking of animal flesh from a certain location. A typical illustration of the intricate interdependence between animal-human health and the environment would be the infection caused by the "West Nile Virus," which is transferred to people via mosquitoes. In this case, the ideal approach would necessitate monitoring of the mosquito population, the migration pattern of birds carrying the virus, and the climate conditions that create suitable conditions for mosquitoes to breed. The primary difficulty with flu viruses is that their genomes are continuously altered as they evolve, and so they may impact other animals, including humans, by easily entering the food chain. The virus may also be transmitted from people to animals, as evidenced by recent reports of SARs-CoV-2 being isolated from animals; two cats in New York, a tiger from the Bronx Zoo, and later, three additional lions and tigers were confirmed to be carrying the virus. Officials at the zoo suspect that sick zookeepers may have transmitted the coronavirus. As a result, appropriate hygiene procedures and frequent health checks of zoo animals and their handlers are the only

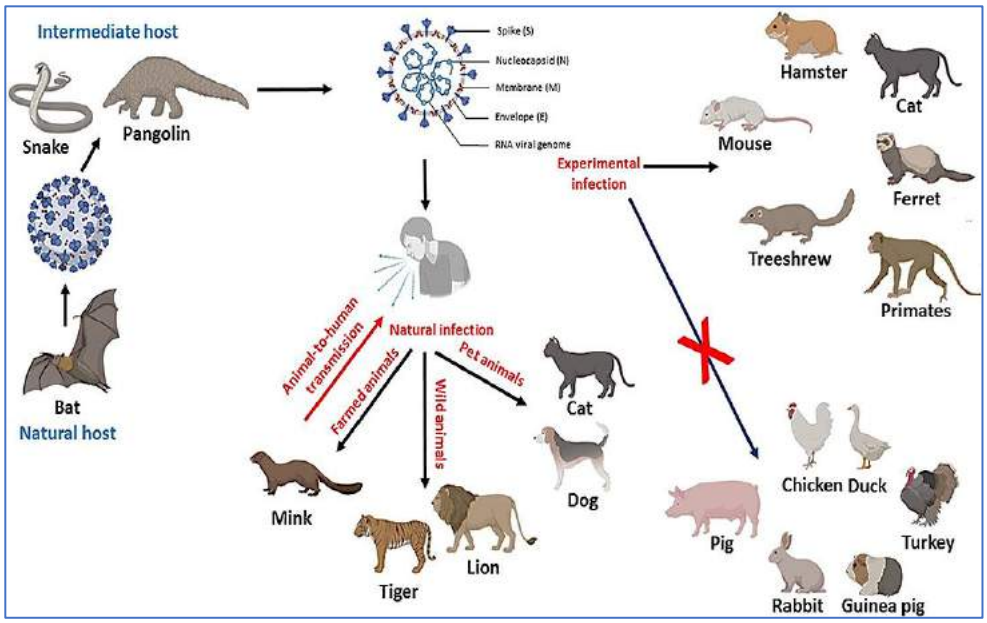

Fig 1: Diagram depicting the probable role of animals in SARS-CoV-2 transmission, putative intermediate hosts, natural and experimental animal infection.
(Source: Frontiers in Veterinary Science Journal doi: 10.3389/fvets.2020.596391).

means to avoid disease transmission from animal to human and vice versa. Therefore, overall, animal health must be protected to safeguard human health.

Based on the facts presented above, the tenets of One Health will be effective in dealing with COVID-19, which is believed to arise in animals and then be passed to humans, implying that such viruses thrive at the human-animal interface and are influenced by environmental factors. However, we must not forget that this pandemic is the consequence of human actions. Hence, humans are the sole species entrusted with resolving this issue.

Human and Environmental Convergence

To comprehend the human-environment interface, consider the West African Ebola outbreak, one of the causes of which was deforestation, which spanned the gap between animal and human habitat. Similarly, the development of the Nipah virus was related to an increase in fruit bat migration, while avian influenza was linked to uncontrolled chicken production. Thus, human manipulations such as biodiversity loss, increasing livestock production, illegal wildlife trafficking, and climate change have all resulted in the emergence of novel infectious diseases, either directly or indirectly. Our continued devastation of wildlife as a result of the exponential population explosion has brought us close to wild animals and plants that can spread diseases from animals to people. Furthermore, global warming, chemical pollution from automobiles and industry, and urban growth have all posed serious threats to wildlife. So, these infectious zoonotic illnesses can be a cause or a result of biodiversity loss. This pandemic has simply established that humans, like other animals, are equally vulnerable to environmental circumstances. To successfully deal with current and future pandemics, a collaborative One Health approach will be required, which includes preserving human and animal health through chemical waste management, monitoring biodiversity, addressing climate and ecosystem change, and reducing carbon footprint. One of the primary goals of the One Health strategy should be to reduce deforestation and forest fragmentation, which will reduce interactions between virus-carrying animal species and people. As a corollary, to achieve a future with enhanced human and animal health, we must also promote environmental health to sustain natural equilibrium.

Importance of one health approach to COVID-19

The cornerstone of the One Health strategy, as stated by the CDC, is three C's i.e., Communication, coordination, and cooperation. If done under the supervision of specialists from many sectors such as animal health (veterinarians), environmental health (ecologists, agricultural workers, and wildlife experts), and human health, this integrated holistic technique would undoubtedly minimise the occurrence and spread of such illnesses.

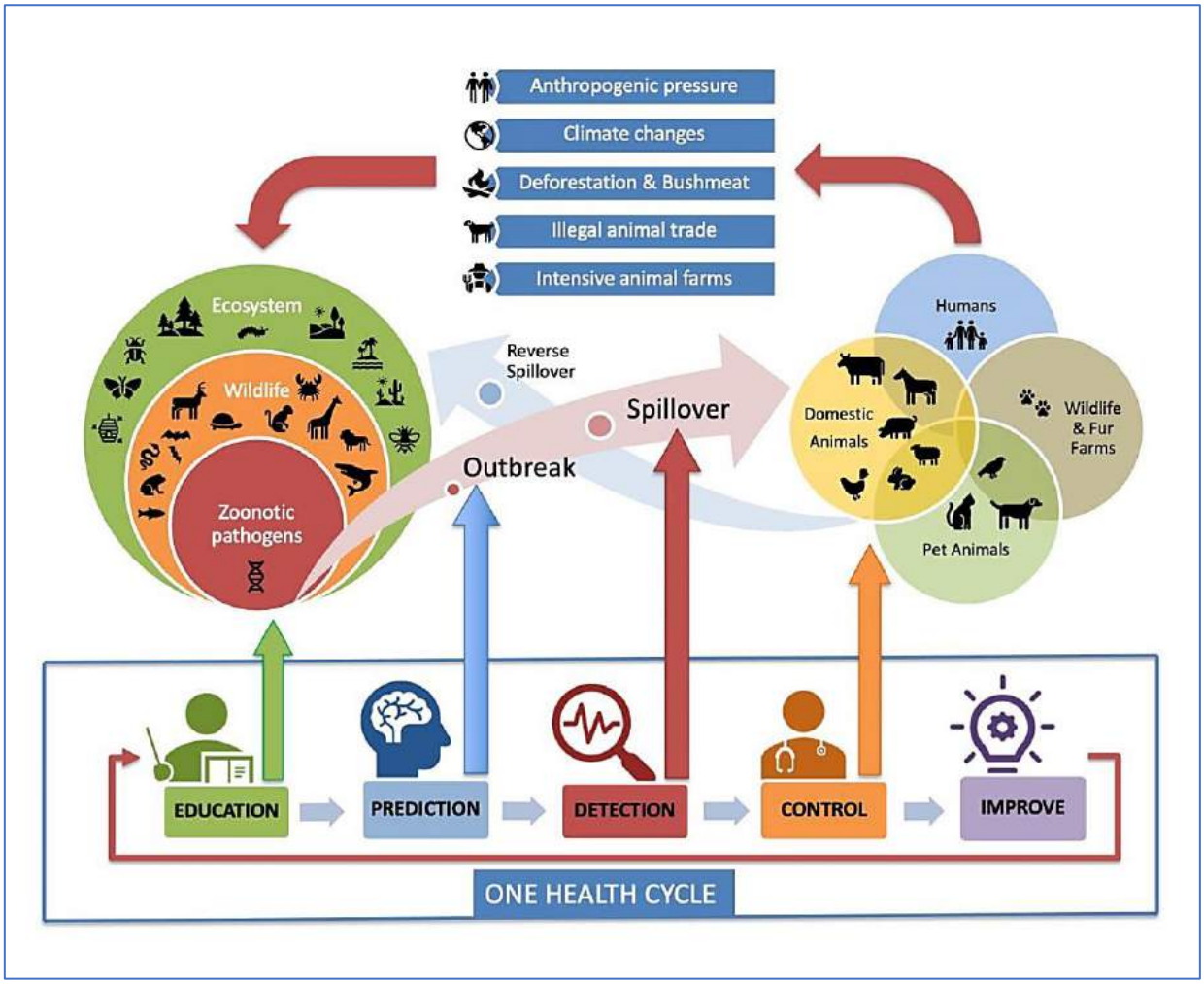

Fig 2: Management of zoonotic spill over with a one health approach

(a) Green colour -the processes of early education (b) Blue colour- early prediction that boost the early detection (c) Red colour- detection followed by control (d) Orange colour- control efforts.

Early education improves the percentage of young people who can detect zoonosis, whereas artificial intelligence technologies employed in early prediction improve the capacity to anticipate an epidemic in wildlife before it spreads. Anthropogenic pressure, deforestation and bushmeat, climate change, illicit animal trading, and extensive animal farms are all human-generated causal factors causing the emergence and resurgence of zoonotic diseases. *(Source:* Frontiers in Public Health *Zucca P et al*)

For the successful implementation of the One Health concept on a global scale, an intense collaboration of various bodies such as WHO, various health organisations, and national governments would be required, leading to the formulation and implementation of stringent policies such as laws and penalties. Furthermore, it has been demonstrated to be a superior strategy to illness prevention when compared to other traditional techniques. Furthermore, the uncertainty and worry associated with COVID-19 are now rising fast with the number of afflicted patients; hence, we also require psychologists (mental health professionals) to handle people's mental health concerns. Figure 2 explains one health cycle.

Conclusions

We must embrace the "One Health Programme" from the global to the most local levels to avert looming pandemics, which are likely to occur considering the world's constantly rising

population and urbanization. In India, the One Health strategy is receiving positive feedback from a variety of industries. Yet, we are still in the early stages and must incorporate helpful international standards-based techniques to deliver the best healthcare services.

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Popular Article

Methane reduction potential of Vegetable Oils

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Abstract

In ruminants, the vast majority of enteric methane (CH4) production occurs in the reticulo-rumen. Reducing CH4 production not only improves feed energy utilization, but also enhances the system efficiency. Mitigation of CH4 emissions is receiving great attention, especially through dietary manipulations. It is evident that effects of fatty acids on methanogenesis depend on their chemical nature. Oils as a dietary supplement are usually used as sources of unsaturated fatty acids, mostly linoleic acid (LA), to increase the concentration of biohydrogenation intermediates i.e.conjugated linoleic acids (CLA) and the trans-vaccenic acid (VA) content in ruminant products.

Introduction

Methane production by ruminants has received global attention due to its contribution to the greenhouse effect and global warming. The major contributor to the climate change is greenhouse gases (GHG) like methane, CO_2 and N_2O. Although most attention has been focussed on CO_2, but CH_4 and N_2O are extremely potent GHGs with methane having 21 fold greater global warming potentials (GWPs) than does CO_2 (Sirohi *et al* 2013). Globally, for ruminant systems, nitrous oxide contributes about 49% of the total GWP of emissions and methane about 42%, leaving only 9% contribution of CO_2. The lifespan of CH_4 in

the atmosphere is 12 years (while that of CO_2 and N_2O is 100 and 120 years, respectively) therefore reducing CH_4 emissions would have a more rapid effect on the environment.

Mitigation strategies to reduce enteric methane emissions from dairy animals is the main concern of today, to prevent global warming and to increase the productive potential of these animals, by diverting energy lost through methane to productive purposes (milk and meat etc.). Rumen methanogenesis results in the loss of 6-10% of gross energy intake (GEI), or 8-14% of the digestible energy intake of ruminants (Okine *et al* 2004). The amount of methane released depends on dietary factors like soluble sugars, dietary lipids, level of feeding, roughage to concentrate ratio, rate of passage of digesta, efficiency of feed conversion, processing and supplementation (Bakshi and Wadhwa 2009).

Among livestock, methane production is greatest in ruminants, as methanogens are able to produce methane freely through the normal process of feed digestion. Rumen digestion of feed components by the microbiota (bacteria, protozoa, fungi), under anaerobic conditions, results in the production of volatile fatty acids (VFA), mainly acetate, propionate and butyrate used by the animal as source of energy and the production of gases (CO_2 and CH_4) eliminated through eructation. Several mechanisms influence the availability of hydrogen in the rumen and subsequent production of enteric methane emissions by ruminants. Enteric methane emissions represent an economic loss to the farmer where feed is converted to CH_4 rather than to product output. Hence, decreasing the production of enteric methane in ruminants without altering animal production is desirable both as a strategy to reduce global GHG emission and as a means of improving feed conversion efficiency (Martin *et al* 2010).

Strategic reduction of rumen methanogenesis

There are two mechanisms available by which methane production can be reduced in livestock. These mechanisms influence the availability of H_2 in the rumen and subsequent production of enteric CH_4 emissions by livestock. Processes that yield propionate act as net proton-using reactions while those that yield acetate result in a net increase in protons. Hence mitigation strategies aiming at reducing CH_4 production must work towards increasing the propionate production. This will reduce CH_4 production by removing some of the H_2 produced during ruminal fermentation. Another mechanism widely accepted is to supplement anti-methanogenic agents which will inhibit the process of methanogenesis either by directly inhibiting the methanogenic microbe in the rumen or by increasing more propionate production. In the anaerobic conditions prevailing in the rumen, the oxidation reactions required to obtain energy in the form of ATP release hydrogen. The amount of hydrogen produced is highly dependent on the diet and type of rumen microbes as the microbial fermentation of feeds

produces different end products that are not equivalent in term of hydrogen output. For instance, the formation of propionic acid consumes hydrogen whereas the formation of acetic and butyric acids releases hydrogen.

From this it can be concluded that if ruminal fermentation patterns are shifted from acetate to propionate, both hydrogen and methane production will be reduced. This relationship between methane emissions and the ratio of the various VFA has been well documented and it provides opportunities to reduce methane emissions. Another mechanism by which methane production may be reduced during the rumen fermentation process is through the provision of alternative hydrogen acceptors or sinks. Compounds such as unsaturated fatty acids provide alternative hydrogen acceptors, consuming hydrogen in limited quantities, during bio hydration. Thus any mitigation strategy aimed at reducing methanogen populations must include an alternative pathway for H_2 removal from the rumen as well. It should therefore be possible to reduce CH_4 production by inhibiting H_2 liberating reactions or by promoting alternative H_2-using reactions or routes for disposing of H_2 during fermentation.

Reduction of Methane by Vegetable oils supplementation

Adding fats to the diet reduces CH_4 emissions by decreasing organic matter fermentation in the rumen, reducing the activity of methanogens and protozoal numbers, and for lipids rich in unsaturated fatty acids, through hydrogenation of fatty acids (Beauchemin *et al* 2008). Fat supplementation to ruminant feeds increase milk fat content and increase diets energy to match energy requirements of high producing animals with the mandate that it must not compromise rumen fermentation and, concomitantly, DMI (dry matter intake) and milk fat percentage. In other hand, feeding lipids has received attention as mechanism to methane emission from ruminant, which is one of recent environmental concerns. Various beneficial and detrimental effects have been stated from different investigations for utilization of fat sources in ruminant ration. However, plant oils, because of their unsaturated fatty acid contents can modify rumen fermentation based on fatty acid composition, origin and saturation. Fats and oils change the fermentation process in the rumen, producing more propionic acid and less methane. This enables better digestion of lower quality feed during drier seasons, thereby reducing methane emissions and increasing productivity (Yasothai 2014). Vegetable oils rich in unsaturated fatty acids are saturated in a process called bio hydrogenation, carried out mainly by *Butyrivibrio* species, consuming hydrogen in the process, which makes this process a potential alternate hydrogen sink, since the saturation of a double bond requires 1 mole of hydrogen. The mechanism of action of saturated fatty acids has been related to their ability to damage cell membranes, leading to K+ leakage an indicator of damaged membrane followed by cell death. Furthermore, lipids reduce

methane emissions through multiple mechanisms: reduction of fermentable organic matter (lipids are not a source of energy for rumen bacteria); reduction of methanogenic activity due to the presence of medium-chain fatty acids; toxic effects on cellulolytic bacteria and protozoa due to the effect of polyunsaturated fatty acids (PUFAs) and bio hydrogenation of PUFAs. Methane production has been consistently reduced by adding fat or fatty acids to ruminant diets, and it is estimated that fat can reduce methane emissions by 4–5% (g/kg DMI) for every 1 % increase in the fat content of the diet. It is evident that fatty acid effects on methanogenesis depend on their chemical nature. Oils as a dietary supplement are usually used as sources of unsaturated fatty acids, mostly linoleic acid (LA), to increase the concentration of biohydrogenation intermediates, i.e. conjugated linoleic acids (CLA), and the *trans* vaccenic acid (VA) content in ruminant products. Lipid supplements rich in medium chain fatty acids (12 to 14 carbons) such as coconut, palm or canola oils (rich in lauric acid), or purified myristic acid, are more effective in depressing methane emissions in diets rich in concentrate and low in Ca (Machmuller *et al* 2003). Various studies have proved that vegetable oils are very effective in methane mitigation. Santra *et al* (2013) studied the effect of four locally available vegetable oils viz., mustard oil, sunflower oil, sesame oil and rice bran oil and found that total rumen protozoa as well as isotrichidae and entodiniomorphid population and methane production decreased ($P<0.01$) due to sunflower oil in the medium. Panayakaew *et al* (2013) reported coconut and krabok oil supplemented in two doses, providing either 80 (C80 and K80) or 120 mg (C120 and K120) of C12:0 + C14:0 per 100 ml of incubation fluid reduced methane production ($P<0.05$) and increased propionate production ($P<0.05$) at the expense of acetate ($P<0.05$) and butyrate production ($P<0.05$). Mahajan et *al* (2016a) conducted a study to assess the effect of carrot seed oil, canola seed oil and rape seed oil supplemented @ 1, 2 and 3% on DM basis on rumen fermentation and methanogenesis *in-vitro* and they observed that the methane production was significantly lowest when oil was supplemented at 3% level. In the same year Mahajan et *al* (2016b) observed lowest ($P<0.05$) methane production due to cotton seed oil supplementation at 1% level as compared to other vegetable oils.

Conclusion

In conclusion the effectiveness of adding lipids to the diet to reduce CH_4 emissions depends on many factors including level of supplementation, fat source, fatty acid profile, form in which the fat is administered (i.e., either as refined oil or as full-fat oilseeds) and the type of diet. However, level of added fat is by far the most important factor. In most cases, 2 to 3% fat can be added to ruminant's diets without negative effects. The total amount of fat in the diet (added fat plus fat

in the basal diet) should not exceed 6 to 7% of the diet otherwise a depression in DMI may occur, negating the advantages of increased energy.

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Popular Article

Paracetamol (Acetaminophen) Toxicosis in Feline Species

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Abstract

Paracetamol is a commonly used drug in human medicine. This NSAID is highly toxic to feline species because the lack of the enzyme glucuronyl transferase. The lack of awareness among the pet owners is one of the major etiology for this condition. The condition is fatal if not treated and correct diagnosis and treatment can ensure a favourable outcome.

Keywords: cat, paracetamol, N-acetyl cysteine

Introduction

Paracetamol also known as acetaminophen, toxicity is more common among domestic cats. Due to the lack of knowledge about the side effects of this drug in feline species and easy availability at home. It is a non- steroidal anti-inflammatory drug and widely used in human medicine because of its anti-pyretic and analgesic properties (Court and David, 1997). Felines are very much sensitive for even small quantity of the drug compared to other species. Various forms are available like tablets, capsules, suspensions, intravenous and intramuscular forms (Pothiappan *et al.*, 2014).

Pathogenesis

Paracetamol (acetaminophen) is a para- aminophenol derivative which possesses predominant analgesic property with mild anti-inflammatory effects. The mechanism of action is achieve through the inhibition of cyclo-oxygenase (COX) enzyme and it is more selective for COX- 2 than COX- 1. Pharmacokinetic data of paracetamol in animals are very limited. The metabolism of the paracetamol undergo different pathways in humans include conjugation with glucuronic acid, sulphate and cysteine. According to Perry (1998) the primary site for the

metabolism of paracetamol is the liver through three major pathways like glucuronidation, sulfation, N-hydroxylation and conjugation with glutathione. Small portion of acetaminophen is metabolized through the cytochrome P-450 enzyme pathway and producing a toxic metabolite called N- acetyl-para-benzoquinoneimine (NAPQI). Normally the toxic effects of NAPQI is reduced by its conjugation with glutathione. Acetaminophen toxicity in animals generally occur when the glucuronidation and sulfation pathways become saturated. If NAPQI is accumulated in tissues it will bind to cellular proteins and membranes, finally leads to cell injury and death (Allen, 2003).

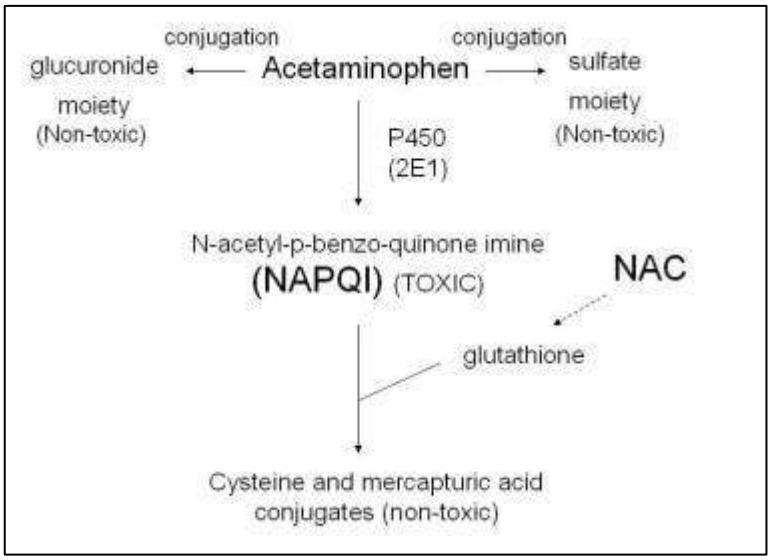

Fig. 1 Paracetamol - Biotransformation

(https://images.app.goo.gl/VLQ1Jtyy3jefghkH7)

In cats the reduced capacity for glucuronide conjugation and the paracetamol is easily converted to reactive electrophilic metabolite are make more susceptible for toxicity. Cats normally have low concentration of the enzyme glucuronyl transferase. Deficiency of the glucuronide conjugation pathway results more drug being conjugated to sulfates. But the sulfation pathway is also lower in cats compared to other species (Allen, 2003). There is no safe dose of paracetamol for cats. The enzyme glucuronyl transferase which is required for the metabolism of acetaminophen into nontoxic products. Deficiency of this enzyme in cats is the major aetiology of the toxicity. The main target of paracetamol toxicity in cats are the erythrocytes than the liver. Because the greater susceptibility of cats to oxidative injury of erythrocytes (Aronson and Drobatz, 1996).

Clinical Signs

The first three clinical signs exhibited by the cat after paracetamol toxicity are the dyspnoea, tachycardia and cyanosis. The affected animals shows anorexia, facial and paw oedema, dullness, muddy mucous membranes, respiratory distress and haematuria (Kore and Anita, 1998). According to Finco *et al.*, (1975) the affected cats were exhibited reddish brown urine and oedema of head. The case history of Rajesh *et al.*, (2017) the affected animal showed vomiting, anorexia, reduced body temperature, weak and shallow pulse rate, haemorrhagic enteritis and finally coma. Other clinical signs include methaemoglobinaemia, anemia, haemoglobinuria (from intravascular haemolysis) and icterus due to lysis of red blood cells and hepatic necrosis.

Diagnosis

Diagnosis mainly based on the owner's history and clinical signs.

Treatment

The specific antidote for the paracetamol toxicity is N- acetyl cysteine at the dose rate of 140 mg/kg as intravenously as loading dose after that 70 mg/kg intravenously or orally every 6 hours for 5 times. N- Acetyl cysteine is directly bind to the metabolites of acetaminophen and enhance the elimination. It also serve as a glutathione precursor (Pothiappan *et al.*, 2014). Acetyl cysteine reduces the viscosity of secretions by splitting of disulphide bonds of the muco-proteins. It also detoxifies the toxic intermediate metabolite. Ascorbic acid tablets are also included in the treatment protocol because it offers some hepatic protection by scavenging the reactive metabolite. The antibiotic and fluid therapy are also essential in the treatment protocol.

Conclusion

Paracetamol toxicosis is a life threatening condition in feline species. The correct diagnosis and timely treatment will give the good result.

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Popular Article

Elephants

A Need to Conserve for Biological Balance

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Abstract

Elephants are the largest terrestrial Mammalian herbivores, play an important ecological role in maintaining forest ecosystem diversity. The major threats to the elephant survival are habitat destruction and fragmentation, illegal poaching, human- elephant conflict, global warming, Forest fire, climatic changes. If elephant survival decreases, absolutely other species population also get decreases. Entire ecosystem will be collapsed. Conservation by Stopping illegal Trades, reducing poaching, Awareness to local people near Elephant niche. If we go without elephants, the natural balance will be disturbed and the existence of mankind on this planet will be questioned.

Introduction

It is no exaggeration to say that the "Elephant" is a creature that has an indispensable place in the animal kingdom and has an indelible mark on the human mind. All living things in the world, from the one-celled amoeba to the large blue whale, make a unique contribution to their habitat and depend on other organisms for survival. Everything in the ecosystem is interconnected. So, the extinction of one species would severely threaten the survival of another species. Here the Elephants play a vital role in Survival of other species. The role of the elephant in protecting the forest is immense. Seed dispersal of many plants is possible through Elephant's dung. Researchers refer to the elephant as source of support and "KEYSTONE SPECIES", as it helps the forest and other species in many ways.

Proboscidean Creatures

A total of three species in the elephant family are still alive in the world. They are African bush elephants, African Wild elephants and Asian elephants. There are many differences between these species. The elephant is the largest of the terrestrial animals with trunk-shaped nose. Elephants are an animal with a social lifestyle. They drink 100, 150 to 200 liters of water a day. Like man, the elephant has the habit of bathing in water daily. The elephant needs 200 to 250 kg of food daily. So, two-thirds of the time in a day is spent searching for food. An elephant's diet may include grass, herbs, bark, fruit and tree foliage. In tropical forest, an elephant's diet may include as many as 230 species with leaves, twigs, bark and fruit (White et al.1993). Their digestibility efficiency is very low when compared to other Monogastric animals. About 40 percent of the only food is digested. So, they have to consume too much food per day. The undigested serves as a Seed dispersal factor, thus conserving the Eco-system.

Role of Elephants in Ecological Balance

Elephants, the largest terrestrial mega-herbivores, play an important ecological role in maintaining forest ecosystem diversity. Elephant population dynamics are generally difficult. Since they have long life span, High Gestation period, and Low mortality. The comparing ecological parameters like Trees are also relatively slow-growing. Achieving a complete understanding of the interaction require several centuries of observation. But through certain relationships between elephants and their habitats we can formulate a general interaction. They are categorized as follows,

1) **BIO BULL-DOZER**

The elephant travels long distances in search of food and water. The Home Range of the Asian elephant is more than 1000 km^2 and the Home Range of the African elephant is more than 4000 km^2. During its migration, the elephant breaks off the branches of large trees along the way and eats them. They also trample and destroy thorny plants. The large elephant destroys dense vegetation during migration and creates a clear path (Jones et al., 1994). Thus, other animals can easily move along this path and increase their habitat. Elephants break off branches for food, which naturally prunes the trees and makes to grow faster. During any major storm in the forest, the elephant plays a major role in repairing damage caused by falling trees. Thus, they act as a "BIO-BULLDOZER" in repairing the Forest.

2) **BOREWELL MAMMAL**

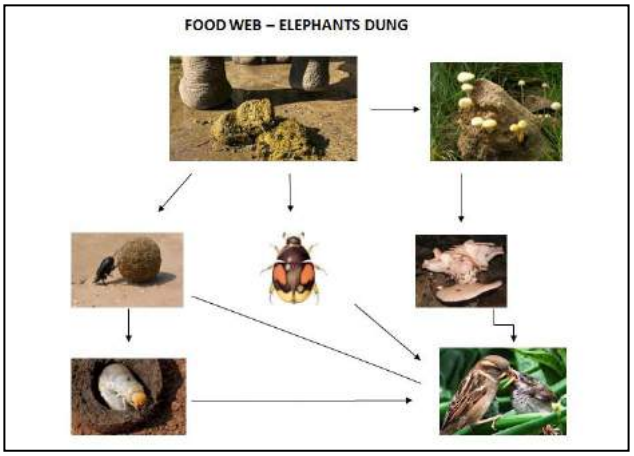
During the dry summer periods in the river basins, the elephants use their immense power to find groundwater. They often dig with their Tusks and Trunk to get water. Other animals rely on this aspect of elephant behavior, and rush to drink water from the dug waterholes once the elephants

have their fill and left. Droughts can be devastating, particularly in areas where rainfall is infrequent, as the animals dwelling there are not equipped to deal with the drastic change in the climate. Elephants possess the ability to create a water source for themselves and other animals during such severe times. The digged Water troughs acts as a reservoir for many wild animals in the hot dry period. The presence of elephants and their health status is a major criterion for the particular habitat sustainability.

3) SEED DISPERSER

If a forest is to be healthy, the survival of elephants must be there. The seed that enters the Elephant's Digestive tract is excreted undigested has excellent germination capacity. From these seeds, plants, grasses and trees thrive in new places and create habitat for other organisms. In the wild, elephants spread seeds from one place to another. This causes trees, plants and vines to grow in large numbers and creates a new forest as wide. Seeds of 19.1 % of 1,284 dung piles were found recently (Campos-Arceiz, Blake S, 2011). Thus, Elephants plays a Lead role in creating and maintaining Bio-diversity in terrestrial Ecosystem.

4) DUNG AS A BIO-SOURCE



Elephant dung is food source for many creatures, including ants, scorpions, beetles, spiders and termites. Countless insects are flocking to the new manure. Dung Roller collect these elephant dung and store it as food source for their larvae. Elephant dung is an important food for insectivorous birds, since they feed on the Dung roller beetles and other insects that feed on the Dung. The decomposed Dung acts a major Fertilizing source for Plants, Trees and as a Culture medium for Fungi too. Thus, Elephants creates a Complex interlinked Food Web in Terrestrial Habitual Ecosystem.

Threats to elephant survival

The population of India's national heritage animal -The elephants has shown a significant declining rate nowadays. Based on last census which was taken in the year 2017 has shown that the population decreased by about 3,000 compared to previous census in 2012. The major threats by humans to the elephant survival are habitat destruction and fragmentation, illegal poaching, human- elephant conflict and global warming. Forest fire, climatic changes are the natural causes.

1. Habitat Loss

The most major threat to elephants is habitat destruction and fragmentation. Humans utilize the forest lands for constructions, mining, logging, farming and livestock grazing. Due to these reasons elephant's lifestyle get collapsed. Deforestation results in food scarcity so elephants enter into the nearby villages for their food and water and this finally end up with human - elephant interactions. Both the elephants and people can be wounded or killed in the conflict. Roads, railways, pipelines and human settlements create a barrier to elephant movements and fragmenting their habitats into ever smaller areas. Without corridors to link these islands of habitat, breeding programs among the population of elephants get modified and the chance of interbreeding between the small groups of elephants is getting more. This is not good for a healthy genetic diversity of the population.

2. Poaching

Poaching is another major threat to the elephants. Elephants are poached primarily for their ivory, hides and meat. Ivory, which comes from elephant tusks is considered as very valuable one and keeping the ornamental things which are made from ivory is regarded as a pride by some people. Because of these reasons and high price of ivory, poachers illegally kill the elephants. Hides are used in leather bags, belts to gun holders and flask containers and they sold for high prices in the market.

And some captive elephants are harmed for their tail hair. For centuries, mythology has believed that wearing an elephant hair bracelet and rings would protect people from illness and it brings prosperity. These are the major reasons for poaching of an elephant.

3. Human - elephant conflict

It is the result of habitat loss and fragmentation. Due to loss of habitat elephants came to the villages, roads and roam around for the food and water. In the meantime, both public and elephants are wounded and sometimes killed. While crossing roads and rail tracks accidents may occur. A total of 186 elephants were killed after being hit by trains across India from 2009-10 to 2020-21 according to the Ministry of Environment, Forest and Climate Change (MoEFCC), Government of India. In 2013, chapramari forest train accident killed or injured 17 Indian elephants is one of the worst accident in the recent history. Death of Pregnant wild elephant in Kerala's silent valley national park due to pineapple filled with crackers and exploded

in her mouth when she chomped on it and another elephant die after resort workers throw burning tyre in masinagudi are the recent and crucial attacks by the humans on the precious creatures. According to WWF over 100 people were killed by elephants each year in India. Both humans and elephants were affected in the conflict.

4. Global warming

Both nature and human activities contribute to the rise of temperature around the world. But majorly temperature rise is caused by various human factors. Global warming affect elephant health in different ways. Elephants need plenty of food and water for their survival. When temperature increases, it is difficult for the plants to grow and drought may occur. So, elephant didn't get enough food and leads to death. Elephants are very sensitive to temperature rise. They are affected with sunburn when temperature rise in extreme. Heat stress results in change of mating season and finally population decreased.

5. Food chain loss

Food chain loss is the accidental and minor cause for the elephant population decline. We can understand better with the example: When elephant and deer live in the grassland's ecosystem and their major source of food is grass (Fishlock, V. Lee P.C.,2013.). If there is an increased population of deer occurs means finally deer eat all grasses and elephants won't get any food. At last elephant will suffer from loss of body weight. And finally, it leads to death of an elephant.

Impacts of declining elephant population

Elephants are referred to as 'ecosystem-engineers', 'architects' or 'gardeners'. This is because they shape, build and rejuvenate natural landscapes. One of the most significant effects of elephant population decline is dispersal of seeds and growth of plants in the forest. Many species of trees would die out entirely.

Elephant supplies water to other animals by digging waterholes in drought season. In the absence of elephants other animals can't get water in dry seasons. Other than that, elephants serve many important functions in the ecosystem as we seen above. If elephant survival decreases, absolutely other species population also get decreases. Entire ecosystem will be collapsed and finally, we will left with elephant pictures and disintegrated ecosystem to our next generation.

Conservation of elephants

1. Protecting remaining habitat:

As we know habitat destruction is the foremost threat to the elephants. We should concentrate more on habitat preservation. By planting and growing the trees, protecting remaining intact forest lands from deforestation are the ways to conserve the habitats. Prevent

the forest area from livestock grazers also a minor part of conservation (Graham et al., 2009). Corridors play an important role in preserving elephants. Creating corridors allow movement between isolated populations and it minimize the human elephant conflict and increase the gene pool.

2. Say 'No' to illegal trades:

Elephant ivory trade not only threatens the survival of our iconic species but also endangers the lives of other animals and humans. Government should take some strict measures to prevent poaching activities, strict measures in the sense toughening the laws and higher penalties for those activities. Certain measures need to prevent the illegal trade of ornamental products made from tusks. Regular tracking of elephants with harmless and undetectable trackers must needed to watch regular activities. University of Utah researchers developed a new weapon to fight against poachers. By measuring the radioactive carbon-14 deposited in tusks by open air nuclear bomb test, it reveals the year an animal died, thus whether the ivory was taken illegally or not.

3. Rescue and rehabilitation:

By rescue and rehabilitation, we can save some of the elephants which are affected from injuries. The aim of this center is to rehabilitate and provide high degree of veterinary care, treatment, and enrichment to facilitate recovery for elephants that were found astray, injured, abused, exploited, maimed, orphaned, trapped, sick, treated in cruel manner by owners/ handlers/mahouts and also such elephants that are held in illegal custody or with improper/ incomplete ownership papers in violation of laws. Such elephants are rescued and rehabilitated and provide proper care to them. By this way we can save some of the giants.

4. Awareness:

Creating awareness among the people about the importance of elephants in the ecology and its role play an important part in conservation. Active involvement of young minds in conservation of elephants will surely create a great impact in our society. Including wildlife in school curriculum will show seeds of wildlife importance in future generations. Involving local communities near the forest areas to track the elephants and reduce the conflict between humans and elephants are now practiced in many states.

Conclusion

Animals and nature are intertwined. Our ancestors worshipped nature, with the vision that if we protect nature, it will make us live. Animal livelihoods are affected as man damages natural resources. History shows that the Tribe peoples who lived in the forests lived together in harmony

with the forests and the animals that lived with them. Tribe people worship and adore the forest where they lived, their habitat, and the wildlife that lived with them as deities. Elephants makes a huge web among the Eco-system, which can't be replaced by any Mammalian Species. So it's our moral duty to conserve and enhance the sustainability of our huge giants.

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Popular Article Nutritional Management for Healthy Coat and Skin in Pet Dogs

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Introduction

Dogs are more than just pet and a companion to many people's around the world. Pet dogs' wanders freely in each and every corner of home even play with children in beds. They are treated as one of the family members and in this case, their proper vaccination for preventing transmissible diseases as well as for maintenance of health is a subject of concern for all. Now a day, skin health is also becoming a problem due to nutritional deficiencies as well as fungal, bacterial skin infections. Dogs are a pleasurable pet especially when they are blessed with healthy skin and lustrous fur. The skin is a large, metabolically active organ with a high physiologic requirement for protein and other nutrients. It is not surprising, therefore, that subtle changes in its nutrient supply can have a marked effect on skin and coat condition. Dietary factors may play a role in the etiology and therapy of skin disease in three arenas, i.e., nutrient deficiency or imbalance, nutritional supplementation for therapeutic effect and dietary sensitivity.

Functions of healthy coat and skin in pet dogs:

- Skin and coat provide a barrier that protects a dog from external objects, chemicals, and environmental stressors.
- Skin also contains nerves and nerve endings that help a pet sense heat, cold, pressure, and pain.
- It is important part of the immune system in pet animal body.
- Healthy coat helps keep a pet's temperature properly regulated by providing an insulating layer of fur.
- Skin also serves as a storage site for several nutrients like protein, minerals and vitamins.

Strategies for keeping coat and skin healthy in pet dogs:

Several approaches for keeping the coat and skin healthy, which may include:

1. Proper Nutrition
2. Regular Brushing
3. Grooming and Bathing
4. Protect Against Sand, Sea and Chlorine
5. Prevent Fleas and Ticks

Role of nutrients in maintaining the healthy coat and skin:

Pet dog requires balanced feed to satisfy the need of nutrients like water, energy, protein, minerals and vitamins.

1. Protein:

Hair is composed of 95% protein, which is rich in the sulfur-containing amino acids like methionine and cystine. Normal growth of hair and keratinization of the skin thus create a high demand for protein and may account for between 25 and 30% of the animal's daily protein requirement (Scott et al.,1995). Protein deficiency is rare in clinical practice but is occasionally encountered after starvation, disease-induced inappetence or the prolonged feeding of a poorly formulated or inappropriate diet. If failure to meet this demand results in the cutaneous manifestations of protein malnutrition including brittle, depigmented hair, which is easily shed and slow to regrow, excessive scaling and thin. High quality protein sources like meat, eggs and milk should be provided to rectify the deficiency. As per AAFCO, crude protein requirement in the diet of dog is 22 % for adult dog.

2. Essential fatty acids:

Essential fatty acids have a structural role in cell membranes, act as precursors for eicosanoids such as prostaglandins and leukotrienes, and are vital for maintaining normal skin structure and function. Of the (n-6) PUFA, linoleic acid (18:2) is involved in the maintenance of the cutaneous water permeability barrier, and arachidonic acid (20:4) regulates epidermal proliferation via prostaglandin E2. Manipulation of dietary PUFA may also alter the balance of pro- and anti-inflammatory eicosanoid production and has been used therapeutically for the management of some inflammatory skin disorders, particularly those associated with hypersensitivity reactions.

Requirement of fat in adult dog is 5 to 7 % as per AAFCO. Linoleic acid as essential fatty has major role in dog's coat and skin health. Without enough linoleic acid, dogs might experience a dull and dry coat, hair loss, greasy skin and increased susceptibility to skin inflammation. Also, omega-3 fatty acids have increasingly gained popularity as a means of treatment for dogs with

pruritic and inflammatory skin conditions, such as atopic dogs (Saevik et al.,2002).It available in Fish oils, such as salmon, mackerel, halibut, and herring. Also found in oils from some plants such as Walnuts and soybeans.Omega-6 fatty acids include Linoleic acid (LA), gamma linolenic acid (GLA), and arachidonic acid (AA). It plays a critical role in skin health by maintaining the outer most water barrier of the skin. Omega-6 is found in safflower, sunflower, corn and evening primrose and Borage oils. It is also present in poultry and pork fat. National Research Council (NRC) recommends a ratio of 2.6:1 to 26:1 omega-6 to omega-3. Optimal ratio in the diet of dogs may reduce the incidence of some diseases, such as cancer and sudden cardiac death (NRC, 2006).

3. Minerals and Vitamins:

Dog needs minerals and vitamins for a healthy skin and coat. The best way to provide these nutrients is by feeding a complete and balanced diet full of essential minerals and vitamins, rather than giving him supplements.

a) Zinc:

Zinc plays a critical role in regulating many aspects of cellular metabolism. Zinc is an integral component of a wide range of metalloenzymes and cofactor for RNA and DNA polymerases. It involved in rapidly dividing cells of epidermis. Zinc deficiency in dogs causes dull and rough coat and skin lesions including scaling and crusting. Black puppy patients (Labradors) with skin disease related to zinc deficiency had pronounced graying of hair (Broek and Thoday,1986). Dietary requirement of zinc is 5.00 mg per 100 gm dry matter recommended for healthy dog by NRC, 1985.

b) Copper:

It helps in iron absorption so that important part of red blood cell functions. It also acts as an antioxidant, is a part of many enzymes, and is necessary for the formation of melanin, the pigment that darkens hair and skin. It is found in meat, liver, fish, whole grains, and legumes and is typically added as a supplement to commercially prepared foods. Copper deficiency is extremely unlikely if a dog eats a nutritionally balanced diet. Problems are most often associated with copper excess, not generally from an improperly formulated diet but instead due to inborn errors of metabolism that eventually cause too much copper to accumulate in the liver. At excessively high levels, copper results in oxidative stress, inflammation, and eventually to liver scarring (cirrhosis) and failure. Dietary requirement of copper is 0.70 mg per 100 gm dry matter recommended for healthy dog by NRC, 1985.

c) Vitamin A:

Vitamin A (retinol and its derivatives) plays role in differentiation of cells of basal membrane into columnar cells and maintains the epithelial integrity. Both deficiency and excess of vitamin A can give rise to cutaneous lesions of hyperkeratinization and scaling, alopecia, poor hair coat and increased susceptibility to microbial infections (Scott et al., 1995). Vitamin A–responsive dermatosis is a rare condition that is seen almost exclusively in Cocker spaniels even when fed an apparently nutritionally adequate diet (Ihrke and Goldschmidt, 1983). Dietary requirement of Vitamin A is 500 IU per 100 gm dry matter recommended for healthy dog by NRC, 1985.

d) Vitamin E:

Vitamin E is a fat-soluble nutrient that is essential for pet's body to develop strong and healthy muscles, and healthy circulatory and immune systems. It's also an antioxidant, helping to protect cells from damage caused by free radicals. If dog is suffering from excessive moulting, thin or balding patches on their coat, dry or flaky skin, Poor coat condition they may benefit from a Vitamin E boost. If skin problems are localized, Vitamin E can be applied topically. If use bathtub, try adding Vitamin E oil to the water in the tub. Vitamin E is high in protein sources like eggs. Also find it naturally in vegetables and nuts like dandelion, spinach, peanuts, and sunflower seeds (Watson, 1998). Dietary requirement of Vitamin E is 5.00 IU per 100 gm dry matter recommended for healthy dog by NRC, 1985.

e) Vitamin B:

Vitamin B-complex are involved as cofactors in many metabolic functions, especially energy metabolism and synthetic pathways. Because they are water soluble, they are not stored in the body. Skin lesions associated with deficiencies of B- group vitamins include dry, flaky seborrhea and alopecia. Pyridoxine deficiency may cause a dull, waxy, unkempt coat with fine scales and patchy alopecia.

f) Biotin:

It is one of the B complex vitamins. It's also known as vitamin H. Biotin plays a large role in maintaining healthy skin and hair, as well as playing an important role in growth, digestion, muscle formation and in enabling the body to use glucose as an energy source. Biotin deficiencies are rare, but there are several symptoms show like scaly skin, dry and dull hair/coat, scruffy appearance on skin. This condition may occur in the unusual circumstance of feeding large amounts of raw egg whites which contain avidin, a protein that binds biotin and prevents its gastrointestinal absorption. They are commonly combined with key ingredients such as Omega 3 for dogs which work in the skin as natural anti-inflammatory processes. Some of the

most important natural sources of biotin are seed oils (hemp seed oil is a safe one) and liver. And of course, eggs. Other foods include Meat, sardines, green leafy vegetables, Cauliflower.

Conclusion

Along with fungal and secondary bacterial infections, nutritional deficiencies are also a major cause of skin and coat mal-conditions in pet dogs. Balanced nutrition and feeding with mineral and vitamin supplement are the remedy for healthy coat and skin in pet dogs.

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Popular Article

Prospects of Integrated fish farming- An Overview

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Abstract

Concept of integrated fish farming refers to the production, integrated management and exhaustive utilization of aquaculture, agriculture and livestock, with significance on aquaculture. Integrated fish farming is the techniques by which fish is cultured along with poultry, paddy, piggery or any other animals and with aquatic crops like Trapa (Singhara) and Eurylale (Makhana). In recent overview of India integrated fish farming is a best way to generate income by the farmers and contribute in development of economy as well as. It is also a best way of utilizing one farming waste as useful manure to other related farming. India has a long history of integrated fish farming with cultivation of aquatic plant alongwith fish culture and has shown tremendous results in modern farming practices.

Introduction

Aquaculture is the growing food producing sector that fulfils the nutritional requirement of the ever growing population with the 14.16mmt in the country. The concurrent linkage between two or more farming practices, of one is the aquaculture is the major activity is integrated fish farming (IFF). This farming method is regarded as the efficient in utilizing farm available resources, energy saving and waste recycling and maintain ecological balance. The IFF provides an opportunity to reduce risk by diversifying crops and addition income is generated for small and medium farming practices. Agriculture is the backbone of the country with the total food grain production of 305.44 million tonnes produces large amount of plants and animal residues. Livestock wastes are used in the aquaculture system that increases productivity of water and indirectly increase fish production. India supports a large quantity of livestock population of 535.78 million including 148.88 goats and 74.26 million sheep, over 192.49 million cattles, 9.06 million pigs and 851.81million poultry (Livestock

census, 2020). The agro-based industries including breweries, food processing plans, and sugar industries produce wastes in the biomaterial with good amount of nutrients can be recycled and used as compost in farming. The IFF promotes and ensures biodiversity management, soil and water fertility management, organic farming inclusion and management of biological cycle in the system.

Fish Species Culture in Integrated Fish Farming

The proper composition and systems like polyculture, composite fish farming, multi species concept is kept in mind while stocking fishes in aquaculture system. In conventional farming polyculture stocking system of six carp species with combination of indigenous Indian major carps (*Catla catla, Labeo rohita and Cirrhinus mrigal*) along with exotic species (Silver carp, Grass carp and Common carp) were used in aquaculture farms. These days many other fish species selected on the basis of compatibility, habitat preferences and food acceptability criteria are used for selecting fishes for stocking. Some medium and major carps are identified as the important regional species that are IFF polyculture system including *Labeo gonius, L. calbasu, L. Bata, L. fimbriatus, Puntius sarana*. The carp's species are also culture in mixed system with proper ratio composition and optimum utilization of available resources in the farm along with catfishes (*Clarius batracus, Heteropneustes fossilis, Anabas testudunius and Channa* species) and freshwater prawn i.e. *Macrobrachium* species.

Integrated Fish Farming Systems

Generally there are two types of integrated fish farming practiced in Indian farming context. Following approaches are used-

- Single System approach
- Multi- System approach

1. Single System approach

The one to one single system includes agri- aquaculture based system and livestock fish system are the most commonly used practice. Agri- aquaculture based system includes paddy-fish culture, mushroom fish culture, horticulture- fish system, seri-fish system with fish culture system as major component and other agriculture practices as minor practices in farm. Livestock fish system mainly includes duck- cum fish farming, pig cum fish farming and poultry cum fish farming. . In many parts of the country fish is cultured alongwith aquatic plants like Trapa (Singhara) and Eurylale (Makhana) and earn additional income seasonally.

The integration of paddy cum fish culture is most popular in Pokkali fields of Kerala. The interval between rice production and fish stocking is such that allow degradation of material

in that field. This method of integration allows proper utilization of water. In the field, fish feed on the natural fish food organisms, insects while tillering to rice field. The resistant rice variety used in rice cum fish intergration are Tulsi, Panidhan, CR26077, Rajaranjan etc and the yield is increased by 10-15% in the system.

The horticulture cum fish integration is the most common practice in both mariculture and freshwater culture system. The fruit or vegetables are sown in the dykes and adjoining areas. The dwarf variety of coconut, banana and mango are sown in the adjoining areas. In addition pineapple, ginger, turmeric owing to moist soil can be sown in nearby areas.

The livestock cum fish integration involves manuring of fish ponds by the dung released from poultry, duck house, pigs, goat etc. The ducks enters ponds and eat aquatic insects which are harmful to small fishes and also allows aeration with its movement in the pond. In addition this integration system also allows a good amount of income from the eggs, chicken, meat of reared animals.

2. Multi System approach

The multi-system includes 3A culture practices including agri-aqua-animal husbandry with fish culture system as major component and other agriculture and livestock farming practices as minor practices in farm. This system combines all farming commodities at one place and utilize the available resources wisely.

In this type of approach more than two farming systems are planned to utilize available farm resources. In traditional system, the dung from the animal husbandry is used as manure in agriculture field and aquaculture pond, the agriculture field provides food and fodder for the animals reared in the farm. When the fish pond water is changed over a period of time, it can be utilized in agriculture field as the water contains all the essential nutrients in it. In modern IFF system, the waste from food processing industries, breweries, sugar industries, dried leaves, biogas slurry etc. are left for decomposition for a period of time and are utilized in the farm. This method is the considered as the innovation for recycling, agricultural diversification and organically standard sustainability.

When the pond is dried for some period before stocking of next culture, some farmer utilize the area for short term oil crop with low requirement of water irrigation. The excess nutrients from the dried leaves of cultivated plants are utilized in the next fish culture system. In addition, the pond dykes with free space are utilized for sowing different horticulture crops, agro-forestry, seasonal plantation etc. The seasonal and perennial ponds should be efficiently utilized for multi- cropping system and overall sustainable production.

Conclusion

Integrated fish farming provides a good source of produce and income to small and marginal land holders. This method totally run on organic and eco- friendly measures and ensures high returns and also protects the small farmers from total losses from crop failure. The present IFF methods along with the traditional knowledge of farmers should be utilized with proper planning, strategies and execution to generate additional income from farms. There is huge urge for scientific innovation in the present method of IFF to make maximum benefit from it..

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Popular Article

Zoonoses Associated With Dogs: An Overview

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Abstract

A zoonotic disease is a disease that can be passed from animals to human beings. These diseases can be caused by several viruses, bacteria, parasites and fungi. The diseases associated with dogs include rabies, tularaemia, brucellosis, leptospirosis, campylobacterosis, salmonellosis, pathogenic E. coli, cryptosporidiosis, giardiasis, ringworm infection, external parasites, echinococcosis, and cutaneous and visceral larva migrans. These zoonotic diseases get acquired by human by various routes like direct contact, indirectly via contamination of food and water, fomites or vector borne by eating meat from infected animals.

Introduction

The population of pet dogs in India amounted for around 19.5 million in the year 2018. The population was forecast to reach over 31 million by the end of year 2023. The growth in the number of pet dogs in India had led to the increase in of pet food sales, from approximately 139 million U.S. dollars in 2014 to approximately 285 million dollars in 2018 (Statistical Research Department, 2021). Because of this, increasing numbers of dogs live inside the home with their owners, often sleeping in their beds. While dogs can be a beneficial addition to a family, the risk of disease transmission from dogs to humans should be an important consideration.

Dogs have roles that range from treasured family member to working dog to stray dog. The role of a dog in society makes a substantial difference in the role that it plays in zoonotic disease

transmission and our ability to prevent those diseases from occurring. In locations such as the United States, in which feral and stray dog control programs are in place and functioning, pet dogs become an important target for zoonotic disease prevention (Macpherson, 2005).

Rabies

It is an infectious viral disease that primarily affects the nervous system. It is transmitted only by bite from a rabid animal. The virus was present in saliva in high concentration. If you are bitten by any animal even a household pet it is important to consult with your health care provider.

Dogs, cats and ferrets should be vaccinated against rabies. Vaccinating pets not only protects them but it provides a “buffer zone” between humans and rabid wild animals. Oregon law requires all dogs to be vaccinated against rabies as early as three months of age. Oregon law requires that unvaccinated pets that may have been in contact with rabid animals to be vaccinated and quarantined for 4 months (dogs and cats) or 6 months (ferrets), or euthanized. The contact animal, such as a bat, is considered rabid unless it is tested and is negative. Vaccinated dog were immediately, kept under the owner's control, and quarantined for 45 days. If signs suggestive of rabies develop, the animal should be euthanized and tested (Takayama, 2008).

Leptospirosis

It is a bacterial disease spread through the urine of infected animals. In people, the symptoms are often flu-like. The risk of getting leptospirosis through common contact with a dog is low; the primary mode of transmission is through contact with contaminated animal urine. Symptoms in dogs include fever, vomiting, abdominal pain, diarrhoea, refusal to eat, severe weakness and depression, renal disease, and liver dysfunction. To help prevent leptospirosis, vaccinate your dog and keep rodents under control, and avoid contact with rodents and wildlife, including carcasses (Dubey et al., 2021).

Lyme disease

It is a bacterial disease that can cause a "bull's-eye" rash with fever, headache, and muscle or joint pain. If you are in an area where there are ticks, such as the woods, wear light-coloured clothing so that ticks can be spotted more easily and removed before becoming attached, wear long-sleeved shirts, and tuck your pants into socks (Murray, 2010).

Methicillin Resistant Staphylococcus Aureus

Transmission of MRSA infections between pets and humans are increasing, with the most common being infections of the skin, soft-tissue and surgical infections. Dog or cat bites can result in infection, caused by bacteria from the animal's mouth and on the patients' body. Animals are potential reservoirs of MSRA infection due to increasing prevalence of community-acquired MRSA (CA-MRSA) in humans and domestic animals such as dogs, cats and horses.

Zoonotic Ancylostomiasis

Cutaneous contact with the infective stages of canine hookworms can lead to the development of cutaneous larva migrans (CLM) in humans.

Toxocariasis

Humans become infected with Toxocara when they accidentally ingest embryonated eggs through contamination of infected soil, food, fomites or by direct contact with dogs. While most people infected by Toxocara do not develop overt clinical disease, three clinical syndromes have been associated with Toxocara infection in humans: (i) visceral larva migrans (VLM); (ii) ocular larva migrans (OLM); and (iii) covert toxocariasis.

Echinococcosis

Dogs and other suitable canids (wolves and foxes) are the major definitive host for Echinococcus granulosus, the cause of unilocular hydatid disease (cystic echinococcosis) in livestock and humans.

Cryptosporidosis

It is an infection of the gastrointestinal system caused by the parasite *Cryptosporidium parvum*. Symptoms include watery diarrhoea, fever, abdominal cramps, nausea, and vomiting. Infection in immunosuppressed individuals such as the very young, the elderly or those with HIV/AIDS may be life threatening. Cryptosporidiosis has been found in people, cats and dogs living in the same environment, suggesting the potential for zoonotic transfer between species exists.

Giardiasis

It also known as traveller’s diarrhoea caused by the parasite *Giardia*, giardiasis is the most frequent cause of nonbacterial diarrhoea in North America and the most commonly diagnosed

intestinal parasite in humans. It is transmitted most frequently through contaminated water. The most common sign of giardiasis in dogs is diarrhoea, which can be acute, chronic, or intermittent.

Ringworm

It is not a worm, but a skin and scalp disease caused by fungus. Ringworm usually makes a bald patch of scaly skin or a ring-shaped rash that is reddish and may be itchy. The rash can be dry and scaly or wet and crusty. Ringworm is transmitted by direct contact with an infected animal's skin or hair. Dogs, especially puppies, can pass ringworm to people, so preventative care by your veterinarian is important.

Conclusions

Washing of hands with soap and running water for at least 20 seconds, after contact with pets, pet food and pet bowls. Routinely clean pet food bowls, feeding areas, litter boxes and habitats. Keep children younger than age 5 away from pet food and feeding areas. Regular veterinary care is important for the health of every animal. Because any dog at any age can become infected with parasites, an annual exam with a faecal exam is important. One of the best ways to prevent zoonotic diseases is to promptly clean up pet waste.

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Popular Article

Public Health Significance of Avian Influenza

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Abstract

Avian influenza refers to the disease caused by infection with avian influenza Type A viruses. These viruses are found in wild aquatic birds all over the world and can infect domestic poultry and other birds and animals. Humans are not generally infected by avian flu viruses, but cases of human infections with avian flu viruses have, however, been reported on an infrequent basis. The majority of human influenza infections are caused by influenza A (H5N1) and A (H7N9) virus which have been associated with direct or indirect contact with infected live or dead poultry. Controlling the disease in the animal source is critical to decrease risk to humans. To minimize public health risk, quality surveillance in both animal and human populations, thorough investigation of every human infection and risk-based pandemic planning are essential.

Introduction

Avian Influenza also called as avian flu and bird flu, is one of the most important economical disease of the poultry industry. It is caused by viruses in the family *Orthomyxoviridae*, genus *Influenza virus* A, which contains a genome composed of eight segments of single-stranded negative-sense RNA and spikes of hemagglutinin and neuraminidase glycoproteins present on its surface. There are 18 known HA subtypes and 11 known NA subtypes. Many different combinations of HA and NA proteins are possible. Avian influenza strains are divided into 2 types based on their pathogenecity: highly pathogenic avian influenza (HPAI) and low pathogenic avian influenza (LPAI). Avian influenza A viruses (AIVs)

are pathogens that infect a wide range of avian species. Spillover to human populations and other species occurs occasionally, resulting in disease of varying severity (Philippon et al., 2020). In developed countries, most commercially farmed poultry is clear of this virus, and such illnesses are uncommon. When the infection is present, it is generally as the LPAI virus, but if the chickens or turkeys are infected with the HPAI virus, the result can be disastrous, with approaching 100 percent death. In recent past, India suffered multiple outbreaks of avian Influenza (H5N8 and H5N1) at various epicenters in Delhi, Gwalior, Rajpura, Hissar, Bellary, Kottayam, Ahmedabad and Daman.

Infection in birds

Avian influenza viruses are shed in the faeces and respiratory secretions of the infected birds. Once an avian influenza virus has entered a poultry flock, due to the close proximity of the birds it can spread in the farm by either the fecal-oral route or through aerosols. Fomites can also play an important role in transmission and flies may act as mechanical vectors (Reed et al., 2003). LPAI viruses produces clinical signs which are reduction in weight gain in broiler poultry or a temporary decline in egg production in layers. In comparison, HPAI viruses can result in high mortalities up to 90-100% in a flock within 48 hours and cause epidemics that may spread rapidly and result in severe trade restrictions (Swayne and Suarez, 2000).

Infection in Humans

Although avian influenza A viruses usually do not infect people, rare cases of human infection with H5N1 and H1N1 have been reported as a result of poor hygiene or prolonged contact with infected birds, their secretions or excretions. When enough virus enters a person's eyes, nose, or mouth, or is inhaled, human infections with bird flu viruses can occur. This can happen when a person breathes in virus that is in the air (in droplets or possibly dust), or when a person touches something that has virus on it and then contacts their mouth, eyes, or nose. The people who are at highest risk of getting this infection include poultry farm workers, veterinarians, wildlife biologists, ornithologists etc. Symptoms of avian influenza infection in people are almost similar to common cold and may include fever, malaise, cough, sore throat, muscle aches, abdominal pain, chest pain, conjunctivitis, parenchymal pneumonitis and diarrhoea. However, it may result in much more severe course than classic influenza (Kumar et al., 2018).

Diagnosis

For diagnosis, avian influenza viruses can be detected in oropharyngeal, tracheal and/or cloacal swabs from live birds and samples from internal organs of dead birds. In humans, viruses may be found in samples from the upper and/or lower respiratory tract. Viruses can be isolated in embryonated eggs.

Treatment

There is no specific treatment for influenza virus infections in animals. Poultry flocks infected with HPAI viruses are depopulated. The disposition of infected LPAI flocks may vary with the virus and the country. In humans, treatment for may vary, depending on the severity of the case, and can include antibiotics to treat or prevent secondary bacterial pneumonia and antivirals. Antiviral drugs are most effective if they are started within the first 48 hours after the onset of clinical signs.

Prevention & Control

Prevention and control includes closing infected poultry markets to control the source of virus, avoiding contact with sick birds and their environment, employing good sanitation and hygiene and using personal protective equipment (PPE) such as respirators, goggles, gloves, wherever appropriate. Since, these viruses have been found in eggs and meat from several avian species, therefore, careful food handling practices are very important when working with poultry or wild game bird products in endemic areas. All poultry products including eggs and meat should be completely cooked before eating (Cardona et al., 2009). Constant monitoring of avian influenza infections in captive as well as free-living wild birds is part of control programme for avian influenza in India.

Conclusions

AI outbreaks have caused severe economic losses and agricultural trade restrictions. Biosecurity measures can be established to prevent interaction of wild birds and domestic poultry, thereby reducing the risk of AI virus introduction into domestic poultry. There is concern for public health from the H5N1 HPAI viruses because of human infections and fatalities. Besides H5N1 virus will adapt over time to be able to infect and spread person-to-person. Various components are needed for successful control and mitigation strategies.

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Popular Article

Anatomy and its Application in Clinical Practices

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Veterinary science is an ocean of knowledge on topics dealing with varieties of different subjects besides being popularly known for its role in the treatment of different species of animals. Among the different subjects that veterinary courses cover, the basics of Veterinary learning is the area of Veterinary Anatomy. Veterinary Anatomy deals with the study of form and structure of animals and birds. According to Vasalius, 1543 "Anatomy should rightly be regarded as the firm foundation of whole art of medicine and its essential preliminaries". That means to be a good veterinarian in terms of nutrition, physiology, pathology, medicine, gynaecology, surgery etc. a thorough knowledge of Anatomy is very much essential.

The history of Indian veterinary medicine is related to the development of human medicine; because, the ancient Indian physicians not only treated human beings and animals but also trained other people in the care of animals. Aryans placed great emphasis on protection of cows. Atharvaveda provides interesting information about ailments of animals, herbal medicines, and cure of diseases. The first known veterinarian of the world was Shalihotra, he was an expert in equine husbandry and medicine and wrote the Haya Ayurveda. A text Gaja Ayurveda was written by Sage Palakapya, who was expert in dealing with elephant treatments. During the period of Dhanwantari (2500 BC), he described the Ayurveda into 8 chapters including 'Shalya' means surgery and 'Kaya Chikitsa' means Anatomy. Shalihotra (2350BC) was believed to be the first Veterinarian who wrote "Shalihotra Samhita" with 12000 Shlokas

in Sanskrit language. He described the structure of body of horses along with description of equine and elephant anatomy, physiology, surgery etc. In Mahabharata (1000 BC), it was mentioned that Nakula and Sahadeva, the two Pandava brothers were experts of horse and cattle husbandry respectively. Gokul and Mathura were famous for excellent breeds of cows, high milk production, quality curd, butter, and other products, where Lord Krishna passed his childhood. Buddha was a great protector of all kinds of animals and birds (including game birds) in ancient India. The great king Ashoka (300 BC) erected the first known veterinary hospitals of the world. He arranged cultivation of herbal medicines for care and treatment of men and animals in his kingdom.

People with a passion for animals, medicine and biology might consider learning veterinary anatomy; as such learning opens the opportunity for careers that involve working with animals. The study of animal anatomy can be applied to field conditions that includes animal care & treatment, animal surgery, veterinary medicine and animal husbandry.

Veterinary anatomy is a vast subject that deals with study of different organ systems of the body namely the integumentary system (skin, hair, nails, etc) , the skeletal system, muscular system, lymphatic system, digestive system, endocrine system, urinary system, and other systems including the respiratory, cardiovascular, reproductive and neurological systems that deals the gross study and microscopic characters of a organ.

The structure of animal body has fascinated people since Palaeolithic era (early phase of the Stone Age) with mural paintings depicting the superficial anatomy of animals. Comparative anatomy has a long and noble history with evidence in Babylon suggesting the study of earliest scientific anatomical study through the tablets which had been recorded, few remains indicating the Babylonian knowledge on anatomy. During the second century, Galen's studies paved the way for modern neuroscience, *On the Usefulness of Parts of the Body*. In seventeenth century, William Harvey, developed his theory on the one-way valves in the heart in the earlier veterinary text by Italian Carlo Ruini in *Anatomia del Cavallo (Anatomy of the Horse)*.

Grossly, anatomy may involve dissection or non-invasive methods keeping in mind the ambitions to collect data about the larger structures of organs and organ systems. During dissection, the animal cadaver is cut open and organs are studied. Non-invasive methods include endoscopy, angiography, ultra sound imaging, magnetic resonance imaging, computed tomography and X-ray. Endoscopy is a technique used to perform study of the gastrointestinal

tract, often the primary organ of interest by inserting a tube with a camera at its end. Angiography is the study of the blood vessels of living animals by inserting an radio opaque dye into an animal to highlight the circulatory system during imaging technology.Techniques such as magnetic resonance imaging (MRI), computed tomography (CT), or x-ray also reveal information about the inside of a living body.

X-Ray of tibia and fibula, anatomical knowledge is the first basic requirement to analyse an X-ray film (Photograph credit: Dr. C.K.Singh, Assistant Professor, Dept of Surgery and Radiology)

Histology is vital for understanding the advancement of human medicine, veterinary medicine, biology, and other aspects of life sciences. Tissue samples, or biopsies, are taken from animals and analysed by a histologist. The microscopic study of biological tissues can help to explain the cause as to why a person and animal died unexpectedly.

As in forensic investigations, biological tissues from deceased people and animals can be analysed, so that investigators may better understand the causes of death. Biological samples from archaeological sites can provide useful data about what was going on in ancient history.

The sex related diseases and deformities can be reduced by knowing the anatomy of structures and organs associated with it. Studies revealed that quantity of bone tissue of the tibiotarsus (weight, volume, diameter of the diaphysis, area of the cortex) was smaller in female broiler chicken than male, although the occurrence of varus-valgus deformations of the intertarsal joint was largely reduced in female chickens (8.8% versus 19.9% in males at 42 days of age), the thinness of bone diaphysis was counter-balanced by modifications in the composition of the matrix and in the porosity of the cortex, leading to equal biomechanical characteristics of tibiotarsi in both sexes.

The anatomical location and course of the nerves, veins and arteries are important for veterinary practices for application of local anaesthetics drugs, fluids and medicines which cannot be administered orally. The anatomical location of major organs like lungs, heart, kidney, liver, gastric, and other structures, are sites for palpation and percussion for different diagnostics methods.

Pregnancy diagnosis in Asian elephant without knowing the anatomical features imaging diagnostic techniques cannot be used (Photograph credit: Dr. K.K.Sarma, Professor & Head, Dept of Surgery and Radiology)

Biomechanics help understand how an animal stays at rest (stay apparatus as in horse), or during simple walk, or intensives exercises or running, and how changes occur in the mechanism, that help experts to understand the condition of the animal for its lameness and deformity.

Understanding of a disease process begins with the knowledge of anatomy and when a client explains about a problem with his animal, we will be able to visualize where the problem exists and what anatomical structures may be affected. Hence, a solid understanding of anatomy is highly essential as a starting point for making a diagnosis. As for example anatomical knowledge also helps us to recognize abnormalities in an animal by applying anatomical knowledge in study of a radiographs (x-rays) or by palpating (physically examining) the animals, one can identify the normal anatomical features of organs or any deformity or deviation from the normal structure and treat accordingly. It is the foundation knowledge for all the concerned veterinarians to groom oneself for expertise service.

Fixing a modified splint in hind limb of an Asian elephant. It is very important to know the anatomy of the body region to design and modify equipment's and techniques for surgical correction procedures. (Photograph credit: Dr. K.K.Sarma, Professor & Head, Dept of Surgery and Radiology)

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Popular Article

Attappady Black – The black gold among the goat breeds of Kerala

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Black pepper, the king of spices is known as the black gold among the agrarian community of Kerala, but for the goat rearing farming community of Attappady area, Attappady black goat breed is their black gold. Attappady black goat also known as Attappady, breed hails from the Attappady area (spread over an area of 827 sq. kms) an extensive mountain valley at the headwaters of the Bhavani River settled below the Nilgiri Hills of the Western Ghats, which in turn is situated on the northeastern side of the Palakkad district. In addition, the ICAR-National Bureau of Animal Genetic Resources (NBAGR), Karnal has given Attappady black goat (Accession Number- INDIA_GOAT_0900_ATTAPADYBLACK_06001), the tittle of registered breed of goat among the 34 goat breeds of India.

Attappady goats – heritage of tribes

Attappady goats are reared among the tribal communities of Pudur, Agali, Sholayoor Grama Panchayats of Attappady area. The custodians of these goats are tribal population belonging to Irula, Kurumba, Muthuka. These communities give Attappady goats a family member status. In addition, these goats play a major role in the socio- economic traditional life of the said communities. The financial status of the families of these areas is accessed using the number of goats owned by a family. The goats are also used as gift among the various traditional rituals (especially marriage ceremonies) followed by these communities. Traditionally, these communities believe that milk and meat of Attappady goats provides them with good health as

well as has medicinal properties. The goats are allowed to graze throughout the daytime and are given shelter during night time only by the traditional goat farmers. The shed is constructed using wood and other natural materials.

Merits of Attappady goats

Body confirmation is of lean type in general. The animals are black in color with bronze colored eyes. Ears are medium in length drooping over the lateral side of the face. Horns are present in both males and females and they are curved laterally upwards and backwards. Tassels are present in some animals. Their tail is of a bunchy type and curved. Adult males above 18 months of age weigh on average 35 kg and females weigh 31 kg (Stephen *et al.*, 2005). They have strong legs as well as hooves to climb the rocky mountains of Attappady which is the highlight of the breed.

High disease resistant capacity and climatic resilient nature of these goats makes them farmers' black gold. The amount of water required by these goats is less. They used to relish low fiber quality grass which are usually neglected by other goats. Females come into first heat by 8-9 months of age and first kidding at the age of 13-14 months. Usually they produce a single progeny per kidding. The birth weight of males and females is around 1.73 kg and 1.60 kg respectively. They produce very small quantity of milk – around 350-400 milliliter per day (Mathivathani *et al.,* 2020). These goats are mainly reared for meat purpose. These animals are good for extensive grazing system rather than stall feeding system.

Attappady goats at the verge of extinction

Owing to the belief that black goats meat is having high quality, taste and medicinal properties, the meat is having high demand as well as value in market. Due to the reckless slaughter of these goats for meat, they are at the verge of extinction. The intermediaries are exploiting the tribal communities who are rearing the Attappady goats economically and deprive these farmers with huge margin of profit. In addition, the reduction in number of good quality breeding males have led to inbreeding depression and uncontrolled natural mating with other non-descript bucks during grazing time has led to the decline of Attappady goat population. Around 4000 goats remain in true breed among the Attappady goat farmers. There is a conservation center under the Animal Husbandry Department in Attappady to protect the Attappady black goat. And this native goats are conserved at Kerala Livestock Development Board- Dhoni farm, Goat farm unit of College of Veterinary and Animal Sciences, Mannuthy (KVASU) and Thiruvizhamkunnu farm, Palakkad district. Several research studies have also been conducted about Attappady black by these institutions.

Is Attappady goats eligible for Geographical Indication Status?

According to World Intellectual Property Organization (WIPO), a geographical indication (GI) is a sign used on products that have a specific geographical origin and possess qualities or a reputation that are due to that origin. In order to function as a GI, a sign must identify a product as originating in a given place. In addition, the qualities, characteristics or reputation of the product should be fundamentally due to the place of origin. Since the qualities depend on the geographical place of production, there is a clear link between the product and its original place of production. When a product gets GI tag, it becomes a brand and the economic value of it enhances there by import and export chances get increased. *Jeerakasala* and *Gandhakasala* rice varieties, *Vazhakulam pineapple*, *Malabar pepper*, *Marayur jaggery* etc. are the several agricultural commodities of Kerala that got GI tag. Also, *Kadaknath chicken* meat from Jhabua district of Madhya Pradesh has awarded GI tag – the first of its kind to come under the umbrella of GI. Recently, *Osmanabadi goat* breed, known as 'lifesavers of farmers' in the suicide zone of the Marathwada and Vidarbha regions of Maharashtra has applied for GI. In these circumstances, Attappady black originated from the Attappady area, having all the traditional value of the tribal population has got all the eligibility to become GI. To save the Attappady from extinction and to promote the tribal community who rear Attappady, GI tag status is inevitable to aid in. The Kerala

State Biodiversity Board has to give a special focus in this regard and to conserve the black gold of Attappady.

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Popular Article

A1 and A2 Milk and its Impact on Human Health

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Abstract

Casein is the predominant protein of milk, with a number of thirteen variants. A1 and A2 are the most common variants, which are called A1 β-casein (A1-milk) and A2 β-casein (A2-milk). Besides the nutritional factors of milk, there exist a hypothesis that a particular component of milk protein i.e., beta casein protein might found to be associated with some human health related conditions like Cardiovascular Diseases (CVD), Type I diabetes, neurological disorder and other health issues. Though it were found to cause such ailments based on some human and animal trials, however, no any clear clarification on it exists till date. Thus, it can be concluded that for a proper and detailed explanation on the health impact of A1 & A2 milk, long term clinical trials and research including participants from different regions, age, gender and physiological states should be used.

Introduction

Milk is a highly nutritious food with a good source of protein, fat, carbohydrates, vitamins and other various minerals in it, which are necessary for sustaining and maintaining a healthy life. It is an oil-in-water emulsion, with an average composition of 87.1% water, 8.9% Solids-not-fat, 3.3% protein, 4.6 % lactose, 4% fat, 0.70% minerals and

0.15% miscellaneous components. Of all the components of milk, protein is the one that is associated with the subject A1 and A2 Milk. The proteins of milk consist mainly of casein and serum or whey protein. Casein is the predominant milk protein and is exist only in milk constituting almost 80% of the total milk proteins, which are present in form of complex aggregates. The remaining 20% of total milk proteins are termed whey proteins. The chief subgroup of casein based on their different peptide chains are: α_{S1}- Casein (39–46% of the total caseins), α_{S2}- Casein (8–11 %), β -Casein (25–35 %) and κ -Casein (8–15 %), which are all heterogeneous and consists of several genetic variants. Within β-casein, there are a number of variants which are genetically determined. However, there are thirteen genetic variants of β-casein found in cow´s milk. A1 and A2 are the most common variants, which are called A1 β-casein (A1-milk) and A2 β-casein (A2-milk). Serum or whey proteins constitute β-Lactoglobulin, α-Lactalbumin, Serum albumin, Proteose peptone, and Immunoglobulins (IgGl, IgG2, IgA, IgM). Miscellaneous milk protein lactoferrin, transferrin, membrane proteins and enzymes are also found (Daniloski *et. al.* 2021; Walstra *et. al.* 2006). Above and beyond it's nutritive value, there exist an hypothesis that consumption of milk with the particular component of beta casein protein might be harmful to human health. With this concept there evolved a number of companies marketing and popularizing milk consists of only A2 beta casein as A2 milk, a New Zealand based Company named a2 Milk Company Ltd. is a pioneer.

What is A1 & A2 milk?

Milk proteins have a wide range of different structure and properties since they are heterogeneous group of polymeric compound. The β-Casein of milk exists in a number of variants which are determined genetically. It was found that there are 13 genetic variants of β-Casein in milch cattle (i.e. A1, A2, A3, B, C, D, E, F, G, H1, H2 I, and J). But A1, A2 & B milk are the most compound forms in dairy cattle. Therefore, it is called as A1 milk- milk that contains A1 variant of β -Casein and A2 milk with the A2 variant (Daniloski *et. al.* 2021).

Biochemical Structure of A1 β- Casein & A2 β -Casein

Beta Casein consists of 209 amino acid proteins. The difference between A1 and A2 β-Casein lies in the fact that at the 67th position of amino acid chain of the Casein A1 milk has histidine (coded by CAT, i.e. Cytosine- Adenosine-Thymine) while A2 milk has Proline, (coded by CCT Cytosine- Cytosine-Thymine) at the 67th position (Fig. 1) (Kaskous, 2020). A1 protein variant is commonly found in milk from cross breed and European breeds of cattle, while the A2 milk protein variant is found basically in the indigenous cows and buffaloes of India which was

thought to be undergone mutation of single amino acid in European dairy breeds a few thousand years ago (Sebastiani *et. al.* 2020). The A1 & A2 status of cow is determined by a pair of genes on the 6th chromosome of bovine genome. There are two major alleles of the genes, i.e. A1 & A2 β Casein alleles. A cow may carry two copies of the β Casein genes, i.e. either A2A2 (Homozygous), A1A2 (Heterozygous) or A1A1 (Homozygous) alleles (Chitra, 2021). DNA based techniques like Polymerase Chain Reaction- Restriction Fragment Polymorphism, Polymerase Amplifications created restriction sites and single stranded conformational Polymorphism can be used to observe there alleles (Gorkhali *et. al.* 2021).

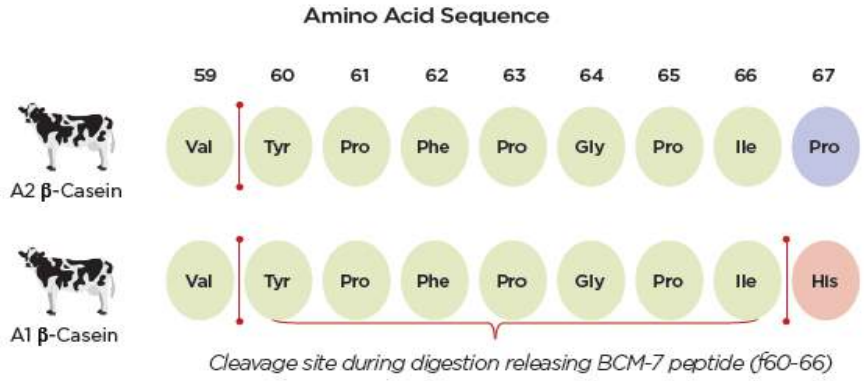

Figure 1: β-Casein sequence

Digestion of Casein and Betacasomorphins (BCMs)

Digestion of protein A1 β-Casein by proteolytic enzymes result in releasing of a range of different peptides including β-Casmorphins, since histidine (His^{67}) in A1 milk allows for easier proteolytic cleavage of its bond; while proline (Pro^{67}) in A2 milk hinders the cleavage by the enzymes due to its structural features (Summer *et.al.*2020). These BCMs are bioactive peptides and are recognized for their opioid features and a high opioid receptor affinity. Generally, BCMs are comprised of 4-11 amino acid peptides that are stored in an inactive state within the native protein sequence and are released during gastrointestinal digestion. The important BCMs are BCM5 & BCM7, with fragment f60-64 and f60-66 of β-Casein respectively (Daniloski *et. al.* 2021).

Hypothesis of A1 and A2 milk

Consumption of A1 milk by human has been hypothesized to be related to occurrence of some health related conditions and non-communicable diseases which were demonstrated by various animal and human trials. Lactose intolerance is a condition that is commonly encountered due to lacking of the enzyme lactase which is required for digestion of lactose and characterized

by indigestion, bloat and diarrhea. Most important cause of it is genetic or loss or injury to the small bowel mucosa, nonetheless, in some situations this intolerance of lactose could be due to difficulties associated with digestion of A1 milk rather than lactose (Jianquin *et.al.* 2015).

If the BCMs happen to cross the intestinal membrane and thereby enter into the circulation, it will affect the other organs. Thus on reaching the blood stream it can cause serious ailments like Coronary Heart Disease and Type I diabetes. Nonetheless, a query remains that whether BCM7 can normally pass the gut blood barrier; it may be possible if same individual suffer from increased permeability of the gut membranes due to some conditions like – stress, stomach ulcers, autism, under developed intestinal barrier in the case of infants or older patients or ulcerative colitis (Shani-Levi *et.al.* 2017). Like in the case of "leaky gut" condition where the permeability of the intestine is increased allowing the passage of substances through it, thus these findings are contradictive to the supposed mechanism of "leaky gut" syndrome. So for a better confirmation this hypothesis needs to be tested under clinical conditions.

Despite the fact that human and animal studies on the effect of A1 milk on Cardiovascular Diseases (CVD) reported that the incidence of CVD was related with the intake of A1 casein milk (Elliott *et. al.* 1999). However, Daniloski *et. al.* (2021) contradicted it by commenting that was no any indication that consumption of A1 milk had any CV health implications in comparison to A2 milk.

Yet again incidence of juvenile insulin dependent Type I diabetes mellitus was reported with the consumption of A1 Beta milk by influencing the glucose homeostasis (Chia *et.al.* 2018). Nevertheless, this process requires few generations in order to express its effect. It was also noted that A2 milk did not possess any diabetes protective effect.

Neurological disorder such as schizophrenia, autism and sudden infant death syndrome were also found associated with the consumption of A1 milk by some researchers (Sun *et. al.* 2003). However a recent study on human by Gonzalez-Domenech *et al.* (2020) found that casein free diet did not influence BCM7 concentration in urine nor correlate with behavioral symptoms of autism. Thus, negligible difference of A1 & A2 milk has been observed with regards to mental health, even though the consumption of bovine milk and dipeptidyl peptidase-4 enzyme activity (enzyme for cleavage of BCM 7) are the potential factors describing the pathogenesis of autism (Jarmo-Lowska *et. al.* 2019).

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Conclusion

Controversy and debate over the A1 and A2 milk hypothesis as which one is more favorable to health have been discussed for long. Arguments on how the conventional milk comprising both the A1 and A2 genetic variants is associated to various health related issues and whether A2 milk have any beneficial effect on health have been discussed. Still the findings of the studies over the role of A1 and A2 milk in health related conditions remains controversial and uncertain though some studies have presented the disadvantages of A1 milk compared to that of A2 milk. Also it was demonstrated by clinical trials that A2 milk have some beneficial effects on the gastro-intestinal system but it does not completely support the negative effects of A1 milk. Thus, it can be concluded that for a proper and detailed explanation on the health impact of A1 and A2 milk long term clinical trials and research including participants from different regions, age, gender and physiological states should be used. Detail study on the role of particular β-Casein variants and BCM in the development of non-communicable diseases and its mechanism of actions should also be explored.

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Popular Article

A1 and A2 Milk and its Impact on Human Health

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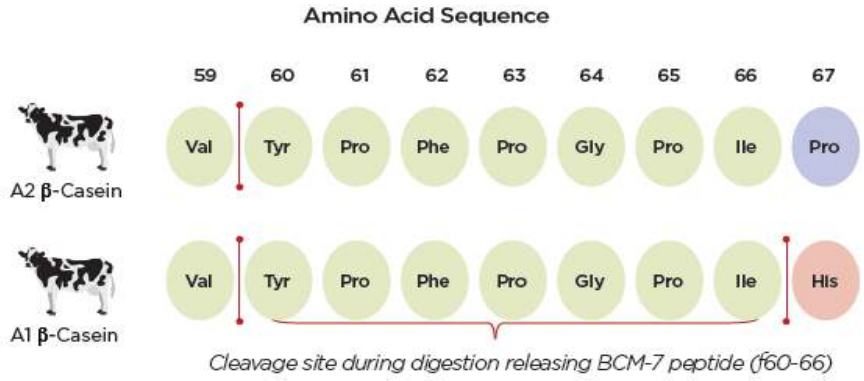

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Popular Article

Prevention and Control of Rabies in India

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Abstract

Rabies is an ancient and most frequent zoonotic disease caused by Lyssavirus species of the family Rhabdoviridae. The control of rabies is a major public health challenge in India. In spite of potent anti-rabies vaccines and immunoglobulins available, rabies is far away from control and elimination from India. An effective strategy for the prevention and control of rabies in India is required. India launched many programmes and projects on the prevention and control of rabies. Anti-rabies vaccination in both, human and animal, Animal Birth Control programme, one health approach and community awareness programme about rabies are implemented in India for control of rabies.

Key words: Rabies, India, vaccination

Introduction

Rabies is one of the ancient recognized diseases affecting humans and the most important zoonotic diseases in India. The word rabies origin from the word "rabere" which means "to be mad". Rabies is known since the advent of civilization. The first official evidence of rabies diseases showed in the pre-mosaic Eshmuna code of Babylon in the twenty-third century before Christ. Although, it was scientist Louis Pasteur in 1880's identified a virus as the cause of rabies disease (Singh *et al.*, 2017). Rabies is a deadly disease caused by the rabies virus, a neurotropic virus and a prototype of the Lyssavirus of Rhabdoviridae family. It has been acknowledged in India since the Vedic period and is described in the ancient Indian scripture Atharvaveda (Deshmukh, 2004). Rabies is mainly a disease of dogs, foxes, wolves, mongooses, coyotes, cats, jackals, skunks, badgers, monkeys, bats and humans. The dog has been and still is, the main reservoir of rabies in India (Ghosh, 2006). Street dogs and jackals in India are the main vectors or reservoirs that carry rabies in humans and other animals through

the bite of the infected ones. Bat mediated rabies, which is most prevalent in Latin American countries, has not been reported in India (Singh *et al.*, 2017).

The South Asian region evidence a highest incidence of rabies outbreak, with India and Bangladesh in the lead. Increasing in stray dog population, urbanization and the lack of environmental hygiene among the densely populated rural communities are considered as critical risk factors in the predominance of rabies in Asian (Singh *et al.*, 2017). As per India concern, the islands of Andaman and Lakshadweep are rabies free. The main source of infection in humans is the saliva of rabid infected animals. Domestic dog is the cause of greater than 90% of human rabies in India. Above 20,000 rabies deaths arise annually in India, which representing one-third of global human rabies. In spite of the availability of safe and effective vaccines and understanding of the disease, dog-mediated rabies causes around 61,000 annual deaths worldwide in humans, of which about 16,450 cases occur in India alone. The different reasons behind it are lack of awareness about the bite wound cleaning, vaccination, use of anti-rabies immunoglobulins in bite cases, non-availability of the vaccines in remote places, rabies wound proper management. Due to under-reporting, rabies disease falls amidst the eighteen neglected tropical diseases. Rabies cases outbreaks in domestic and wild animals in India are recorded round the year with all such cases traced back to the bite of rabid dogs (Singh *et al*., 1995). A study carryout from 11 states and union territories of India from January 2012 to December 2014 showed that about 52.3% of rabies cases were from Karnataka, 18% from Maharashtra, 7.8% from Tamil Nadu, 6.3% from Kerala and 3.1% from Andhra Pradesh states. West Bengal was the most affected state, with 47 rabies deaths in 2016, followed that Karnataka with 19 deaths.

Prevention and control of rabies in India

1. Vaccination in humans and animals for control of rabies

Pioneering anti-rabies immunization was performed on a boy Joseph Meister by Louis Pasteur in late phase of 19th century. After that many of effective and safe, second and third generation vaccines have been developed for use in animals and humans. Currently, various vaccines such as recombinant rabies virus strains or rabies antigen-glycoprotein (G protein), either as a component of non-pathogenic viruses, or in form of DNA vaccines are being developed (Ohara *et al.*, 2013). The Association for Prevention and Control of Rabies in India in the first half of 2017 under a World Health Organization (WHO) project is assembling new evidence in support of dog-mediated human rabies eradication in India considering cost-effectiveness, practicability and impact of improving access and coverage to rabies postexposure prophylaxis and rabies vaccination policies.

a). Pre-exposure vaccination of rabies in humans

Pre-exposure prophylaxis is a way of rabies vaccination that is administered to protect a man from getting rabies prior to an exposure to a rabid animal or any other possible mode of exposure to rabies virus. People who gain benefit most from this pre-exposure vaccination are the ones who have high risk of coming in contact with body fluid/ tissues, saliva of rabid animals, increasing their risk of rabies. Pre-exposure vaccination is advisable to people at high risk of exposure like veterinarians, laboratory staff working with rabies virus, veterinary technicians, animal control officers, wildlife rehabilitators, zoo employees, wildlife handlers/ officers, animal handlers, children living in areas at risk and individuals living in or travelling to areas of risk. The schedule of pre-exposure vaccination of rabies consists of three intramuscular (1 ml) or intradermal (i.d.) injections (0.1 ml volume) of cell culture/ embryonated egg adapted vaccine on days 0, 7 and 21 or 28.

b). Post-exposure prophylaxis of rabies in humans

Post-exposure vaccination of rabies is carried out after the bite of rabies suspected animal to prevent the development of disease. Postexposure prophylaxis of rabies in human consists of a dose of human rabies immune globulin and rabies vaccine given on the day of the rabies infection. The post-exposure vaccination schedule consists of 5 doses of i.m. injection of cell culture vaccines on days 0, 3, 7, 14 and 28 for post-exposure prophylaxis (Singh *et al*., 2017). In rabies endemic areas, every animal bite or contact from a suspected rabid animal requires prompt post-exposure prophylaxis such as wound treatment and immunization depending on the location of injury with the suspected case.

2. World Health Organization project on evaluation of neutralizing activity of monoclonal antibody combination against rabies

A project undertaken by WHO, in collaboration with WHO collaborating centres for rabies developed a cocktail of unique combinations of monoclonal antibodies to replace rabies immunoglobulin. The first rabies monoclonal antibodies to be licensed for commercial production is “Rabishield” in 2016 in India by the serum institute of India in collaboration with Mass Biologics, USA.

3. Animal birth control programme for rabies control

Animal Birth Control of Dogs Rules, 2001 was started in 2001. Animal Birth Control rules comes under the sub-section (1) of section 38 of the Prevention of Cruelty to Animals Act, 1960 (59 of 1960), Ministry of Culture, Government of India. Animal Birth Control rules (ABC) directs the municipalities work with different animal welfare organisations to execute the ABC programme. These rules take steps for monitoring the dog bite cases to find out the reasons of dog bite, the area where it took place and whether it was from a stray and a pet dog.

The Animal Birth Control programme created by World Health Organization for the control the population of street dogs and eradicate rabies diseases (Reece and Chawla, 2006).

4. Project on prevention and control of human rabies started in the 11th five-year plan of Government of India

In the 11th plan (2007–2012) that rabies control efforts are first mentioned in the form of pilot projects for the control of human rabies, for which 8.65 crore rupees were allocated. A pilot project on prevention and control of human rabies has been started in the 11th five year plan by GOI in five cities of Ahmadabad, Bangalore, Delhi, Pune and Madurai. The project was launched by the National Centre for Disease Control being the nodal agency. The main vision of this project is to bring together both medical and veterinary profession for preventing human deaths due to rabies. The project activities include routine diagnosis of rabies in animals, sero conversion studies in humans and animals, post-exposure prophylaxis treatment consultancy, training in laboratory techniques and rabies control are being executed by the National Centre for Disease Control.

5. National rabies control program initiated in the 12th five-year plan of Government of India

The Ministry of Health and Family Welfare of the Government of India declared funding for a national rabies control programme as part of the 12th five-year plan in 2014. This rabies control programme is coordinated by the National Centre for Disease Control, New Delhi, and the Animal Welfare Board of India, with the aim of reduction by half human rabies deaths by the end of 2017. Under 12th Plan the program was initiated with the objective to control rabies deaths and transmission through dog bite. The program has two components namely, human component and animal component. All the states and union territory have been incorporated for human rabies component by adopting training of health professionals, i.e. inoculation of vaccines, surveillance of human rabies, educational awareness in community to Post-exposure prophylaxis, animal bite management to the victims and strengthening of the laboratories. While, the animal component is regulated by the Animal Welfare Board of India, Ministry of Environment, Forest and climate change which is running a pilot study in Haryana and Chennai. In this component, street dog population survey, mass vaccination and stray dog population management and strengthening surveillance was carried out.

6. Prevention and control programmes of rabies commenced in India

Many agencies are engaged in rabies control program in India such as Ministry of Health, Ministry of Agriculture, State Animal Husbandry Departments, Animal Welfare Board, Local Civic Bodies, Government veterinary colleges. Pilot scheme on prevention and control of human rabies initiated from 2008 to 2012 by National Centre for Disease Control, Ministry

of Health and Family Welfare, Government of India. It implemented in the cities of Delhi, Ahmedabad, Bangalore, Madurai and Pune. Many Non-Governmental Organizations (NGO's) are also engaged in rabies control such as association for prevention and control of rabies in India, Rabies in Asia Foundation which started most of the projects for control of rabies. The Global Alliance for Rabies Control is a non-profit organization and Commonwealth Veterinary Association are also supporting for rabies control. The Karuna Animal Welfare Association Non-governmental organization located at Bangalore is also actively participating in rabies control program. Different states and union territory of India to initiate mass vaccination of domestic and stray dogs for control of rabies (Rahman, 2011).

i) Sikkim Anti-Rabies and Animal Health programme for elimination of dog mediated rabies

The Sikkim Anti-Rabies and Animal Health (SARAH) programme is a state-wide animal birth control initiated in 2005 in the city of Gangtok. It is also an animal welfare and public health proposal of the Department of Animal Husbandry Livestock, Fisheries and Veterinary Services of Government of Sikkim working collaboratively with the Brigitte Bardot France-based a non-governmental organization, Australia-based NGO, Vets Beyond Borders and the Sikkim Society for prevention of cruelty of animals to make Sikkim rabies free. The aims are to protection of ecosystem and public health by controlling the street dog and cat population of Sikkim in a sustainable, humane and benevolent manner (Byrnes *et al*., 2017).

ii). Mission Rabies in Goa for control of rabies

Mission rabies worldwide veterinary services have formulated a programme in Goa keeping in mind two main Aims i.e. Eradication of Rabies and Rabies free Goa. Government of Goa is concerned about the suffering of stray animals on the streets and has come up with a scheme to reduce the suffering of the stray dog population. Uncontrolled breeding has resulted in large number of sick and starving dogs and puppies on the streets and beaches. The Municipalities and Panchayats are work with International Animal Welfare Organization to reduce and manage the number of strays by sterilizing under animal birth control programme and vaccinating them against rabies.

iii). Education project about rabies awareness in school children in Karnataka State

In Karnataka, the project was introduced into the school curricula to make awareness among the school children about the disease and its control measures. Because more than 60% of all people who die of rabies are children in India. The main objective of the project is to relieve the burden of rabies in dogs in India and to reduce human rabies deaths (Rahman, 2011).

7. National Centre for Disease Control, World Health Organization, Association for prevention and control of rabies in India, national multi-centric rabies survey

The survey was published in May 2004. The survey reported Andaman and Nicobar Islands, and Lakshadweep are free of rabies. Majority of the human rabies deaths occurred in adults, males and in low-income groups in India. On the laboratory evidence, most common animal reservoirs for rabies are dogs, cats, cattle, goats and pigs.

8. Importance of society awareness and education of rabies

Even after the implementation of many programmes for rabies control, the lack of community awareness about rabies control is a major obstacle that thwarts efforts to prevent human deaths caused by rabies. Awareness amongst school children is required. Many studies have assessed the community knowledge and attitudes towards rabies, its prevention and control in an urban slum and the factors influencing rabies awareness in those areas through random sampling method. Awareness among the people about first aid of dog bites is required. The results of their study showed that only 54.1% of population was aware that rabies is a deadly disease and only half of the population knew about the proper post-bite first aid management of wound. Hence along with control programmes, intensive public awareness programmes regarding the consequence rabies, vaccination and post-exposure first aid are to be implemented (Herbert *et al*., 2012).

9. One health approach for control of rabies

The one-way approach to prevention of human rabies and the reduction of its burden by focusing mainly on medical interventions has not been useful. Hence effective "one health approach, for control of rabies is required. Under the One Health Initiative, WHO, Office International des Epizooties, Food and Agriculture Organization, and Global Alliance for Rabies Control are working on simultaneous campaigns to eliminate canine rabies through the vaccination of dogs, the treatment of human rabies exposures with wound washing and post-exposure prophylaxis and the enhancement of education about rabies prevention where it is needed most. Tamil Nadu has pioneered a "One Health" committee to address the challenge of rabies in dogs and humans. Rabies control strategy in Tamil Nadu involves postexposure vaccination of humans after dog bites, whereas potential supplemental approaches include dog's vaccination and sterilization.

10. Ending human deaths from dog-mediated rabies by 2030

In December 2015, countries from across the world met with WHO, the World Organization for Animal Health, the Food and Agriculture Organization of the United Nations and the Global Alliance for Rabies Control agreed to end human deaths from dog-mediated

rabies by 2030. Ending human deaths from dog-mediated rabies by 2030 will require an active role from India.

11. Building strategic and sustainable partnerships between the government agencies for human health and animal welfare with non-governmental agencies involved in delivery of services to increase knowledge and promote dog bite wound management practices in vulnerable human population or societies helping with vaccination of stray canines, enhancing rabies surveillance and developing multiple reference laboratories for early diagnosis of rabies are indispensable for long term rabies control.

Conclusion

The control of Rabies, a zoonotic viral disease is a major public challenge in India. The keys to rabies prevention and control in India depend upon the development of newer rabies vaccination technology which is cost effective for vaccination in both, humans and animals, different rabies control programs initiated in a different state with the collaboration of National and international health agencies. Also, awareness about rabies among all society people is required. One Health concept plays an important role in the prevention and control of rabies in India.

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Municipal solid waste compost: Potentials and threats to soil ecosystem

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Abstract

Municipal solid waste compost (MSWC) has been used successfully as soil amendments in agricultural lands for crop production as a source of nutrients and organic matter addition. Application of MSWC to agricultural soils has shown several advantages like supplying plant nutrients to soil and improving soil fertility, improving soil structures, water holding capacity and soil biological health. Also, application of MSWC raises concern on trace and heavy metals build up in soil under long term period. Hence, quality evaluation of MSWC before its application for agricultural purpose is essential for maintaining soil health and ecosystem service.

Keywords: Municipal solid waste compost, plant nutrients, heavy metals

Introduction

India is the second most populous nation in the world, is getting urbanized in a greater pace. The rapid development of urbanization has led to tremendous increase in generation of municipal solid waste (MSW) every year. Majority of the city solid waste generated in India were disposed through open dumps and landfills which poses health issues to soil, plant, animal and human being. Nearly 70% of the collected municipal solid waste are dumped in landfills raising a huge concern on land degradation, greenhouse gas (GHG) emissions and public health (Ghosh *et al*., 2018). Several technologies like waste incineration, gasification and composting has been executed by local urban bodies and pollution control board for safer disposal of waste without deteriorating natural resources and ecosystem service. Through these technologies nearly one-fourth of the total waste generated has been recycled for better disposal.

Municipal Solid Waste Compost

Composting of municipal solid waste to have municipal solid waste compost (MSWC) as a product finds a better solution for safer disposal under solid waste management strategies. The relatively safer and stabilized/matured MSWC has been used successfully as soil amendments in agricultural lands for crop production as a source of nutrients and organic matter addition. Several published reports on MSWC application to agricultural soils indicates that it has shown several advantages, supplying plant nutrients to soil, improving soil structures, water holding capacity and soil biological health. Also, application of MSWC raises concern on trace and heavy metals build up in soil under long term period (Madrid *et al*., 2007). The presence of trace and heavy metals will eventually restrict its application to soil, because of loading possibility of contaminants in soil that could negatively affect soil health and could pose a long-term environmental hazard.

Among the technologies available for municipal solid waste utilization under solid waste management strategies, composting is the most widely used treatment suitable for MSW having organic component of 60-70%. According to an estimate reported by Saha *et al*. (2017) that India has an potential of producing about 5 and 14 MT compost each year containing about 120-250 tonnes of major plant nutrients, N, P_2O_5, and K_2O.

Municipal solid waste compost quality

Municipal solid waste compost (MSWC) is a organic-mineral complex of heterogeneous in nature with varying particle size distribution and composition. The MSWC quality and its composition generally varies and mostly depends on the quality composition of the original materials (MSW) and the composting methodology. Several researchers reported that physico-chemical characteristic of MSWC and the trace metal content and their availability depends on the particle size fractions of composted MSW (Saha *et al*., 2013). Vyas (2011) reported that the pH of the MSWC collected from Bangalore, Malad, Delhi, Bhopal, Nashik, Ahemdabad and Gwalior were found to be on alkaline ranging from 6.89 to 7.79 with an average value of 7.24. The moisture content of the MSW compost was ranging from 18 to 32% with the average value of 25.01%.The organic matter of MSW compost ranged between 17.21 to 40.5 % with an average value of 27.92% .The nitrogen content of MSW compost Bangalore, Malad, Nashik and Ahemdabad exceeds 1 % while in Delhi, Bhopal and Gwalior samples the average nitrogen content was 0.88 %.The values of phosphorus and potassium of MSW compost were in the range of 0.15 to 1 % and 0.65 to 1.03% with average of 0.64 and 0.83 % respectively.

In generally, the municipal solid waste compost has higher potentially trace metal concentration and greater availability in the smaller sized particle of municipal solid waste compost in comparison to larger sized particle (Saha *et al*., 2013). Saha *et al*. (2013) conducted to investigate physico-chemical properties, fertilizing potential and heavy metal polluting potentials of municipal solid waste composts produced in 29 cities of the country. The result indicated that municipal solid waste compost prepared from biogenic wastes of segregated source had higher organic matter, total nitrogen and total phosphorus to an extent of 57, 77 and 78%, respectively as compared to compost prepared from biogenic waste of non-segregated source. The trace metal concentration was also significantly lower to an extent of 63, 78, 64, 84, 50 and 63% for Zn, Cu, Cd, Pb, Ni and Cr, respectively as compared to compost prepared from biogenic waste of non-segregated source/mixed waste.

Municipal Solid waste compost on crop yield

Municipal Solid Waste compost application to agricultural field as source or plant nutrients and soil amendments is the most effective strategies of MSW management because of its advantages over traditional means such as landfilling or incineration. . Application of MSW compost (MSWC) in agricultural soils can directly improves soil physic-chemical properties and thereby promote plant growth (Bundela, 2010). Increase in the grain yield of various crop under municipal solid waste compost application has been reported by several authors (Coumar *et al* 2021). It also found that the total plant canopy cover increased with MSWC application during the five years of the study. Application of MSWC significantly increased the dry matter yield of spinach leaves and roots compared to the control. Approximately 12.87 and 18.33% increase was observed in the dry matter yield of spinach leaves and roots when MSWC was applied (Coumar *et al*., 2021) Several studies have shown that MSWC products are generally rich in plant nutrients and organic matter, which stimulates plant growth and yield. The yield of tomatoes was increased in a fine sandy loam with increased rates of MSWC application (62 and 124 Mg ha-1) during three consecutive years as compared to controls (Maynard, 1995).

Municipal Solid waste compost on soil health

MSW compost application improves soil porosity, water infiltration, soil aeration, soil bulk density and stability of soil aggregates. Soil incorporation of MSW compost improves the pore size distribution by increasing the storage pores and consequently increasing the water holding capacity. The primary benefit of MSW compost application is due to high organic matter content resulting in improving organic carbon content in soil. Repeated application of MSW compost consistently increased soil organic matter content and soil C/N ratio to levels greater than those of unamended soil. Coumar *et al*. (2021) observed that the SOC content in

the post-harvest soil increased following the application of MSWC at 10 t ha^{-1} rate to an extent of 47.73% as compared to the unamended soil (control) under pot culture study. Application of MSWC also significantly affects the soil pH and EC content depending upon the original characteristics of MSWC product.

An increase in the bioavailable plant macro and micro nutrients and improvement of soil sorption capacity and base saturation (BS) were also reported. However, the beneficial effects of composts on soil properties depend on soil texture and moisture conditions, as well as on the origin of organic matter (OM), and these may be short termed (Drozd, 2003). Coumar *et al*. (2021) observed that except for available N, significant increase was observed in the levels of plant nutrients in post-harvest soil for the soils amended with MSWC compared to the control. In addition to improvement in physico-chemical properties of soil following the application of MSWC, improvement in soil biological properties have also been reported. Under long-term experiment, it was found that additions of MSW compost increased microbial biomass C (Garcia-Gil *et al*., 2000), phosphodiesterase, alkaline phosphomonoesterase, arylsulphatase, deaminase, urease, and protease (Garcia-Gil *et al*., 2000). On the other hand, there are reports also indicates the negative effect of MSWC application on soil biological properties like decrease in urease and protease activity following the application of MSWC (Garcia-Gil *et al*., 2000)

Municipal Solid waste compost on soil pollution

Several authors have reported changes in physic-chemical properties of soil and enhanced plant growth with the application of MSWC. However, reports also suggest that the environmental problem associated with MSW that is heavy metals are unaffected during degradation of organic waste (composting) and have toxic effects on living organisms when exceeding a certain concentration. In several cases, the addition of MSW compost also caused an increase of heavy metal concentrations in soil Thus, the beneficial aspects should be assessed together with the potentially detrimental ones. Coumar *et al*. (2021) observed that soil amended with MSWC showed significant increase in heavy metal mobility (DTPA-extractable content) in soil and its subsequent transfer to leafy vegetable (transfer coefficient). Cuevas *et al*. (2000) had reported that concentrations trace metals were significantly higher in the MSWC amended soil as compared to control (unamended soil).

Conclusion

Municipal solid waste compost is normally rich in plant nutrients and organic matter which improves soil physical, chemical and biological properties thereby improves soil fertility and crop productivity. Also it contains appreciable amount of trace metal content which may pose

threat to soil health and ecosystem service. Quality evaluation of MSWC before its application for agricultural purpose is essential for maintaining soil health and ecosystem service.

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Strategies for Prevention and Control of Ticks - A Review

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Abstract

The control of arthropod ectoparasites of livestock by systemically delivered chemicals was introduced in the 1950s. Because of their low cost, ease of use, and high level of efficacy ensured for ectoparasite control. The control of acarines like tick is essential for animal husbandry. However, current societal and scientific concerns regarding dependency upon chemicals have emphasised the need for the evaluation of environmentally safe alternatives for tick control. Immunological and biological intervention for the control of tick populations, through the vaccination, is effective way of control. Unlike the activity of chemicals, currently available vaccines do not induce a rapid knockdown of the parasite population and they do not protect the individual from parasitism however if these vaccines are used in an integrated pest-management programme, they have the potential to reduce parasite population over successive generations and reduce or eliminate the need for chemical application.

Key words: Ticks, Ecto-parasite, Prevention, Control

Introduction

Ticks and tick borne diseases pose enormous problems to man and domestic animals worldwide typically these problems associated with domestic animals, especially in sheep and cattle in the tropical and subtropical regions of the world. According to the integrated control of tick and Tick borne diseases (ICTTD) the losses in production of cattle and small ruminants in tropics are estimated annually in the range of $109 billion. In India, the economic losses due to tick and Tick borne diseases are estimated to be US$498.7 million per annum (Ghosh *et al*., 2007) with a global annual loss of $109 billion (Jabbar *et al*., 2007) Cumulative global cost of controlling TTBDs & productivity losses amounts to $7.0 billion USD annually (Saurez *et al*., 2016)

The diseases caused by arthropod-borne pathogens account for over 20% of all emerging infectious diseases recorded between 1940 and 2004 (Jones *et al.,* 2008). Ticks are considered to be second to mosquitoes as vectors of human diseases and the most important vectors of diseases that affect animal health worldwide, with the largest effect on the cattle industry (Fuente *et al*., 2008). It is therefore evident that ticks and their associated transmitted pathogens constitute a growing burden for human and animal health worldwide (Gortazar *et al*., 2014). The major losses caused by ticks are due to their ability to transmit protozoan, rickettsial and viral diseases of livestock, which are of great economic importance world-wide. The *Ixodes* spp., which are distributed worldwide are vectors for several human pathogens viz., *Borrelia, Anaplasma, Coxiella, Francisella, Rickettsia* and *Babesia* species and tick borne encephalitis (TBE) virus.

The *Rhipicephalus* spp. ticks play major role as vector of veterinary importance in tropical and subtropical regions of the world and economically impact cattle production by reducing weight gain, milk production and by transmitting pathogens like Babesiosis, Anaplasmosis, Theileriosis, Cowdriosis and tick-associated Dermatophilosis causing major health and management problems of livestock in many developing countries.

To counteract the adverse effects of ticks, various control programs were followed in modern livestock practices. Currently the main method among them is the use of acaricides but acaricides usage is not sustainable in the long run because of the striking ability of ticks to become resistant. Moreover there is residual effect in animal food products, undesirable effects on animal health and ecosystem. In present scenario, ticks have developed resistance against commercially available acaricides (Ghosh *et al*., 2016 unpublished data)

Further, it has been estimated that, the cost involved in developing new drug to be around US$230 million, with an average duration of 10 years and depicts, present strategy based on acaricides are not cost effective. So all these factors had drawn the attention of researchers to develop more sustainable eco-friendly measures such as anti-tick vaccines.

Methods of tick control

Pasture management

The pasture management viz., pasture spelling, rotational grazing and cultivation of tick-trapping grasses that incurs no additional costs to generate an environment with reduced tick population/tick free environment. Because of the additional effect of the reduced use of

acaricides, a livestock farmer can produce milk and meat of high quality (without acaricide residues) with lower prices.

Chemical control

Modern acaricides belong to the general classes of organophosphates (chlorfenvinphos), formamidines (amitraz), synthetic pyrethroids (flumenthrin), phenylpyrazoles (fipronil) and benzylphenylureas (fluazuron) correctly applied and they can be highly effective. Cost and contamination can be reduced by seasonal timing of application (strategic treatment) based on ecological knowledge. Acaricides are suspended in water for application to the hair coat of domestic animals. Cattle can be immersed in dip-baths containing dip wash or soaked using a pressurized spray-race made of metal tubing and nozzles. Sheep can be treated in smaller dips or showers. Acaricides can be applied to dogs in watery shampoo formulations acaricide-active ingredients are usually soluble in oil. This makes them suitable for concentrated oily formulations which spread from a pour-on applicator over the hair coat. Alternatively, some acaricides are incorporated in polyvinylchloride plastic ear tags for cattle or collars for dogs.

Prediction of best times for treatment can be made using computerized models of the population dynamics of ticks. Farmers lacking sufficient cash to purchase manufactured synthetic acaricides often use various herbal treatments locally available, but such unregistered preparations require careful use to avoid poisoning or skin damage. Problems with acaricides are danger of acute poisoning of treated animals and human staff, residues contaminating in meat and milk, environmental contamination especially water sources, resistance that ticks acquire to acaricides and cost of application (Graf, 2005; Fuente *et al.*, 2015).

Presently, tick control is affected by Integrated Pest Management (IPM) by use of Acaricides resulting in partial efficacy and enhanced selection of resistant tick populations (Mendes *et al.*, 2011).

Semio-chemicals

Semio chemical is a Greek word, semeion which means signal it is a term used for chemical substance or a mixture of chemicals that is used for communication it is a behaviour and physiology modifying chemical and all arthropods use semiochemicals which are naturally released for communication and to alter behaviour of other individuals these are secreted external to the body and when recognized will result in a specific behaviour response such as

food finding, mate finding, escape and other such behaviors animals communicate with each other by means of physical and chemical stimuli information-bearing compounds, or semiochemicals, cause other individuals to modify their behaviour. They occur in vertebrates as well as invertebrates and are probably characteristic of all animals

Biological control methods

The potential of Entomopathogenic fungi to control ticks has been demonstrated in many laboratory bioassays (Chandler *et al*., 2000; Samish *et al*., 2004; Fernandes and Bittencourt, 2008; Leemon and Jonsson, 2008). Most of these studies use aqueous conidial suspensions (mostly conidia suspended in water plus Tween 80) to treat eggs, larvae, nymphs and adults of several species of ticks. Some trials conducted in field or semi-field conditions using aqueous conidial suspensions applied on vegetation (Kaaya and Hassan, 2000) or on infested hosts (Castro *et al*., 1997) have shown promising results. Conidia applied on the host have shown low control efficacy (Correia *et al*.,1998 and Bittencourt *et al*., 1999)

The environmental conditions in the field, including especially high temperature, strong solar ultraviolet (UV) radiation and desiccation, often severely reducing the persistence of fungal conidia in the field and reducing the efficacy of fungal biological control products (Rangel *et al*., 2004; Braga *et al*., 2002) Formulated conidia of entomopathogenic fungi have shown promise as tick-control agents under field conditions *B. bassiana* or *M. anisopliae* conidia suspended in oil (Kaaya and Hassan, 2000) or in a polymerized cellulose gel (Reis *et al*., 2008; Souza *et al*., 2009) afforded promising levels of control with *Rhipicephalus microplus*, *Rhipicephalus sanguineus*, *Rhipicephalus appendiculatus* and *Amblyomma variegatum* in the field.

Entomopathogenic nematodes like *Steinernema carpocapsae, S. thermophilus and Heterorhabditis indica.(* Hussain & D' Souza 2015*)* during invitro studies on *Rhipicepalus* spp. showed more efficacy(100 %) & more virulent.

The main physio-pathological mechanisms of entomopathogenic fungal infection of arthropods are:

(1) **Penetration:** involving adhesion of spores to host cuticle, germination on the cuticle, and penetration of the cuticle using enzymatic and physical activities of the fungus germination and cuticle penetration are strongly influenced by environmental conditions, especially appropriate temperature and humidity.

(2) **Proliferation of mycelia in the host's hemocoel**

(3**) Production of toxic metabolites**. Most of these steps are crucial to entomopathogenic fungal isolates for the efficient killing of their target-arthropod hosts.

Botanical acaricides

Khudrathulla and Jagannath (2000) studied the effect of methonolic extract of *Stylosanthes scabra* on *Ixodid* ticks. The leaves of tobacco (*Nicotianatobacum*) were found effective against *R. Haemophysaloides* (Choudhury *et al*., 2004). Methanolic extracts of neem (*Azadirachtaindica*) leaves and bark, nochi (*Vitex negundo*) leaves, vashambu (*Acoruscalamus*) rhizome and Pungu (*Pongamia glabra*) leaves were tested for the acaricidal effects. Neem bark proved to be the most effective followed by vashamu (Pathak *et al*., 2004).

Immunological control

New approaches are needed for effective control of ticks and tick-borne diseases (TTBDs), of which vaccines appear to be an effective and environmentally sound option (Fuente *et al*., 2015). The only commercially available vaccines against ectoparasites were developed and registered in the early 1990s for the control of cattle tick infestations (Fuente *et al.*, 2007). These vaccines are based on Recombinant *Rhipicephalus microplus* BM86/BM95 antigens and demonstrated the important advantages of being a cost-effective and environmentally friendly alternative with a dual effect of reducing tick infestations and preventing ticks from transmitting disease-causing pathogens.

The protective mechanism characterized for BM86/BM95 tick vaccines is based on the development of antigen-specific antibodies in immunized hosts that interact and subsequently affect the biological function of the targeted antigen within the tick tissues, impairing tick feeding on the immunized hosts (Merino *et al*., 2011). The application of the BM86/BM95-based vaccines results in reduction of the number, weight and reproductive capacity of engorging female ticks, resulting in a gradual reduction in tick infestations in subsequent generations. The greatest vaccine effect was the reduction of larval infestations in subsequent generations. The application of commercial vaccines for the control of cattle ticks demonstrated that tick vaccines also constitute an effective and environmentally sound approach for the control of TTBDs. However, despite recent advances in the identification and characterization of candidate tick vaccine antigens, new tick and pathogen-derived protective antigens need to be identified to increase vaccine efficacy for the control of TBDs (Schetters *et al.*, 2016). The *R.microplus* BM95 glycoprotein is a BM86 homologue that protects cattle against infestations by South American cattle tick strains not protected by BM86 vaccination (Canales *et al.*, 2009b). Studies with BM95 have shown it protects against a broader range of tick strain infestations suggesting BM95 could be a more universal antigen against infestations by *R. microplus* strains from different geographical areas.

Recombinant tick-protective antigens

Tick protein	Tick species	Characterization	References
Bm86/Bm95	*B.microplus*	Gut proteins	Fuente &kocan.,2003
Bm91	*B.microplus*	Peptidase	Willadsen *et al*., 1996
Voraxin	*A.heraeum*	Male engorgement factor	Weiss *et al*., 2004
BmT1	*B.microplus*	Trypsin inhibitor	Andreotti *et al*.,2002
64 P	*R.appendiculatus*	Cement protien	Trimnell *et al*.,2002
Immunoglobulin binding protiens	*R.appendiculatus*	Immunomodulator	Wang& nuttal.,1999
P29	*H.longicornis*	Salivary gland putative extracellular matrix	Mulenga *et al*.,1999
Serpin	*H.longicornis*	Serine protease inhibitor	Imamura *et al*.,2005
4F8	*I.scapularis*	Nucleotidase	Imamura *et al*.,2005
Subolesin (4D8)	*I.scapularis*	Involved in modulation of tick feeding and reproduction	Almazan *et al*.,2003
4E6	*I.scapularis*	Unknown function	Almazan *et al*.,2003

Conclusions and future directions

Tick vaccines focused on targeting important biological processes (predominantly tick attachment and digestion) with the use of single antigens. Although these studies provided much needed insight into tick biology, we are entering a new era that will require of us to understand the mechanism used by ticks to overcome changes in their environments (such as in the presence of vaccines or acaricides) and to expand the knowledge on the 'targetable' genome of ticks.

The limiting step in the development of vector vaccines has been the identification of new antigens that induce protective immune responses whilst preventing pathogen transmission (de la Fuente and Kocan, 2003). The number of proteins that may be of value as antigens has continued to increase quite rapidly over recent years but there have not been many reports of their actual assessment in vaccination trials (Willadsen, 2004; Guerrero *et al*., 2012).

Very few antigens appear to be highly effective on their own suggesting the need for a multi-antigen or chimeric vaccine that incorporates critical tick and pathogen antigenic

epitopes (Almazán *et al.*, 2012, Parizi *et al*., 2012 Moreno-Cid *et al.*, 2013) to elicit synergistic anti-pathogen and anti-tick immune responses. The selection of new vaccine antigens from the study of tick-pathogen interactions using systems biology requires the development of algorithm that allow the selection of the most effective targets to control tick infestations and pathogen transmission (de la Fuente, 2012).

Finally, identification of new protective antigens that are conserved across vector species, with similar structure sequence motifs, may provide the opportunity to develop a universal and so more commercially viable vaccine for the control of multiple arthropod infestations and their associated pathogens.

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Popular Article

Antibiotic resistance and its consequences: A challenge for the 21st century

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Introduction

Any substance that inhibits the growth and replication of a bacterium or kills it outright can be called an antibiotic. Antibiotics are a type of antimicrobial agents designed to target bacterial infections within the body. This makes antibiotics subtly different from the other main kinds of antimicrobials widely used today. But in today's common usage, the term antibiotic is used to refer to almost any drug that attempts to rid the body of a bacterial infection. Since diseases which have a microbial etiology often leads to a lot of distress and pain to the animal as well as to the humans too. So, antibiotics help in mitigating these suffering and distressful conditions and finally leading to speedy recovery and so have gained so much of focus.

The discovery of antibiotics is considered as the biggest medical advancement of the 20th century. Penicillin was the first antibiotic to be discovered in 1929. A large number of antibiotics are available now-a-days. They have been curing infections and saving millions of lives since World War II. However, these one-time miracle cures, are losing their efficacy, as microbes are developing resistance. The medical profession admits that "In the closing years of the last century, there is an uneasy sense that micro-organisms are getting ahead". Now there are new super diseases that are resistant even to the most powerful antibiotics. Indiscriminate use of antibiotics is reducing their efficacy and creating superbugs.

Primarily antibiotics have been used in the animal husbandry sector for three main reasons viz. therapeutics, prophylactic and enhancement in performance (increasing feed conversion ratio, growth rate or yield). With the discovery of Penicillin (natural antimicrobial) the use of antibiotic for therapeutic purposes exhibited a significant increase. Antibiotics are

used rampantly in human as well as veterinary clinical practices. Since there are always two side of coin so the use of antibiotics has encouraged the growth of the resistant microbial strains leading to an imbalance in relationships between the susceptible and resistant micro flora. Diseases and disease causing agents that were once thought to be controlled by antibiotics are now-a-days reported getting resistant.

Another very important reason for getting resistance in microbes is that there is uncontrolled and indiscriminate use of antibiotics in both human and veterinary practice. Indiscriminate use of antibiotics in animal feeds is one of the prime breeding grounds for tough, drug-resistant bacteria. Antibacterial resistance development by overuse of antibiotics, particularly sub therapeutic use of antibiotics in food-producing animals in animal feed has been noted down since 1972. When these resistant bacteria are passed on to people who consume the meat, milk etc, they are exposed to diseases which will become difficult or impossible to treat with antibiotics. These resistant bacteria escape into the surrounding community through the air and water and cause infections in humans that do not respond to antibiotics e.g. nitrofuran in chicken could cause a build-up of antibiotic resistance in humans. Moreover antibiotics have often been added in low doses in the feed of the farm animals to improve their growth and feed conversion efficiency such as in pigs, poultry and cattle and is widely prevalent practice throughout the developing world. The WHO says more than half of the global antibiotic production is used on farm animals. In 1949, Thomas Juke discovered that feeding domestic animals, small amounts of antibiotics increased their growth rates. Since then for over 50 years, the animal industry has been feeding different kinds of antibiotics, particularly to the meat animals like pigs, goats, cattle and poultry. These drugs are referred to as ‘growth promoters’. Though it has been reported that with the addition of antibiotics enhancement in the average daily growth and feed conversion ratios is approximately 3-11 per cent depending upon the species. Antibiotics are fed to meat animals; not to treat their diseases, but to promote growth and repair the illnesses caused due to overcrowding, stressful and unsanitary conditions. In this way animal industry make more money by using antibiotics in the animal feeds. But this practice has increased the chances of getting drug resistant microbes invading the food cycle through either meat or milk very commonly. However in case of humans these antibiotics are available only on a prescription basis, for livestock producers in the name of ‘growth promoters’ they are generally available without any prescription.

Antimicrobial resistance

The World Health Organization has warned on the reemergence of deadly diseases caused by antibiotic-resistant bacteria. Once a microbe develops resistance to a drug, infection by the organism cannot be effectively treated by the drug that was previously eliminating the microbe and thereby the infection. Thus, these mutant disease-causing germs cannot be killed by standard antibiotics and a simple illness like food poisoning can cause death in humans and animals. Children and aged people are more likely to be affected. Also, it takes a long time to develop and standardize a new antibiotic. Sometimes these harmful microbes may multiply in animal body, and transfer their antibiotic-resistant factor to other unrelated bacteria in the host body. In case of infections by these antibiotic resistant harmful microbes, treatment with the prevailing antibiotics may not work. Now-a days, tetracycline-resistant strains of *Staphylococcus aureus* are a major cause of hospital acquired infections in human as well.

Mechanism of antimicrobial resistance

The innate mechanism of getting drug resistance is that when the two components (the antibiotic and the genetic resistance determinant in microorganisms) come together in an environment. The naturally selected resistant genes along with their hosts spreads and propagate under continued antimicrobial selection to finally get amplified which could extend the problem to other hosts and to other geographic locations as well. As microbes evolve, they adapt to their environment. If something stops them from growing and spreading such as an antimicrobial, they evolve new mechanisms to resist the antimicrobials by changing their genetic structure. Changing the genetic structure ensures that the offspring of the resistant microbes are also resistant. Antimicrobial resistance makes it harder to eliminate infections from the body. It has been observed that these resistant genes can get easily transferred among bacteria of different taxonomic and ecological groups by means of mobile genetic elements such as bacteriophages, plasmids, naked DNA or transposons. These genes are generally directed against a single family or type of antibiotic, although multiple genes, each bearing a single drug resistant trait, can accumulate in the same organism. Resistance to multiple drugs was first detected among enteric bacteria viz *Escherichia coli*, *Shigella* and *Salmonella* and such strains pose severe clinical problems and cost lives, particularly in the developing countries as well as developed countries as is commonly seen in Germany in which the extract source of *E. coli* transmission is unknown.

Factors leading to antibiotic resistance

Both natural cases and environmental pressures drive bacteria, fungi, parasites and other microbes to continually change their efforts to evade the drugs which have been developed to get rid of them.

1. **Natural causes:** Microbes undergo random genetic mutations and these changes enhance dug resistance. Resistance to a drug arising by chance in just a few organisms can quickly spread through rapid reproduction to entire populations of a microbe.

a. Resistance genes are often linked with genes specifying resistance to other antimicrobials or toxic substances on the same plasmids.

b. It has also been seen that resistant bacteria may rapidly appear in the host or environment after antibiotic use but are slow to be lost even in the absence of the selecting antibiotic.

2. **Societal pressures:**

a. This includes the overuse and misuse of antimicrobial drugs in people as well as in animals.

b. This also includes the common practice of treating unknown infections with broad-spectrum antimicrobials invariably leading to the emergence of antimicrobial resistance.

c. The increasing use of antimicrobials without proper prescription leading to self therapy especially in developing countries where antimicrobials are readily available over the counter (OTC) escalates resistance to antibiotics in many different bacteria.

3. **Miscellaneous causes:**

a. Antimicrobial in waste waters is being reported with increasing frequency and is potentially important contributors to the environmental selection of antibiotic-resistant organisms.

b. The chronic use of sub-therapeutic amounts of antibiotics for growth promotion in food animals.

c. Antibiotics also enter the environment through the dusting of fruit trees for disease prophylaxis and the application of antibiotic-laden animal manure on croplands.

Misuse as well as overuse of antibiotics is very common in most of the developing countries, including India, where human health is at the lowest priority. As such there are no regulations in India on the use of antibiotics in food animals such as cattle, buffaloes, swine and poultry raised for domestic consumption. The drugs banned or restricted in developed countries for use in animal feed are being rampantly used here. This short term gain in productivity is affecting human health by leaving antibiotic residues in food products like milk, meat and milk products.

In the end we need to use antibiotics in a way which ensures an ecological balance that favors the predominance of susceptible bacterial flora and thus preventing unnecessary development of resistant microflora. But since in nature it is the natural tendency of microbes to continuously evolve various strategies for combating newer and effective antibiotics so primarily we should focus in judicious use of antibiotics and if it is utmost important than it should be focused so that newer antibiotics can be developed and also we should look in certain alternatives to combat especially multiple drug resistant bacteria.

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Popular Article

Immune Electron Microscopy (IEM): Emerging Technique in Disease Diagnosis

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Introduction

IEM is the in situ localization of antigens (molecules) at the ultrastructural level utilising high-affinity specific antibodies. This is a technique for doing immunohistochemistry in an electron microscope utilizing an optical microscope. The great resolution is attributable to the instruments' high electron optical resolution and the preservation of structural information inside the sample. By situating macromolecular processes inside a cellular context, it bridges the information gap between biochemistry, molecule biology, and ultrastructural research.

History

In 1931, physicist Ernst Ruska and electrical engineer Max Knoll developed the first prototype of the electron microscope, for which Ernst Ruska received the Nobel Prize in 1986. (The Nobel Prize in Physics 1986). In the years 1937 and 1938, Ernst Ruska continued his work and enhanced the magnification; the first prototype, which became the first serially produced electron microscope (THPA).

First developed for quantifying plant virus by Derrick (1973). Gold particle labeling technique was first described by Faulk & Taylor in 1971.

Principle

IEM is founded upon the principles of transmission electron microscopy (TEM). IEM uses negative staining techniques for antigen detection and determination of structural organization

of samples. This is quick and accessible way to identify structural information about a sample. The primary antibody is made to attach to a specific antigen in cells. As a result, the gold probe is an important component for immunohistochemistry in the electron microscope because to its excellent electron scattering property.

Basic Facts on Immuno-Electron Microscopy

- **Antigen–antibody interaction:** The most commonly used antibodies belong to the immunoglobulin G class. Antibodies have to be conjugated with electron-dense markers. Commonly used markers are particles such as colloidal gold of different sizes (1–40 nm), nanogold and ferritin, or enzymes such as horseradish peroxidase, which are located by electrondense reaction products (e.g. using diaminobenzidine as substrate). Particulate markers have the advantage that they can be counted directly and therefore allow for quantification of bound antibodies.
- **Detection of antigen**: Approached in two ways:
  - **The pre-embedding method involves the labelling of structures accessible on surfaces** (e.g. on viruses, cells or cleaved samples) of intracellular structures after permeabilization with detergents, followed by direct inspection in the scanning electron microscope or indirect visualization in the transmission electron microscope after sectioning or preparing a replica. Drawbacks are the intrinsic loss or relocation of cellular compounds, variable access of the reagents to the different compartments, and steric hindrance.
  - **The post-embedding labeling of thin sections allows access to determinants present in the different compartments of the cell and to internal viral structures** since they become exposed at the surface of the section. Thawed cryo sections prepared according to the method of Tokuyasu or ultrathin sections of resin-embedded material.

Criteria for Selection of the Immuno-electron Microscopy Technique

- Subcellular localization of the molecule of interest
- Location of target molecule to be detected by this methodology
- Recommended fixative mixture for the antigen under study
- Preservation of antigenicity of the target molecules
- Resin that can be used in the immunoelectron microscopy
- Selection of resin depending on the method used in immunolabeling

- Information that can be obtained by applying immunocytochemistry

General Preparation of Samples for Immuno-Electron Microscopy

- **Fixation**
- **Dehydration**
- **Embedding and sectioning**
- **Ultracryotomy**
- **Labelling for immuno-electron microscopy**
- **Imaging techniques**
- **Quantification and interpretation of immunolabelling**

Three general methods are used, depending on the amount and the intracellular location of the antigen and on the fixation technique: (i) cryo-ultramicrotomy, (ii) pre-embedding, and (iii) post-embedding. All three methods include fixation, sectioning, blocking, labeling, and contrasting in different order before TEM examination.

Fixation

For IEM, fixation is one of the most important steps. The mixture of formaldehyde and a low concentration of glutaraldehyde is the most generally accepted for immunoelectron microscopy. Immersion fixation is useful for the biological specimens (e.g. biopsy specimens, cultured cells). The relation between the fixative solution and size sample should be at least 40:1. Fixation should be appropriate to preserve tissue microstructure and maintain antigenicity. The basic conditions are: a. Maintain good morphological preservation, b. Do not destroy immunogenicity of antigen, c. Prevent extraction of antigens from processing such as fixing and dehydration, d. and do not interfere with antigen-antibody reaction.

Dehydration

Removal of water is a prerequisite for embedding in resins. Dehydration at ambient temperature removes all the cellular water and results in volume shrinkage of up to 50%, loss of lipids, and collapse of macromolecules.

Embedding and Sectioning

To obtain ultrathin sections (60 nm in thickness) of biological material the dehydrated samples have to be stabilized by embedding in plastic. Epoxy resins are usually infiltrated at ambient temperature and polymerized at temperatures above 60^{o}C.

Ultracryotomy

Two types of cryosections: (1) the well established cryosections of chemically prefixed, sucrose-infiltrated material simply frozen in liquid nitrogen and (2) Cryo immobilized by technically demanding rapid freezing techniques. In both approaches the obtained sections are thawed for subsequent immunolabelling**.**

Imaging Techniques

Specimens are studied in electron microscopy in high vacuum, ambient temperature, or frozen conditions. The latter method minimises the damage caused by electron beam radiation and is the sole means to image an object in its fully hydrated form.

Labelling For Immuno-Electron Microscopy

Indirect method (two-step reaction) the bound specific antibody is detected by complexes of markers conjugated to secondary antibodies or protein

The direct method (one-step reaction), where the marker is directly conjugated to the antibody, is used less frequently; for each reaction a specific conjugate has to be prepared.

Pre-Embedding Immunogold Labeling

ADVANTAGES Staining is possible at every antigenic location throughout the specimen. Has higher sensitivity when it comes to finding antigens that are scarce. Produces more distinct and non-diffusible markers that can be easily quantified and indicate the precise sub-cellular localization of antigens.

LIMITATIONS Labelling procedures require extended incubations in buffers to increase the penetration of probes. *Cross-reaction of the primary antibody with unknown proteins *Cross-reaction of secondary antibodies with inappropriate species *Nonspecific immunolabeling *Erroneous transport of tract-tracing agents

Post-Embedding Immunogold Labeling

ADVANTAGES Since immunostaining is done after the sample has been fixed, embedded, and sectioned, these preparation steps will preserve antigenicity and reduce problems regarding ultrastructural preservation. Better reactivity and better visualization of antigenic sites with high resolution allows good quantitative evaluations of labeling intensity and morpho-metrical determinations.

LIMITATIONS: Antibodies cannot penetrate into the resin, and consequently only the antigens that are exposed at thin section surfaces can be labelled.

Double Immunogold Labeling

ADVANTAGES: Ability to be bound to several molecules makes marker being extremely versatile. Provide better understanding on relationship and localization of different types of molecules.

LIMITATIONS: Chances for section contamination are higher than single labeling procedure. Increase in background noise.

Applications

IEM is useful in samples when the presence of a specific antigen is uncertain or where numerous conformations make identification and localization difficult. This method is effective for analyzing viral components in vaccines, viral like particles, proteins isolated from viruses, and other specimens relevant to modern virology applications. IEM is used to examine the structural analysis of cells and tissues at various levels of resolution and to diagnose animal infectious illnesses. Allows identification of multiple agents in a same sample.

Used to detect the presence of enteric viruses such as the Poultry enteritis complex (PEC), which causes enteritis, diarrhoea, poor weight, and high mortality in poultry. To identify significant quantities of Herpesvirus, Poxvirus, and Papillomavirus particles in crusting, blistering, vesicular fluid, or epithelium. In emergency infectious diseases, emerging diseases, and/or suspected bioterrorism situations, this approach is used as a first line of defense. It can also be used to identify infections that are unusual. Corona virus particles, for example, have been found in ferrets having diarrhea. Viruses having low viral titer can be detected by applying techniques of IEM and immune labeling with colloidal gold.

Detects viral illness epidemics in the wild. E.g. Capybaras were found to have an enteric coronavirus, while wild birds were found to have poxvirus and paramyxovirus. Due to immediate results of examinations allows the rapid introduction of therapeutic, preventive and control measures in breeding sites and plan strategies for fighting infection, avoiding unnecessary loss of animals and economic damages. It's used to examine host–parasite interactions, and it's helping to find specific immune targets and parasite antigen expression.

Quantitative IEM makes use of ultrathin sections and gold particle labelling to measure molecular distributions throughout cell compartments.

IEM allows researchers to examine the likelihood of designing a specialised vaccination for protection in the event of future outbreaks caused by infectious organisms. Aids in the diagnostic routine during farm animal epidemics and in determining the danger areas at the study site. When other traditional diagnostic approaches fail to yield appropriate results, this aids in the identification of an unknown virus that has been isolated in tissue culture. When other traditional diagnostic approaches fail to yield reasonable results, it aids in the detection of viral agents that are particularly difficult to develop.

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Popular Article

Lantana camara a noxious weed: harmful effects and its management

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Lantana camara is a known poisonous plant and found to be toxic for most of the ruminant species. Although there are several varieties of *Lantana camara*, however only some of them are toxic. The toxicity of this plant is characterized by **photosensitization, jaundice, and loss of appetite**. The most significant post-mortem findings are cholestatic injury to the liver, distension of the gallbladder, and necrosis of the renal tubules. Although many affected animals die, others survive and complete recovery of the liver lesion may occur. The deaths that occur have been attributed mostly to liver insufficiency and renal failure, but myocardial damage and intestinal paralysis have also been implicated in some animals.

Toxic components of *Lantana camara*

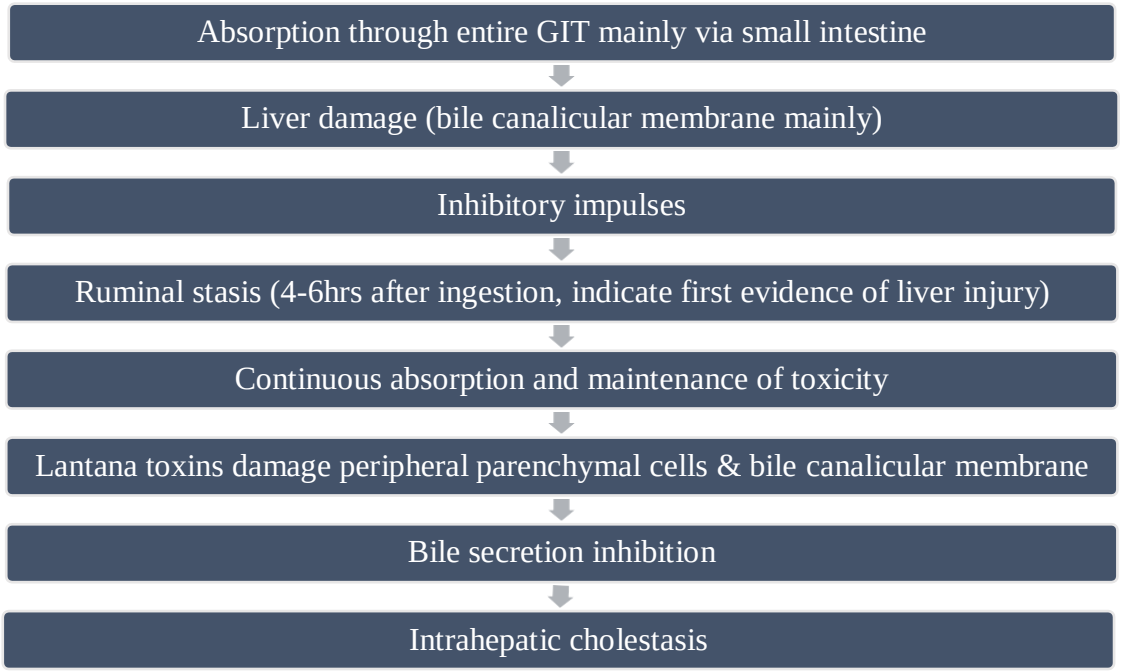
The most important toxic components present in this weed are lantadenes (i.e. lantadene A and lantadene B). **Lantadenes** are pentacyclic triterpenes and often led to hepatotoxicity, photosensitization and jaundice. There are 2 forms isolated from lantana toxin i.e. crystalline and amorphous. The lantadenes are mainly present in the leaves of this plant having varying toxic effects among different species and strains of mammals/livestock. The toxic effects of this plant are evident both in ruminants as well as in non-ruminants.

Action of lantadenes on liver

Lantana toxins cause intrahepatic cholestasis along with the inhibition of bile secretions without widespread hepatic necrosis. Hepatocellular damage precedes the intense and prolonged jaundice observed during lantana poisoning. Significantly, in lantana toxicity, the cells located around the central vein remain normal, while parenchymal cells lying to the periphery of the liver are damaged. Generally, changes associated with intrahepatic cholestasis include dilation of bile canaliculi, loss of microvilli, alterations in enzyme activities and composition of the canalicular membrane. **Phylloerythrin**, a degradation product of chlorophyll formed by the action of microorganisms in the GIT gets accumulated in the liver and leads to photosensitization. This type of photosensitization is also called as hepatogenous photosensitization, which occurs due to the impaired hepatobiliary excretion. This impaired

hepatobiliary excretion of phylloerythrin leads to its accumulation in plasma. The inhibition of bile secretion leads to accumulation of bilirubin and ultimately leads to jaundice.

Flow chart of absorption and mechanism of lantadenes



Clinical signs

The dose of lantadenes determines the severity of ictericity. The clinical signs follow a definite pattern as given below:

- Loss of appetite and decrease in ruminal motility (within 24 h)
- Photosensitization in un-pigmented areas leads to necrosis later on (within 24-48h)
- Icterus (yellowish sclera and other mucus membranes, within 48-72h)
- In acute/ more severe cases (death within 2 to 4 days)
- In less severe cases (death within 1-3 weeks)

Hematological & biochemical alterations in different animal species

Species	Hematological parameters	Biochemical alterations
Cattle	Increase in blood clotting time and PCV but decrease in ESR.	Increase in direct and total bilirubin, increase in phylloerythrin levels, increase in serum AST, ALP, GDH, total protein, albumin, globulin and decrease in A/G ratio.
Sheep	Transient increase in PCV and neutrophils but decline in thrombocytes.	No change in serum ALP, AST and ALT levels.
Goat	Progressive decrease in PCV, Hb and TEC while increase in TLC and blood clotting time.	Rise in serum bilirubin, AST, creatinine, GGT and BUN levels.

Fig.1. Flowering plant of *Lantana camara*

Fig. 2. Yellow discoloration of the peritoneal wall

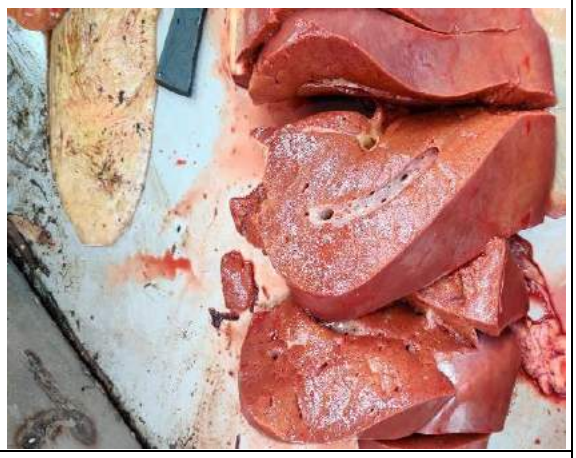


Fig. 3. Yellowish discoloration of liver indicating hepatic cholestasis

Fig. 4. Thickened gall bladder and erosive cholecystitis

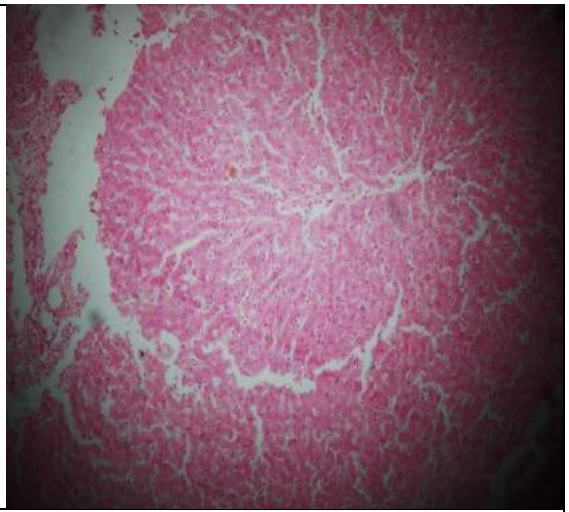


Fig. 5. Bile duct hyperplasia and necrotic hepatitis

Treatment

Specific treatment for lantana toxicity is still lacking, the preventive measures are more effective than curative measures to decline the harmful effects of this notorious weed, but there are some conventional treatment methods which can be applied:

- Keep the intoxicated animals away from light.
- Provide fluid therapy and adequate feed.
- Administration of activated charcoal 5g/kg body weight with electrolyte in stomach tube within 24h, which reduces the absorption of lantadenes.
- Oral administration of liver tonics like Liv-52.
- Vitamin B-complex administration.
- Enzymatic removal of bilirubin by bilirubin-oxidase, which is effective in jaundice.
- Bacterial strains like *Pseudomonas picketii*, *Alcaligenesfaecalis* and *Alcaligenesodorans* can be used which degrades the lantadene A.
- Rumenotomy can be done to evacuate the entire GI tract.

Various drugs used in jaundice

Drug/Active agent	**Mechanism**
Silymarin	Cytoprotective & cell regenerating action
Phosphatidylcholine	Increases the bioavailability of Silymarin
L-carnitine	Protects & promotes mitochondrial hepatocyte function
L-ornithine	Aids in detoxification
L-glutathione	Potent free radical scavenger
N-acetyl cysteine	Replenishes the GSH & help in detoxification
Co-enzyme Q10	Neutralizes free radical in chronic liver diseases
Inositol	Acts as lipotropic agent promoting the flow of fat & bile to and from the liver thus producing decongestion effect on liver

Prevention

It is the cost effective way of controlling the accidental introduction of lantana into the ecosystem. The different ways by which lantana infestation can be prevented includes:

- The international standards for trading partner countries in a well targeted form must be implemented.
- The adequate surveillance and monitoring system for early detection of lantana infestation must be implemented.
- Implementation of strict border controls, transport controls and quarantine methods should be followed. The biosecurity and quarantine system should be strengthened in an organized form.
- Collaboration with government agencies, so that outline can be made to prevent the spread of lantana. Involvement of all the agencies concerned with invasive species management is must.
- Educate and communicate people regarding the harmful effects of this alien weed which can be done by organizing campaigns and training programs.

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Popular Article

Impact of Covid-19 on Human Life Aspect: A Review

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Abstract

The infection of COVID-19, firstly localized to Wuhan city of China, within short period of time it spread to neighbouring provinces. On 30 January, World Health Organisation (WHO) declared as a public health emergency of international concern and waited until 11 march to announce it as a pandemic. COVID-19 (Coronavirus) has severe affected on human life. This pandemic not only disrupted the multinational businesses, global market trading, tourism, transportation, export-import, but also reduced the income generated from the market. COVID-19 pandemic affected all aspect of human life like health, social, economic and education. In developing countries, people suffered from unemployment and hunger. This pandemic is also severely effect education system in world wide. Immediate and foremost action to save life and livelihood. Now it the time of global unity and support especially most vulnerable in our societies.

Introduction

Human being bound their cultural and value system with relative to their aims, expectation, and living standard for a better life. COVID-19 (Coronavirus) has severe affected on human life. This pandemic not only disrupted the multinational businesses, global market trading, tourism, transportation, export-import, but also reduced the income generated from the market (Ayittey *et al*. 2020). This pandemic has affected thousands of peoples, who are either sick or are being killed due to the spread of this disease. Corona virus infection disease 19 which emerged from seafood and animal market in Wuhan, Hubei Province, China in late 2019. The infection of COVID-19, firstly localized to Wuhan city of China, within short period of time it spread to neighbouring provinces. On 30 January, World Health Organisation (WHO) declared as a public health emergency of international concern and waited until 11 march to announce it as a pandemic. (Hua and Shaw, 2020). COVID-19 not only destroyed human life but also collapse economic, social, health and education aspect

of human being. In developing countries, people suffered from unemployment and hunger. This pandemic is also severely effect education system in world wide. Many country has adopted various measures such as lockdown, workplace non-attendance, school closure, suspension of transport facilities etc. for controlling the spread of the COVID-19 pandemic, educational institutions have been temporarily closed.

The impacts of COVID-19 in Human life are divided into different categories

Corona pandemic has effected every human life and also disrupted world economy. This infection has spread almost all country of the world as per WHO reports, and has showed severe implications over countries economic and health systems. (Huang, *et al.*, 2020). Some significant impacts and concerns over the health, economy, education and social aspect of human life.

Health aspect

COVID-19 has severe impact on human health and society. To reduce the incidence of novel infection (COVID -19), worldwide home confinement directive has been implemented. Social isolation and home quarantine can be main stressors ant its consequence come in the form of emotional distress and unpredicted mental health and psychological disorders. (Hossain, *et at*., 2020). Many studies revealed that anxiety, loneliness, boredom, anger, denial, depression, insomnia, harmful substance use, self-harm and suicides in quarantines type problem increased. (Li, *et .al.*, 2020). COVID-I9 infection having many physical symptoms such as cough, hypoxia, anxiety, fever etc. along with side effects of recommended medicines (corticosteroids) may lead to more psychological distress and anxiety. (Wang *et al.*, 2020). Various psychiatric disorders in individuals e.g. anxiety disorders, self-blame, guilt, post-traumatic stress disorder, depressive disorders, delirium, somatic symptoms, panic disorder, psychosis, and even suicide could be reported by many researcher. (Goyal *et al.*, 2020). During the period of lockdown, people were confined to their homes and increased physical inactivity and sedentary time due to this, people get effected long lasting psychological problem such as depression, stress, anxiety, anger, boredom etc. (Duan and Zhu, 2020).

Social aspect

Social impact is any influence on feeling, motives, behaviour, thought of individual from receiving real or imaginary presence of action of other. The social impact of the corona pandemic on children, young and old people in particular may be significant. During COVID 19 pandemic, lockdown has been imposed most of the countries. Service sector is closed, postponement of large scale sport events, cancellation of celebration of cultural and religious festival. Imposed quarantine period, could be also increased stress among the population.

Relationship among family members had to be badly affected. Old people and young child get effected with psychological disorders. Sudden increased in time spent together within a common living space because of COVID-19 lockdown also increase the possibility of stress resulting conflict between intimate partners. Many social activities had been postponed like places for entertainment such as movie and play theatres, sports clubs, gymnasiums, swimming pools etc. (Haleem, *et al*., 2020)

Economy aspect

Any pandemic has severely effect on the human life. COVID-19 has drastic impact on the world economy. To prevent farther spread of infection, many country imposed lockdown and cancellation the international and national flights. These circumstances have severely affected the business transportations of different countries and has led for economy crisis. In industrial sector, daily worker count has been decreased due to significant increase in number of infective case. Tourism is one of the most important sector to boost up the economy of any country but due to pandemic effect, it is completely destroyed. Slowing down the manufacturing of good, disrupted the supply chain of goods, poor cash flow in the market, decreased the per capita income, lack of jobs in market, stop transportation facilities and significant slowing down in the revenue growth etc. these all element effect the economy of any country and global economy. (Haleem, *et al*., 2020)

Education aspect

During the period of novel coronavirus infection, government started the closure of schools and colleges across the country. Various activities like competitive exam., entrance test, board exam., semester examination and admission process in universities and schools has been suspended with effective manner. School is the best place to raise the social awareness and social skill in the children. On the other hand, closure of the school has affected the structure of learning and schooling and also affected teaching and assessment quality of teachers. Higher education sector has severely affected by this pandemic and it also play important element of the economy of any country. Many student have enrolled in universities abroad but due to global closure of transportation, institutes and universities, it is expected that it will reduce the interest for international higher education. Teaching methodology in schools, universities and institutes has been transformed from chalk -talk modal into E- learning modal. E- Learning modal of education required various elements like multimedia mobile phones, internet connectivity, and knowledge of technology for students, teacher and parents of students. Parents are facing many issues in understanding the new methodology of teaching and are not very techno-friendly (Bjorklund and Salvanes 2011).

Conclusions

The COVID-19 pandemic has led to a drastic loss of human life worldwide and put forward a unprecedented challenge related to the health, social, economic and education aspect of human life. Economic and social disruption caused by this pandemic is devasting. Millions of people are at risk of falling into poverty. Life of human being has severely affected with all aspect especially in developing countries. Immediate and foremost action to save life and livelihood. Now it the time of global unity and support especially most vulnerable in our societies. Only by togetherness we can overcome the impact of COVID- 19 on health, social, economic and education aspect related with human being.

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Popular Article

A Healthy Animal: What to Notice

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General outlook of the animal

The healthy animal found to be alert and well aware of its surroundings things. Animal remain active and carry head up to observe things around. It should stand squarely on feet. If an animal stand isolated from group then it could indicate a problem.

An animal which is lethargic and does not show any activity may have health problems.

Gait of animal

A healthy animal walk on its feet taking all weight with balance without any lameness. Any Irregular movement shown by animal may indicate pain arising from the feet or limbs. Another thing we should notice is when one goes near an animal that is lying down, should stand up immediately, if not then animal may have any health problems.

Eyes

The eyes of an animal should be bright and alert without any discharge. Eyes with whitish or cloudy discharge may indicate any underlying health problem. Along with eyes also notice color of eyelid mucosa, it should be pinkish in color.

Ears

Healthy animal should have well-formed ears with ability to react towards the direction of any sound. Ear movements should be proper so that animal can get rid of flies; also the ear can give a rough idea of body temperature of animal.

Mouth

If the animal shows dripping of saliva from mouth it could indicate health problem or a disease. There should not be any kind of injury or wound in the mouth cavity. If animal show slow chewing or incomplete chewing: there may be a problem with the teeth or oral cavity.

Mucous membrane

Mucous membranes are the inner linings of various organs of the body, e.g. eyes, nose, mouth cavity, anus etc. This lining in healthy animals should remain moist. When this lining show any sign of dryness or paleness we have to pay immediate attention towards it as this could become severe with time. The normal color of mucous membrane of different animals are as following:

ANIMALS	**COLOR OF MUCOUS MEMBRANE**
Cattle, sheet and goat	Pale pink
Horse	Pale roseate
Pig	Reddish
Dog	Pale roseate
Cat	Pale pink

***SOURCE:** *Abdisa T (2017) Review on Practical Guidance of Veterinary Clinical Diagnostic Approach. Int J Vet Sci Res 3(2): 006-025.*

Muzzle and nose

In healthy animals the muzzle should be moist. There should be no discharge from nose. Healthy animals have a habit to lick their noses with their tongues.

The coat

Coat of animal shows the overall condition of health of animal. It should be clean, smooth and lustrous and should not have patches of removed hairs i.e. coat cover should be complete. If the coat feels cold, dry or any scales in skin then it may signifies diseases. Whenever animal show symptoms related to skin disorder, immediate attention should be given to the animal to reduce the chances of further aggravation of disease.

Breathing

Breathing should remain smooth and regular if animal is in resting stage. In hot weather and due to movement rate of breathing might increase. We can identify the breathing pattern by looking at the chest and abdominal area.

Body temperature and pulse

Body temperature is most important thing to access the health of animal. If the the animal show abnormal temperature it could indicate any infection or disease and it require timely treatment. Generally temperature can be taken from the rectal area of animal. We can take temperature either by conventional mercury thermometer or by digital thermometer.

Likewise pulse examination is very important while examining the animal for any ailment. Compared to man in animals taking of pulse bit more difficult and requires expertise.

Normal ranges of temperature and pulse rate are summarized in following table:

Sr no	**Animals**	**Temperature/°C**	**Pulse rate/minute**
1.	Cattle	37.8 –39.2	60 – 90
2.	Young calves	38.5 –39.8	100-120
3.	Horse	37.2 - 38	28 – 42
4.	Foal	37.5 -38.5	70-80
5.	Sheep	38.9 - 40	68 - 90
6.	Goat	38.6 –40.2	68 - 90
7.	Pig	37.8- 38.9	60 - 90
8.	Dog	38.6 -39.2(small dog) 37.5 –38.6(large dog)	90 - 130
9.	Cat	37.8 –39.2	110 - 130
10.	Chicken	4 1.7	200 - 400

***SOURCE:** *Abdisa T (2017) Review on Practical Guidance of Veterinary Clinical Diagnostic Approach. Int J Vet Sci Res 3(2): 006-025.*

Generally we found pulse will be higher in the young animal.

Urine

Urine of the animal should be clear and of normal color without any visible haziness. Normally equids have thick yellow urine.

Appetite and feeding

Good appetite is a very important sign of a healthy animal. No appetite for food means animal is sick animals or have any underlying infection. If animal loses appetite suddenly then it should not be taken lightly and we have to seek veterinary care immediately. For example pigs have a natural tendency to rush at their feed, if don't something is wrong. In ruminants e.g. Sheep, goats, cattle, buffalo and camels Cud chewing time is generally around 6 to 8 hours each proper cud chewing is a good sign of health in ruminants if not happening then it may indicate health problem.

Milk

In the dairy animal, a sudden change in the milk production could indicate a health problem. Also any sign of blood or other abnormality in the milk points towards infection of the udder. Tenderness or pain in udder or teat also denotes presence of infection in mammary system.

Faeces and defecation

If an animal exhibit abnormal feaces i.e. too hard, too watery, stained with blood or presence of worm segments, it indicates ill health. When an animal defecate with difficulty or if there is presence of faecal material on its body it also indicate problem with alimentary canal and we have to provide veterinary care immediately in this case.

Pain

Pain of any kind in any part of animals body indicate occurrence of inflammation which could be due to infection or injury. Generally a healthy animal do not show any sign of pain e.g. grinding of teeth, groaning, rolling on ground, kicking etc. if animals show sign of pain then we have to seek immediate veterinary care.

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Popular Article

COVID-19: structure and organization, variants of concern along with diagnostic techniques

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Abstract

Coronaviruses are enveloped positive-stranded RNA viruses of humans and animals. COVID-19 has spread globally since its discovery in Hubei province, China in December 2019. The virus that causes COVID-19 is designated severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2). It has different type of variants of concern and faster rate of transmission than other coronaviruses. Thus, early diagnosis is crucial to prevent the extensive spread of the disease. A combination of computed tomography imaging, whole genome sequencing, and electron microscopy were initially used to screen and identify SARS-CoV-2. The Reverse transcription-polymerase chain reaction (RT-PCR) is the most routinely used method to detect SARS-CoV-2 infections. However, several other faster and accurate assays are being developed for the diagnosis of COVID-19 aiming to control the spread of infection through the identification of patients and immediate isolation. In this article, we will discuss about the orientations, structure, variants of concerns, epidemiology, transmission and various detection methods of the SARS-CoV-2.

Introduction

Structure and organization: - Coronaviruses, named for their "sun-like" shape observed in the electron microscope, use RNA molecules to encode their genes, as do influenza viruses, HIV, and rhinoviruses (common cold). SARS-CoV-2, the virus that causes COVID-19 (Coronavirus disease-2019) previously, it was referred to as 2019-nCoV which infects mammals and birds [1]. Full-genome sequencing and phylogenic analysis indicated that the coronavirus that causes COVID-19 is a beta-coronavirus in the same subgenus as the severe acute respiratory syndrome (SARS) virus (as well as several bat coronaviruses), but in a different clade.

The coronavirus particles are organized with long RNA polymers tightly packed into the canter of the particle, and surrounded by a protective capsid, which is a lattice of repeated protein molecules referred to as coat or capsid proteins. In coronavirus, these proteins are called

nucleocapsid (N). The coronavirus core particle is further surrounded by an outer membrane envelope made of lipids (fats) with proteins inserted. These membranes derive from the cells in which the virus was last assembled but are modified to contain specific viral proteins, including the spike (S), membrane (M), and envelope (E) proteins. A key set of the proteins in the outer membrane project out from the particle and are known as spike proteins (S). It is these proteins which are recognized by receptor proteins on the host cells which will be infected.

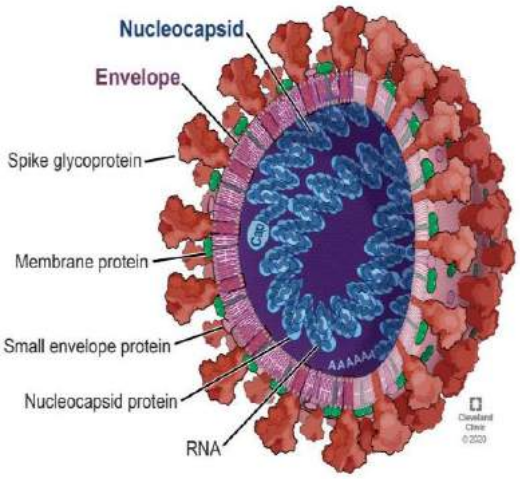

Fig.1. Structure of Coronavirus

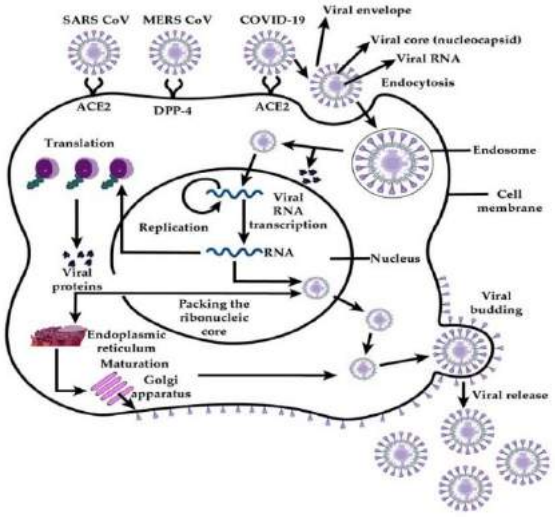

Fig.2. Replication strategies of Covid-19

Coronavirus particles are rapidly inactivated – killed – by exposure to 70% ethanol or 90% isopropanol (rubbing alcohol), hydrogen peroxide solutions, hypochlorite bleach, soaps and detergents, as well as by UV light and the high temperatures of cooking.

Coronaviruses primarily infect human lung cells through a receptor for an enzyme called Angiotensin Converting Enzyme 2 (ACE2). As the first step leading to viral infection, the virus spike protein recognizes and binds to the ACE2 receptor. The virus is then incorporated into the lung cells and the viral RNA is released into the cytoplasm. The viral RNA molecules recruit the cellular apparatus to make thousands of copies of the viral RNA and also instruct the cells to synthesize hundreds of thousands of nucleocapsid, membrane, envelope, and spike proteins. These assemble into new virus particles which bud out of the cell surface membrane. The cells release the newly formed viral particles propagating the infection and eventually die.

The researchers found that the SARS-CoV-2 spike was 10 to 20 times more likely to bind ACE2 on human cells than the spike from the SARS virus from 2002. This may enable SARS-CoV-2 to spread more easily from person to person than the earlier virus [3].

Variants of concern

Like other viruses, SARS-CoV-2 evolves over time. Certain mutation in the SARS-CoV-2 genome have garnered widespread attention because of their rapid emergence within populations and evidence for transmission or clinical implications; these are considered variants of concern.

Table.1 Variants of concern of SARS-CoV-2 [2]

WHO Label	Name (Pango lineage*)	Name (Nextstrain*)	Spike protein substitutions (Receptor-binding domain substitution in bold)	First detected
Alpha	B.1.1.7	20I/501Y.V1	**(E484K)** **(S494P)** **N501Y** A570D D614G P681H	United Kingdom
Beta	B.1.351	20H/501.V2	**K417N** **E484K** **N501Y** D614G	South Africa
Gamma	P.1	20J/501Y.V3	**K417N/T** **E484K** **N501Y** D614G	Japan/Brazil
Delta	B.1.617.2	20A	T19R R158G **L452R** **T478K** D614G P681R D950N	India
Epsilon	B.1.427 B.1.429	20C/S:452R	**L452R** D614G S13I (B.1.429 only) W152C (B.1.429 only)	US-California

Epidemiology

On 31 December 2019, the World Health Organization (WHO) was informed of a cluster of cases of pneumonia of unknown cause detected in Wuhan City, Hubei Province, China. On 12 January 2020, it was announced that a novel coronavirus had been identified in samples obtained from cases and that initial analysis of virus genetic sequences suggested that this was the cause of the outbreak. This virus is referred to as SARS-CoV-2, and the associated disease as COVID-19.

Transmission

The source of the outbreak has yet to be determined. SARS-CoV-2 is primarily transmitted between people through respiratory (droplet and aerosol) and contact routes. Airborne transmission

risk is highest in close proximity (within 2 metres) and poorly ventilated indoor spaces. In addition to respiratory secretions, SARS-CoV-2 has been detected in blood, faeces and urine.

Emerging Diagnostic Test for COVID-19

A) Nucleic acid testing

Nucleic acid tests using amplification of genetic material which are used currently in development for SARS-CoV-2 detection. These techniques RT-PCR, recombinase polymerase amplification, helicase-dependent amplification, and RT-LAMP etc.

Reverse transcriptase polymerase chain reaction (RT-PCR)

Current diagnostic tests for the SARS-CoV-2 pandemic use nucleic acid, antibody and protein-based detections, but viral nucleic acid detection by RT–PCR remains the gold standard [4]. The recognition of SARS-CoV-2 over common respiratory pathogens is contingent on RT–PCR serving as a sensitive, precise and specific viral detection. Despite the test's accuracy, results have not yet enabled the containment of viral infection. In addition, false-negative results may occur because of viral evolution [5,6]. Other limitations of RT–PCR tests include sample storage, low-quality nucleic acid purification, cost and wait times. Despite such limitations, the RT–PCR test remains the gold standard for SARS-CoV-2 diagnostics.

RT loop mediated isothermal amplification (RT-LAMP)

RT-LAMP uses DNA polymerase and four to six primers to bind to six distinct regions on the target genome. In a four-primer system, there are two inner primers (a forward and a reverse inner primer) and two outer primers; LAMP is highly specific for SARS-CoV because it uses a higher number of primers [7]. In LAMP diagnostic tests, a covid patient sample is added to the tube, and the amplified DNA is detected by turbidity (a by-product of the reaction), colour (addition of a pH-sensitive dye), or fluorescence (addition of a fluorescent dye that binds to double-stranded DNA) [9]. The reaction occurs in <1 h at 60–65 °C with an analytical limit of detection of ~75 copies per µL. The approach is simple to operate, easy to visualize for detection, has less background signal, and does not need a thermocycler [8]. The drawbacks to LAMP are the challenges of optimizing primers and reaction conditions. Other isothermal amplification techniques for COVID-19 detection are in development.

SHERLOCK

SHERLOCK is a detection strategy that uses Cas13a ribonuclease for RNA sensing [10]. It is used for detecting SARS-CoV-2 has been released, and another Cas13a-based detection system has been tested with SARS-CoV-2 clinical isolates [11].

B) Protein testing

Viral protein antigens and antibodies that are created in response to a SARS-CoV-2 infection can be used for diagnosing COVID-19. Changes in viral load over the course of the infection may make viral proteins difficult to detect. In contrast, antibodies generated in response to viral proteins may provide a larger window of time for indirectly detecting SARS-CoV-2. Antibody tests can be particularly useful for surveillance of COVID-19. Currently, serological tests (*i.e.*, blood tests for specific antibodies) are developed. Zhang *et al*. detected immunoglobulin G and M (IgG and IgM) from human serum of COVID-19 patients using an enzyme-linked immunosorbent assay (ELISA) [12].

One potential challenge with developing accurate serological tests includes potential cross-reactivity of SARS-CoV-2 antibodies with antibodies generated against other coronaviruses.

C) Radiographic testing

Although quantitative and qualitative tests of viral nucleic acid RT–PCR tests are the primary assay for SARS-CoV-2 detection, the sensitivities of these tests remain low for oropharyngeal (32%) and nasal (63%) swab samples [13]. After the respiratory symptom presentation and nucleic acid viral detections, an initial evaluation of patients with COVID-19 commonly includes radiological examinations. Such examinations include a chest X-ray (CXR), CT or lung ultrasound (LUS).

Supplementary diagnostic testing for COVID-19 provides affirmation and monitoring of viral infection. Conventional CXR possesses sensitivity of nearly 60% for initial detection of COVID-19-related pulmonary disease [14]. These CXR abnormalities include bilateral lower zone and peripherally predominant consolidation and hazy opacities [15]. In addition, CT scans demonstrate a ‘reversed halo’ pattern and signs of septal thickening (16). Distinctive CT images illustrate bilateral pulmonary parenchymal ground-glass and consolidated pulmonary opacities with occasionally rounded morphology and marginal lung dispersal. Lung engrossment with peripheral predominance is seen in individuals with both SARS-CoV and MERS-CoV infections. However, chest CT showing pulmonary ground-glass opacities and alliance is more indicative of SARS-CoV-2 infection [17].

Conclusion

The SARS-CoV-2 pandemic follows a troublesome trajectory. The health, humanitarian, social and economic policies adopted by countries can influence the speed and strength of the recovery. The earlier lack of accessibility for testing has hampered the infection control; however, testing of this novel virus is increasing quickly. The availability of established diagnostic technologies has enabled to plug-and-play in the design of COVID-19 diagnostics. Transmission electron

microscopy was used to identify the morphology of the virus, genome sequencing was used to confirm the identity of the virus, and sequence data were used to help design PCR primers and probes. The rapid identification and sequencing of SARS-CoV-2 has enabled the rapid development of nucleic acid tests. These approaches provide a first line of defence against an outbreak. Diagnostic testing for COVID-19 is vital in detection of the virus, understanding its epidemiology, case management and suppressing transmission. Universal operating procedures and harmonization of the available diagnostic assays are needed for faster screening approaches in the global fight against the pandemic. It is a basic science guide to better appreciate COVID-19 diagnostic complexities and to effect improved disease-combating strategies.

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Popular Article

Scenario of Livestock and Poultry in India: A Review

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Abstract

Livestock has played an indispensable role in the Indian economy. Animal husbandry is culturally and economically integrated into the society. Livestock sector plays a significant role in the welfare of India's rural population as it employs a major section of the countries labour force and also provides a large share of draft power being used to cultivate crop land. Animal husbandry sector contributes 4.11% GDP and 25.6% of total agriculture GDP. Technological backwardness, financial constraints, and inadequate veterinary services are few issues that hinder the progress in the sector.

Introduction

Mankind has been utilizing different animal species from the dawn of civilization for a variety of purposes viz. production of milk, meat, wool, egg and leather. Apart from these, various animal species are also used for draught power, companionship, entertainment, research experimentation, sports, security etc. Livestock sector plays a crucial role in rural economy and livelihood. Animal husbandry, dairy, and fisheries are all important areas in the livestock sector. It has a significant impact on the national economy and the country's socioeconomic growth. The livestock also act as a source of protein in the form of milk, egg and meat. Government is developing this sector in the country as an industry. Various schemes have been initiated aimed at the increasing the availability of genetically improved livestock and poultry, control of diseases, assisting and encouraging the farmers to go for genetically upgraded animals and assured protection against loss of such animals through an establishment mechanism.

Population of Livestock and Its Importance

Their current livestock population is 536.76 million, according to the 20th censes of livestock, showing an increase of 4.8% over livestock census-2012. Animal husbandry sector contributes 4.11 per cent GDP and 25.6 per cent of total agriculture GDP. Livestock is important in India for reasons other than food production. It is a valuable source of draught power, manure for crop cultivation, and residential fuel. Livestock production and agriculture are intrinsically linked, each being dependent on the other, and both are crucial for overall food security. Livestock sector is an important sub-sector of agriculture in the Indian economy. It forms an important livelihood activity for most of the farmers, supporting agriculture in the form of critical inputs, contributing to the health and nutrition of the household, supplementing income, offering employment opportunities, and finally being a dependable bank on hooves in the time of need. It acts as a supplementary and complementary enterprise. Thus, livestock contribute to economic development by reducing the usage of nonrenewable energy. Farmers and rural poor people rely on the livestock sector for a significant portion of their income because livestock elements are generally concentrated among marginal and small farmers in developing countries, the rise of the livestock subsector is expected to help to poverty alleviation.

Species wise population

S.NO.	Species	19th livestock census 2012 (No. in millions)	20th livestock census 2019 (No. in millions)	Growth Rate(%)2012-19
1	Cattle	190.90	193.46	1.34
2	Buffalo	108.70	109.85	1.06
3	Total bovines	299.98	303.76	1.26
4	Sheep	65.07	74.26	14.12
5	Goat	135.17	148.88	10.14
6	Pigs	10.29	9.06	-11.95
7	Others animals	1.54	0.80	-48.05
	Total livestock	512.06	536.76	4.82
8	Poultry	729.21	851.81	16.81

Courtesy: **20th livestock census (2019) report**

India is world's highest livestock owner at about 535.78 million, First in the total buffalo population in the world - 109.85 million buffaloes, Second in the population of goats - 148.88 million goats, Second largest poultry market in the world, Third in the population of sheep (74.26

millions), Fifth in in the population of ducks and chicken (851.81 million), Tenth in camel population in the world - 2.5 lakhs.

Contribution of livestock to people

I. **Food:** The livestock provides food items such as Milk, Meat and Eggs for human consumption. India is number one milk producer in the world.

II. **Fibre and skins:** The livestock also contributes to the production of wool, hair, hides, and pelts. India is produced about 36.74 million Kg in 2019-20

III. **Draft:** Indian farmer especially in rural areas still depend upon bullocks for various agricultural operations. The bullocks are saving a lot on fuel which is a necessary input for using mechanical power like tractors, combine harvesters etc. Pack animals like camels, horses, donkeys, ponies, mules etc are being extensively used to transport goods in different parts of the country in addition to bullocks.

IV. **Dung and other animal waste materials:** Dung and other animal wastes serve as very good farm yard manure and the value of it is worth several crores of rupees.

V. **Storage:** Livestock are considered as 'moving banks' because of their potentiality to dispose off during emergencies. Livestock serve as an asset and in case of emergencies they serve as guarantee for availing loans from the local sources such as money lenders in the villages.

VI. **Sports / recreation:** People also use the animals like cocks, rams, bulls etc for competition and sports. Despite ban on these animal competitions the cock fights, ram fights and bull fights (jalli kattu) are quite common during festive seasons.

VII. **Companion animals:** Dogs are known for their faithfulness and are being used as companions since time immemorial. When the nuclear families are increasing in number and the old parents are forced to lead solitary life the dogs, cats are providing the needed company to the latter thus making them lead a comfortable life.

Role of livestock in farmers' economy

The livestock plays an important role in the economy of farmers. The farmers in India maintain mixed farming system i.e. a combination of crop and livestock where the output of one enterprise becomes the input of another enterprise thereby realize the resource efficiency. The livestock serve the farmers in different ways.

I. **Income**: Livestock is a source of subsidiary income for many families in India especially the resource poor who maintain few heads of animals. The animals also serve as moving banks and assets which provide economic security to the owners.

II. **Employment:** A large number of people in India being less literate and unskilled depend upon agriculture for their livelihoods. But agriculture being seasonal in nature could provide employment for a maximum of 180 days in a year.

III. **Food:** The livestock products such as milk, meat and eggs are an important source of animal protein to the members of the livestock owners.

IV. **Social security:** The animals offer social security to the owners in terms of their status in the society. Gifting of animals during marriages is a very common phenomenon in different parts of the country. Rearing of animals is a part of the Indian culture

V. **Draft:** The bullocks are the back bone of Indian agriculture. The farmers especially the marginal and small depend upon bullocks for ploughing, carting and transport of both inputs and outputs.

VI. **Dung:** In rural areas dung is used for several purposes which include fuel (dung cakes), fertilizer (farm yard manure), and plastering material (poor man's cement).

Livestock Production

As per the first revised estimates of press note on "First Revised Estimates of Natural Income, Consumption Expenditure and Capital Formation For 2019-20'' released by National Statistical Office (NSO), MoSPI on 29th January 2021 the Gross Value Added (GVA) of livestock sector is about Rs. 9, 62,682 crore at current prices during financial year 2019-20 Which is about 28.36% of Agricultural and Allied sector GVA and 5.21% of total GVA. At a constant prices (2011-12), the GVA of livestock sector is about 5, 77,720 crore during FY 2019-20 with a positive growth of 7.00 per cent over previous financial year.

1. PRODUCTION OF MILK

India is still the world's greatest milk producer, accounting for 22% of global milk production. Milk production during 2018-19 and 2019-20 is 187.75 million tonnes and 198.40 million tonnes respectively showing an annual growth of 5.68 per cent. The per capita availability of milk in India was 407 grams per day in 2019-20. According to ICMR recommendations per capita 280 grams/day is required. Largest Share in Total Milk Production in India: Uttar Pradesh (16.3%) and Second Largest Share Rajasthan (12.6%, 23.67 million tons).

2. EGG PRODUCTION

Currently the total eggs production is around 114.38 billion numbers during 2019-20. The per capita availability (2019-20) is around 86 eggs per annum. The egg production has shown positive growth as 10.19% during 2019-20.

3. WOOL PRODUCTION

Wool production in the beginning of the 12th five year plan (2012-13) was 46.05 million Kg and increased to 48.14 million Kg in 2014-15 but declined to 36.74 million Kg in 2019-20. The wool production has shown negative growth rate as (-) 9.10% during 2019-20.

4. MEAT PRODUCTION

Meat production in the the beginning of the 12th five year plan (2012-13) was 5.95 million tonnes which has been further increased to 8.60 million tonnes in 2019-20. The meat production has shown positive growth 5.98% during 2019-20.

5. FISH PRODUCTION

In 2001 overall fish production was 5666 thousand tonnes it gradually increasing continuously. At present, India's total fish production is about 14.16 million MT.

Conclusion

Indian livestock industry makes up for a significant amount of world's livestock resources. Both the national economy as well as the socio-economic growth of the country is backed by the livestock sector. The livestock sector is performing well in the manner of production, value addition and export of dairy, fishery, wool, poultry and other products. India has one of the largest populations of livestock and stands first in milk production. Livestock helps in women empowerment and provides livelihood to many marginal farmers. In Agriculture based economy real development can be achieved only by developing farming community who raise livestock as the main component.

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