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LIVESTOCK PRODUCTION MANAGEMENT

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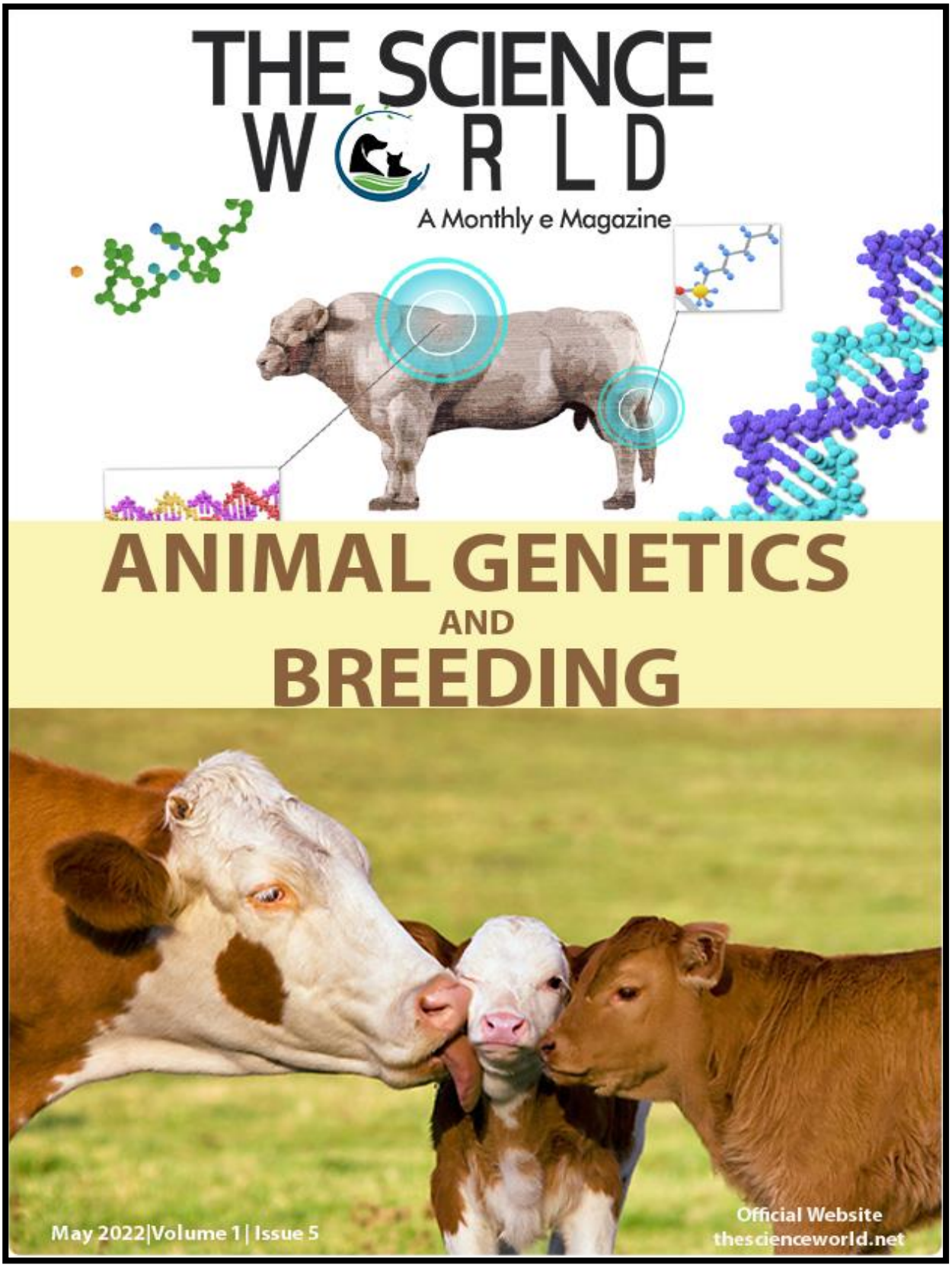
UPCOMING MAY, 2022 ISSUE4

LIVESTOCK PRODUCTION MANAGEMENT



Best articles of the Issue

*The list of Best Articles will be Announced soon

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Best Veterinarian Award

Dr. Kamal Sarma

Dr. Kamal Sarma was born in Guwahati (Assam) in the year 1973. He started his schooling from Guwahati and joined B.V.Sc. & A.H. in Assam Agricultural University, Khanapara (Guwahati) in the year 1990 and graduated in the year 1996. He completed his M.V.Sc. degree in the year 1999 and PhD degree in the year 2009 with specialization in Veterinary Anatomy from the same institution. He had started his Professional carrier as a Junior Research Fellow in Assam Agricultural University, Khanapara for 1 year and subsequently worked as Research Associate in the same institute for another 1 year in I.C.A.R. sponsored ad-hoc projects. He then joined as Assistant Professor (Veterinary Anatomy) in SKUAST-Jammu in the year 2001. He has acted as Head, Division of Veterinary Anatomy, SKUAST-Jammu for 2 terms. Presently he has been shouldering the additional charge as Head, Division of Veterinary & Animal Husbandry Extension Education. During his professional carrier of about 21 years, in addition to teaching various U.G. and P.G. courses, he has published 218 research papers in National and International journals of repute, 1 Book, 5 popular articles, 3 review articles, several book chapters and 7 laboratory manuals of different U.G. courses and he has presented 6 lead papers and 35 research papers in National and International Conferences. He has been awarded with the prestigious Fellow of Indian Association of Veterinary Anatomists in the year 2022, Distinguished Scientist Award in 2021 by the Society for Agriculture & Allied Research, India, Associate member award by National Academy of Veterinary Sciences of India (NAVS) in 2019 along with Best paper and Best poster awards in various IAVA conferences. He has successfully completed 3 university funded Research Projects as Principal Investigator and presently handling another 2 of such projects. He is actively involved as Member of editorial board of 1 International and 1 National journal and also acting as Referee of 14 National and International journals. So far, he has guided 01 PhD and 05 M.V.Sc students in the capacity of major advisor and 40 such students as member of Advisory committee. Besides, he has been acting as external expert to conduct various U.G & P.G. examinations in addition to acting as external expert in M.V.Sc. and PhD thesis viva voce examinations in different SAUs.

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Euthanasia in animals: Option or Obligation

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Abstract

Euthanasia can be a morally complex and stressful part of veterinary practice however; it is regarded as far less controversial than euthanasia in humans. The advisability of euthanasia and the scenarios under which practitioners are justified in actively offering, or passively allowing euthanasia is still a debate. Veterinarians refuse some requests for euthanasia that they feel would be unethical. The human-animal relationship should be respected by discussing euthanasia openly, providing an appropriate place to conduct the process, offering the opportunity for animal owners to be present, fully informing about what they will see, and giving emotional support and information about grief counseling as needed.

Keywords: Animals, Decide, Disease, Kill, Life, Pain

Death is a fundamental and omnipresent element. Death is usually regarded as a foe to be feared, combated, and, if all works well, conquered. However, in certain circumstances prolonging life may prolong a patient's agony (Benrubi, 1992). This unsettling outcome has ignited heated discussions over the advisability of euthanasia and the scenarios under which practitioners are justified in actively offering, or passively allowing, pain-ridden, comatose, and/or terminally ill patients to die peacefully (Singer and Siegler, 1990).

In human medical settings, the *sanctity* of life is given primacy over the *quality* of life which leads to a rejection of "mercy killing" (AVMA, 1988). Though it is a matter of considerable concern in animal rights circles, the killing of non-human animals typically is regarded as far less controversial in the larger society than is the killing of humans. Euthanasia can be a morally complex and stressful part of veterinary practice (Gardner and Hini, 2006) and may even be a

cause of mental health issues within the profession. Therefore, practitioners might be expected to consider refusing some requests for euthanasia that they feel would be unethical. Understanding why practitioners refuse euthanasia or not may inform guidance documents and teaching programmes, assist policy making and provide insight into issues such as the high suicide rate among veterinary professionals (Bartram and Baldwin 2008).

Since animals are non-linguistic, they are thought to be incapable of comprehending pain, death, the future, or constructing and reflecting on their identities (Rollin, 1990). As a result, animals are often regarded as property to be owned or used by humans rather than autonomous players engaged in a mutually established interaction and therefore deserving attention more than accorded to any valuable property. The philosophical, scientific, and commonsensical arguments commonly offered to justify the human ownership, use, and eventual disposal of nonhuman animals i.e. to deny their personhood sometimes become problematic when they are applied to severely damaged neonates (Anspach, 1993) or more mature beings (Goode, 1994) who are ostensibly human but, lacking independence, language, the apparent ability to self-reflect, and other key attributes, may be relegated to the status of nonperson.

The emotional intensity of the relationships that often develop between people and their nonhuman companion animals commonly prompts human caretakers to be ambivalent about, or reject entirely, the definition of their animals as mindless, objectified, nonpersons (Sanders, 1993). Instead, they see the animals with which they share their everyday lives as unique, emotional, reciprocating, and thoughtful "friends" or "family members". Widespread uncertainty concerning, or outright rejection of, the animal-as-object perspective generates considerable societal ambivalence about the appropriateness of mistreating nonhuman animals, killing and eating them, using them as scientific instruments (Bowd and Shapiro, 1993), or callously disposing of them when they are "used up." Given the close ties that commonly develop between people and their animal companions, these philosophical and social policy issues become intensely personal when caretakers confront decisions regarding the provision of medical care and if, when, and how to manage their animals' deaths.

The human-animal relationship should be respected by discussing euthanasia openly, providing an appropriate place to conduct the process, offering the opportunity for animal owners and/or caretakers to be present when at all possible (consistent with the best interests of the animal

and the owners and caretakers), fully informing those present about what they will see (including possible unpleasant side effects), and giving emotional support and information about grief counseling as needed (Nogueira Borden *et al.*, 2010). Regardless of the euthanasia method chosen, it is important to consider the level of understanding and perceptions of those in attendance as they witness euthanasia. When death has been achieved and verified, owners and caretakers should be verbally notified (Martin *et al.*, 2004).

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Approaches to modify Reproductive Seasonality in Goats

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Abstract

Almost all species at the time of origin were seasonal breeders for assurance of feed to their young ones for better survival. But as domestication started this phenomenon is no more applicable for most of the species. Goats of the temperate regions are still seasonal breeders. Period of sexual quiescence can be minimized by different strategies like hormonal, male effect, etc. to get progeny throughout the year.

Introduction

Goats have first domesticated some 10,000 years ago. Originating from a few wild goat and sheep ancestor varieties in the region of today's Iraq, Iran, Syria and eastern Turkey. In 1784, the Italian Biologist Lazzaro Spallanzani wrote "*It is well known that almost all animals, except man, have a stated season for the propagation of their species"*. Goats are seasonally polyestrous and breed at a specific time ensures the survival of offspring by aligning parturition with an adequate period of nutrition and climate circumstances. Within different latitudes, photoperiod is the principal factor that regulates seasonality in goats. Food availability and social interactions are also common factors that affect reproduction.

Reproductive seasonality in goats

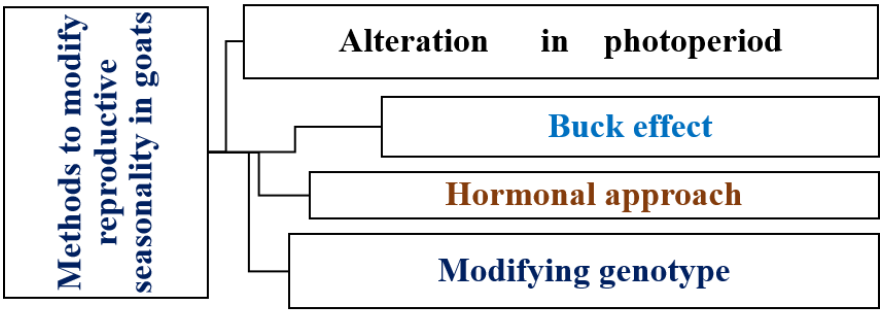
Reproductive seasonality is observed in goat breeds of the temperate region (Chemineau *et al*., 1992a) and some local breeds adapted to or originating from subtropical

latitudes. For goats, originating from tropical and subtropical environments, reproductive seasonality is less marked and some local breeds have just a short anoestrous period or breed all year round (Arroyo *et al*., 2007).

Purpose of modifying seasonality of breeding in goats

- To decrease fluctuation of income that means to obtain products like milk & meat throughout the whole year.
- To obtain 3 kidding in a 2-year rotation.

Methods To Modify Reproductive Seasonality in Goats



1. Alteration in photoperiod

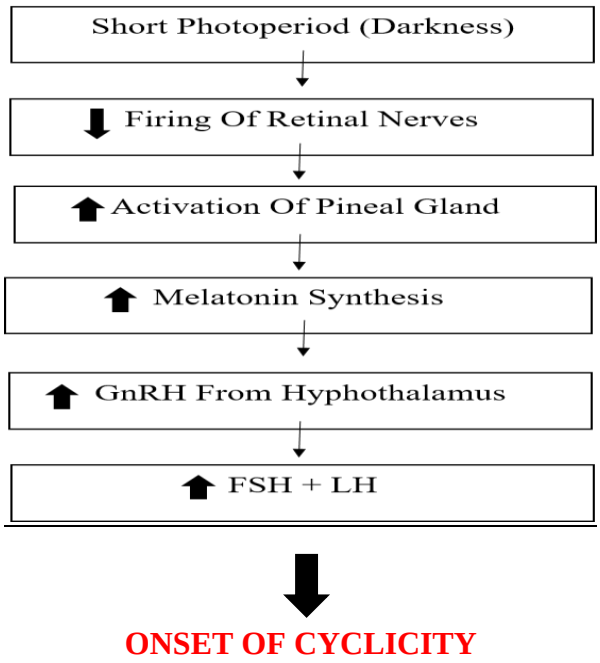
The seasonality of reproduction in goats is controlled by day length (Malpaux *et al*., 2001); out-of-season reproduction can be achieved using strategies based on changing the length of the photoperiod. Treatments based on the alternation of Long days (LD) and Short days (SD) can be used in either closed or open barns by imposing an artificial light regimen. Under field conditions, SD effects are easily provided by melatonin implants. This advances the onset of the breeding season and induces ovulatory activity in females throughout seasonal anestrus.

Protocol for manipulation of photoperiod-

Change the length of time the goats are exposed to light to mimic the lengths of daylight experienced in late summer and early autumn. This requires a minimum of 16 hours of light each day for a minimum of 45 days, with a light intensity of 200 lux measured at the doe's eye level. The length of the light period is then progressively and steadily reduced by 1 to 2 hours per week until 8-10 hours of light per day is attained. A gradual change in light causes activation of melatonin receptors in the hypothalamus. Breeding bucks should be presented to the doe

after 6-8 weeks of the termination of light treatment, the doe will be in the heat after 10-20 days of buck introduction. (Gómez-Brunet *et al*., 2008).

How does photoperiod affect cyclicity?

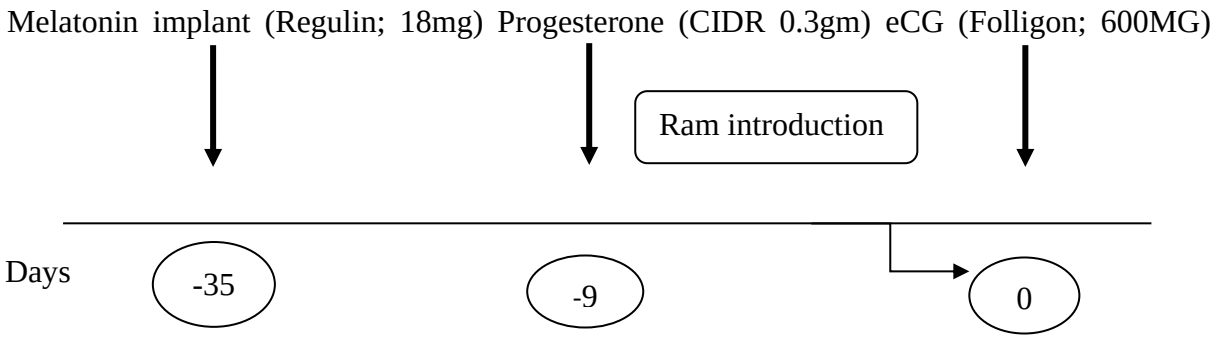


2. Ram effect

The "Buck effect" is when non-cycling goats are stimulated to ovulate by the sudden introduction of a novel buck. Bucks secrete chemical substances called pheromones, which are perceived by the doe and can stimulate the onset of estrus approaching the onset of the breeding season. To get the good effect, the doe should be strictly isolated from bucks for at least 6 weeks. Doe must have no contact with bucks by sight, sound, or smell, which means that they must be separated by a considerable distance. In addition, when using a vasectomized or teaser buck, this can allow the doe to achieve several estrous cycles before the desired date of breeding, which will increase fertility. The mechanism involved in the buck effect is mainly pheromonal and mediated via the female vomeronasal organ (VNO).

3. Hormonal approach

The administration of a synthetic progestagen (FGA: fluorogestone acetate), eCG (equine chorionic gonadotropin), hCG (human chorionic gonadotropin) and cloprostenol (PGF2α analog) induces and synchronise ovulation rapidly, ensuring high fertility (~60% kidding) with just one round of AI performed 46-48 h after treatment.



Modifying genotype

Knocking out the gene that responds towards lights and induces breeding is another way to modify seasonality. Crossing the photo-sensitive goats (breeds of temperate) with that of photo-insensitive (breeds of tropics) may also modify the reproductive seasonality. However, this method is still unexplored.

Conclusion

Goats are seasonal breeders in temperate regions and the photoperiod is the main reason for this seasonality. We can modify seasonality for breeding purposes in goats by using light treatment, hormonal treatment and by using buck to get more progeny and its product throughout the whole year.

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Acaricide Toxicity in Animals

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Abstract

Ectoparasite infestation is one of the major concerns among livestock and pet animals which can eventually lead to decrease in production and can act as carriers of hemoparasites thereby lead to death of animal due to anemia. Acaricides are compounds which are commonly used for destroying ticks and mites. Various classes of compounds are used as acaricides. Accidental exposure or inadvertent use can lead to poisoning especially large animals. In small animals mostly it occurs as a result of malicious intent. Pathological aspects of these toxicities are reviewed in this paper.

Introduction

Infestation with ectoparasites is one of the major problems in the veterinary field. Several group of ectoparasites are there like flies, fleas, lice, ticks and mites. Ectoparasite infestation can eventually lead to the decrease in the production of farm animals as well as many of them can act as carriers of hemoparasites. As far as cattle is concerned common hemoparasites like Babesia, Anaplasma and Theileria are transmitted by various classes of ticks. This can lead to anemia and even death of the animal. Similar is with dogs also, ticks are responsible for transmitting Ehrlicia, Babesia and Hepatozoan. Mite infestation like Demodex, Sarcoptic mange etc is also very common in dogs as well as in livestock which can lead to severe dermatitis lesions. So, it is very important to control these ectoparasites. Insecticide group include various classes of compounds like organophosphorus compounds, organochlorine compounds, carbamate group of compounds, pyrethroid insecticides, neonicotinoid insecticides, formamidine compounds and natural products. Acaricides are the compounds used for killing ticks and mites. Among the various classes of insecticides those which are commonly used in the field condition as acaricide include, Formamidine compounds, Permethrins and Pyrethroids, Avermectins and novel insecticides like Fipronil. Poisoning often

occurs due to inadvertent or accidental use as well as can be due to malicious intent. The present paper deals with toxicities associated with acaricides and its pathology.

Formamidine insecticides

Amitraz is a synthetic formamidine insecticide. It is indicated against mites, lice and ticks in cattle, sheep and swine. In dogs it is used against ticks and mites. It is used as drug of choice for treating localized and generalized demodicosis in dogs. Amitraz is contraindicated in horses. Common commercial preparations of amitraz are available as 12.5 %w/v. Trade names of the compound are Ectodex, Ridd, Taktic, Triatox etc.Amitraz act by stimulating α2 adrenoreceptors and inhibiting monoamine oxidases. They also act on Octopaminergic receptors on the central nervous system. It is responsible for the toxic effects of amitraz. Resistance against amitraz in cattle ticks was found to be due to the mutation in this octopamine receptor gene. CNS depression in amitraz toxicity is due to weak anti serotonin activity. Stimulation of α2 adreno receptors produces symptoms like loss of consciousness, breathing depression, seizures, bradycardia, hypotension and hypothermia. It can induce mydriasis due to stimulation of post synaptic α2 receptors. Cardiovascular system and CNS are the main targets for amitraz. Toxicity depends mainly on type of formulation and species. Ingestion of amitraz impregnated collars is mainly causing toxicity. But in horses, dermal application itself can produce toxicity. In horses they produce intestinal hypomotility and atony leading to impaction. Horse exhibit typical colic symptoms like inappetence, pawing, sweating, non-defecation, anuria and ataxia in amitraz toxicity (Phetudomsinsuk *et al.*, 2014). Other than digestive signs, neurological abnormalities like incoordination, diminished cranial nerve reflexes and symptoms of respiratory and circulatory dysfunction also noticed in experimental poisoning (Duarte *et al.*, 2003). In case of cats even low concentration can produce mild transient toxicity Dogs also exhibited toxicity symptoms like mydriasis, hypothermia bradycardia, hypotension CNS symptoms like ataxia, incoordination and hyperglycaemia. In a comparative study it was found that dogs are more sensitive to cardiorespiratory alterations, while cats are sensitive to hypothermia and hyperglycaemia than dogs. Decrease in plasma cortisol level also noticed. Electrocardiographic abnormalities like prolonged QT interval with regular sinus rhythm are also recorded in an English bull dog in amitraz toxicity. Accidental poisoning with amitraz also reported in cattle and they exhibited signs like reduced rumen motility, congestion of episcleral vessels, bloat and loss of pupillary reflex (Kizil et al, 2008). In a study conducted in mice to find the pathological changes in acute intoxication and found that liver showed degenerative changes and fatty changes and directly proportional to the dose

given. Xylene and other substance added to the formulation are found to be more toxic than amitraz and produced adverse effects in kidney (Filazi *et al.*, 2004). In a dog following ingestion of amitraz formulated dip severe subcutaneous oedema, ascites, renal haemorrhage and diffuse hepatomegaly also reported Histopathological examination revealed cortical haemorrhage, necrotic changes in the glomerulus and tubules, obliteration of interstitium, dilatation of sinusoids, fatty hepatosis and necrosis (Oglesby *et al.*, 2006). Yohimbine, α2 adrenoreceptor antagonist can be used to reverse the alterations produced in amitraz toxicity. For alleviating the symptoms supportive therapy with emetics, activated charcoal, saline cathartics and intravenous fluid administration also practiced.

Pyrethrins and pyrethroids

Pyrethrin are natural insecticides extracted from *Chrysanthemum cinerifolium* plant and pyrethroids are synthetic analogues. Two prominent pyrethrins are Pyrethrin I and II. Synthetic pyrethroids are classified in to two groups based on the structure and clinical signs that is Type I or Non- cyano pyrethroids and Type II or cyano pyrethroids. Type I is less toxic as compared to type II compounds. Due to the rapid degradation and non-persistence in the environment, they are widely used now a days. Various mechanism of actions is proposed for pyrethroids. Type I pyrethroids act on sodium channels and produce delayed depolarization while type II pyrethroids produce persistent depolarization. The activity of monoamine oxidase increased and Na-K- ATPase activity decreased in different regions of the CNS in rats on Deltamethrin exposure (Husain *et al*., 2010). Females are more sensitive to toxicity than males. They are less toxic to the mammals because they can bind more strongly to the sodium channels at low temperature. Insect ambient temperature is 25˚C which is low as compared to mammalian temperature. They produce “Knockdown” effect in insects. Intoxication occurs by the accidental ingestion or by excessive use of ectoparasiticide. Due to the lack of hepatic glucuronosyltransferase cats are highly sensitive to toxicity. Type I pyrethroids cause tremor syndrome in which animal exhibits restlessness, incoordination, hyperactivity, sensitivity to external stimuli and tremors. Type II pyrethroids produce choreoathetosis and salivation syndrome. Animal exhibits pawing and burrowing behavior, salivation, coarse tremors progressing to sinuous writhing and colonic seizures. Felines exhibit symptoms like tremors or muscle fasciculations, twitches, hyper aesthesia, pyrexia, ptyalism, ataxia, mydriasis and temporary blindness on permethrin toxicity (Boland and Angles, 2010). In rabbits following intraperitoneal administration of cypermethrin increase in serum AST level accompanied by degenerative changes and bile duct hyperplasia in liver and increase in urea and creatinine

concentration and decrease in serum total protein, albumin and globulin along with histological changes like pyknotic nuclei, necrosis and sloughed tubular epithelium, cast deposition and increased urinary space (Ahmed *et al.*, 2011). In a study conducted in rat, to know the effects of Bifenthrin, a pyrethroid on biochemical parameter it was found that with high concentration of bifenthrin, serum cholesterol, ALT and AST level increases and decrease in serum protein, albumin and globulin level noticed. Pyrethroids are found to be toxic to the mammalian Central nervous system in acute intoxication. On Fen valerate intoxication in mice and rat two distinct neurologic defect were observed, a reversible ataxia/ incoordination and a neuropathologic effect manifested as sparse axonal damage in peripheral nerves. Peripheral nerve lesions are characterized by single or multiple swollen or fragmented axons surrounded by displaced myelin sheath. Vacuolated appearance of myelin sheath gives a characteristic 'bubble packet' appearance. In a study conducted in rats to know about the histopathologic changes in the tibial and sciatic nerve, myelin ovoids indicative of axonal damage noticed by teasing of nerves of rats sacrificed after 4 days of treatment. TEM studies revealed that the degenerated axons are completely filled with organelles like mitochondria and electron dense lamellar bodies resembling myelin figures (Calore *et al*., 2000).

Avermectins

Avermectins are the fermentation product of the fungus *Streptomyces avermitilis.* Ivermectin which is composed of a mixture of ivermectin B1a and B1b is a widely used anti parasite drug. They have wide spectrum of activity against nematodes and arthropod parasites of animals. In dogs it is commonly used for the treatment of heart worms and mange infestation. They act on GABA receptor mediated chloride channel. Mammals are less susceptible to toxicity as compared to arthropods and nematodes. It is because GABA mediated intraneuronal inhibitors are present in central nervous system only and a high concentration is required for toxicity. It is impermeable to the mammalian blood brain barrier because of the endothelial tight junctions present and also due to MDR1a P- glycoprotein. Mice are found to be susceptible to ivermectin toxicity due to lack of MDR1a P- glycoprotein. Collie breeds are susceptible to toxicity due MDR1 gene mutation and p- glycoprotein deficiency. Sensitive collies showed homozygous 4 bp exonic deletion (Roulet *et al*., 2003). LD50 for ivermectin in beagle dogs was reported to be 80 mg/kg BW. In Collie breeds 50-60µg/kg was found to be safe. Clinical signs exhibited may depend on route and dose of administration. Gastrointestinal absorption is found to be more rapid than subcutaneous absorption. In a report it was suggested that collie breeds of dogs on exposure to oral ivermectin at a dose rate of 400µg/ kg showed

rapid and severe clinical course than dogs that received 200- 250µg/kg dose subcutaneously (Hopper *et al*, 2002). Dogs exhibit symptoms like ataxia, disorientation, obtundation, hypersalivation and mydriasis. Stupor and coma can be observed in severe cases. Ivermectin toxicosis also reported in other breeds like Doberman pinschers and in Australian shepherds. In cattle on intravenous administration depression, ataxia, diarrhea, difficulty in breathing, tachycardia and miosis could be seen. Miosis in cattle and mydriasis in dog could be due to species difference in response to the drug. On clinicopathological examination decrease in glucose level can be seen along with increase in serum creatinine phosphokinase, glutamyl transpeptidase and lactic dehydrogenase level. Severity of lesions depends on the dose. On sub chronic exposure ivermectin induce neuronal degeneration and necrosis in brain. Degenerative lesions are evident in various parenchymatous organs. In testis, thickening of capsule, necrosis of the epithelial lining, vacuolations in spermatogenic cells and formation of sperm giant cell could be observed. Liver may show congestion of the blood vessels, thrombosis of the portal vessels, hepatocytes undergo mild vacuolar to fatty change, hyperplasia of the epithelial cell lining the duct with periductular mononuclear infiltration and fibrosis. Kidney showed congestion of renal blood vessels, glomerular tuft shrinkage, eosinophilic substance in the bowman's space, vacuolation of cytoplasm of affected tubules and necrosis and desquamation of affected epithelium. Spleen showed thickening of splenic capsule with lymphoid depletion of white pulp associated with hemosiderosis. Ovary showed presence of degenerated follicle in the follicular lumen of mature graafian follicles. Barbiturates like pentobarbital and phenobarbital can be used for alleviating the symptoms. Diazepam should be avoided.

Fipronil

It is a phenyl pyrazole insecticide used for flea and tick control in dogs and cats. They are highly lipid soluble but do not penetrate skin easily. Fipronil is widely distributed in stratum corneum, viable epidermis and pilosebaceous units. Oral absorption after ingestion and can be detected in liver, adrenal and abdominal fat. The mechanism of FPN toxicity is due to inhibition of GABA – gated chloride channel. Less toxic in mammals due to difference in the shape of GABA receptor. They impede the metabolizing enzymes that contain sulfhydryl groups and uncoupling of oxidative phosphorylation. Fipronil has a wide margin of safety. The application of 0.29% spray to dogs and cats even five times higher dose did not cause any abnormalities. In rats acute over dose cause hind leg splay, tremors and seizures. In rabbits also seizures were noticed. Clinical signs mainly include dermal hyper sensitivity reactions like redness, irritation and alopecia. Usually hiding and other behavioral signs were also exhibited by the animals.

Dermal reactions start in an hour and last for one or two days. Salivation and vomiting also noticed. On post mortem examinations lesions are mostly confined to the liver. Dilatation of sinusoids, ruptured or partial clogging of bile duct and portal vein, damaged hepatic artery and vein and connective tissue, hypertrophy of hepatocytes, stagnation of bile, mild vacuolation and focal necrosis (Kartheek *et al*.,2018). If the animal showed dermal hypersensitivity reactions fipronil should be removed by bathing. Antihistaminic and steroids can be given. Activated charcoal should be given at 1 to 2 g/kg. Valium and phenobarbital can be given.

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Indigenous Breeds of Poultry

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Domestic chicken is one of the most important animal species worldwide which developed from its main wild ancestor, the red jungle fowl (*Gallus gallus*), after its domestication in Southeast Asia in 3,200 BC. Over the years, chicken evolved from their wild form to the several contemporary layers, broilers, bantams, game and fancy breeds, as well as the indigenous village chicken available today. Since early 20th century, the industrialization and globalization of chicken production adversely affected the distribution of chicken genetic resources worldwide, thereby limiting the breed composition to commercial broilers and laying hens.

The Indian birds are mostly non-descripts, having comparatively little value as layers and vary in appearance according to the locality in which they have been bred. The importance of native breeds of poultry birds for rural economy specially in developing and underdeveloped countries is very high as they play a major role for the rural poor and marginalized section of the people as a source of subsidiary income as well as nutritious egg and meat for their own consumption. Hardiness of native chicken is one of the most important positive characters, which is ability to tolerate the harsh environmental condition and poor husbandry practices without much loss in production. There are total 19 indigenous breeds of chicken in India which are discussed as following:

Ankleshwar: It is distributed around Bharuch and Narmada district of Gujarat. This breed of chicken is quite hardy and is associated with tribals maintaining them. It is named after the name of area i.e. Ankleshwar in Bharuch district of Gujarat. Locally, it is known by '*desi/ gowrani/*

gamthi'. It is reared for both meat amd egg purpose. The average age at first egg is roughly 179 days. Annual egg production varies between 78-84 eggs with mean egg weight around 35 gms. The dressing percentage is 62.44%. The adult weights of cock and hen averages around 1.75 and 1.48 kg respectively.

Aseel: 'Aseel' is an arabic word meaning ''pure or thoroughbred'. It is maintained by tribals of North Bastar and South Bastar district of Chattisgarh and Khammam district of Andhra Pradesh. The bird is known for its fighting tendency i.e. pugnacious. It has delicious meat along with excellent heat tolerance and disease resistance. The bird is utilized for game, meat and egg purpose. The average age at first egg is 27-29 weeks and annual egg production varies between 30-36 eggs. The dressing percentage is around 75%.

Busra: This bird is maintained by tribals of Maharashtra and Gujarat. The name 'busra' is derived from 'busrawal'- a tree. Frizzle character is quite common among this breed. The bird is reared for meat as well as egg purpose. The average age at first egg is 5-7 months and annual egg production varies between 40-55 eggs with mean egg weight of 28-38 gm. The dressing percentage is around 65-70%. The adult weight of cock and hen averages between 0.85-1.25 and 0.8-1.2 kg respectively.

Danki: Locally known as 'Dinki'. These birds are reared in Vizianagram, Srikakulam, Vishakapatnam districts of Andhra Pradesh and utilized for game and meat purpose. Its fight is called 'Danki fight' and are conducted on day of Makar Sankranti. The bird can fight continuously for 1-1.5 hrs. The average age at first egg is 6-8 months and annual egg production varies between 25-35

eggs with mean egg weight of 37-54 gm. The adult weights of cock and hen averages 3.1 and 2.2 kg respectively.

Daothigir: This breed is reared by Bodo community in Bodoland region of Assam and along Northern banks of Brahmaputra river. The name is derived from 'Thigir' plant found in this region as its plumage is somewhat similar to flowers of this tree. Utility of this breed is for both egg and meat. The average age at first egg is 6 months and annual egg production varies between 60-70 eggs with mean egg weight of 42-48 gm. The adult weights of cock and hen averages 1.79 and 1.63 kg respectively.

Ghagus: This breed is locally known as 'desi or ghegu' and its name is derived from a peculiar sound. It is reared in Kolar and Banglore districts of Karnataka as well as Chitoor and Anantapur districts of Andhra Pradesh, utilized both for egg and meat. The average age at first egg is 5-8 months and annual egg production varies between 45-60 eggs with mean egg weight of 38-42 gm. The adult weights of cock and hen averages 2.16 and 1.43 kg respectively.

Kalasthi: The birds are found in Chitoor, Nellore and Cuddapah districts of Andhra Pradesh and is named after Sri Kalahastri area of Chitoor district where these birds are found. It is mostly utilized for meat purpose but sometimes also as game bird. The average age at first egg is 5-9 months and annual egg production varies between 32-36 eggs with mean egg weight of 40-44 gm. The adult weights of cock and hen averages 2.48 and 1.25 kg respectively.

kashmir favrolla: This breed is known for its hardiness as it can survive and produce in subzero temperatures. Locally known as 'Kashir Kukkar' and is distributed in Anantnag, Baramula, Budgam, Kupwara, Srinagar and Pulawana districts of Jammu and Kashmir. It is reared for

both egg and meat purpose. The average age at first egg is 6-8 months and annual egg production varies between 60-85 eggs with mean egg weight of 43-74 gm. The adult weights of cock and hen averages 1.8 and 1.4 kg respectively.

Miri: It is distributed around Dhimaji, Sibsagar, Dibrugarh and adjoining districts of Assam where it is utilized for both egg and meat purpose. The name 'Miri'is derived after tribe i.e. Miri/ Mising rearing them. Locally it is known as 'Porog'. The average age at first egg is 6-8 months and annual egg production is roughly 32 eggs with mean egg weight of 41-43 gm. The adult weights of cock and hen averages 1.525 and 1.320 kg respectively with dressing percentage between 65-74%.

Nicobari: This breed is locally called 'Takniet hyum'and is reared by Nicobari tribe of Andaman and Nicobar Island. It is hardy breed reared mainly for egg purpose. The average age at first egg is 5-9 months and annual egg production is roughly 112-237 eggs with mean egg weight of 43-45 gm. The adult weights of cock and hen averages 1.2 and 0.9-1 kg respectively.

Punjab Brown: This breed is distributed throughout Punjab and Haryana utilized mainly for meat and egg. Males have black stripes/spots on neck, wings and tail. The average age at first egg is 5-6 months and annual egg production is 60-80 eggs with mean egg weight of 45-47 gm. The adult weights of cock and hen averages 2-2.2 and 1.4-1.6 kg respectively.

Tellichery: The name of this breed is derived from a place called 'Tellichery' in Kannur district of Kerala. These birds are fast movers, so they are not a easy prey. These are also thought to have some medicinal value as its soup is beneficial for anemia and worm infestations. Normally these birds are reared for meat only. The average age at first egg is 5-8

months and annual egg production is 60-80 eggs with mean egg weight of 34-45 gm. The adult weights of cock and hen averages 1.62 and 1.24 kg respectively.

Kaunayen: Locally known as 'Kwakman/Koman' and distributed in Manipur. These birds are highly alert, energetic and prized for its 'martial qualities'. These are mostly utilized as game bird. The average age at first egg is 5-7 months and annual egg production is roughly 35 eggs with mean egg weight of 41-43 gm. The adult weights of cock and hen averages 2.4-3.8 and 1-2.9 kg respectively.

Uttara: Uttara is native chicken of Uttarkhand which evolved through natural selection and is well adapted to its local environment with appreciable degree of resistance to diseases compared with other exotic breeds of chicken. They have socio-economic importance as they are black in color and have crest/crown type structure on the head. These birds have faethered shank which are not seen in any indigenous chicken breed. They are reared for egg as well as meat purpose. The annual egg production is roughly 125-160 eggs with mean egg weight of 49-52 gm. The adult weights of cock and hen averages 1.3 and 1.1 kg respectively. Dressing percentage is 70-72 %.

Hansli: Birds are tall and slim, and have majestic look. This breed is found in Mayurbhanj and Keonjhar districts of Odisha. The males of the breed are very aggressive with high stamina and dogged fighting qualities and are used for cock fighting which is a popular sport in the region. The average age at first egg is 6 months. The annual egg production is roughly 50-67 eggs with mean egg weight of 40-46 gm. The adult weights of cock and hen averages 3.8 and 2.5 kg respectively.

Kadaknath: Distributed around Dhar and Jhabua districts of Madhya Pradesh. Locally this breed is called Kalamasi i.e. Black flesh due to black colour of its flesh (fibromelanosis) which is considered not only a delicacy but also of medicinal value. The tribals use the blood of Kadaknath in the treatment of chronic diseases in human beings. Its meat also has aphrodisiac properties. It is reared for meat and eggs that are reckoned to be a rich source of protein and iron. The average age at first egg is 6 months and annual egg production is 85-90 eggs with mean egg weight of 40 gm. The adult weights of cock and hen averages 1.6 and 1.125 kg respectively.

Harringhata Black: this breed is found in West Bengal and reared for both egg and meat purpose. As it has great mothering ability, so it can be used as foster mother. The average age at first egg is 4 months and annual egg production is 100-120 eggs with mean egg weight of 42-44 gm. The adult weights of cock and hen averages 1.5 and 1.2 kg respectively.

Mewari: Found in Central and Southern part of Rajasthan. This breed is not an easy prey when attacked by dogs and cats. It is reared for both eggs and meat and their meat & eggs fetch five times more compared to other chicken breeds. The annual egg production is 37-52 eggs with mean egg weight of 53 gm. The adult weights of cock and hen averages 1.9 and 1.2 kg respectively.

Chittagong: This breed is very strong and hardy with a quarrelsome temperament. Hence, possesses all the characteristics of a good game bird. It is found in North Eastern states of India

bordering Bangladesh reared for both meat and eggs. The adult weights of cock and hen averages 3.5-4.5 and 3-4 kg respectively.

Conclusion:

The native breeds of poultry birds are part of balanced farming system playing vital roles not only as high-quality animal protein source but also as emergency cash income. They also play a significant role in the socio-cultural life of the rural community and woman empowerment. The low performance of native breeds of chickens in terms of productivity can be improved via improved husbandry practices, better selection along with better healthcare and feed supplements. Thus, we should encourage the rearing of indigenous breeds of poultry.

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Covid-19 Impact on Agriculture and Food Security

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Abstract

COVID-19 having high transmissibility is more contagious, and its ability to survive on surfaces making it more challenging to destroy and this led to extraordinary socioeconomic disruption (Jafri et al., 2021). Responding to this pandemic, many countries imposed strict control measures such as lockdowns that had seriously impacted food availability, accessibility, altered dietary practices and worsened food insecurity situation. In India for a durable food security the requirements of four pillars (availability, accessibility, utilization and stability) should be fully met. Agriculture which is indispensable for food security disrupted on large scale which led to various disruptions in pre-farm gate and post-farm gate operations like unavailability of agriculture inputs, labour shortage, unavailability of machinery, extension services, agricultural marketing, storage, transportation, processing and others. This article insights how COVID-19 impacted food security and agriculture both positively and negatively and government interventions to combat the pandemic situations

Introduction

Infectious diseases are one of the major causes of death that are responsible for one fourth to one-third of mortality in world. COVID-19 which is an infectious disease first reported in Wuhan, China in early Dec 2019 (Ghosh, 2020) which suddenly escalated and became an unprecedented global health situation (Jafri *et al*., 2021). In March 2020, the WHO declared COVID-19 as a global pandemic.

Features of COVID-19 that makes it challenging are its contagious nature, and its ability to survive on surfaces. The second feature is the delay in developing and approval of drugs. Another feature of COVID-19 is the constant evolution as new strains causing recurrent infections and threat (Shang *et al*., 2021). Poudel *et al* (2020) in his study stated that COVID-19 crises as severe crisis since the Second World War.

As a response to this pandemic, most countries imposed strict control measures like lockdowns which included, quarantine, self-isolation, curfews etc. to mitigate disease spread. Severe preventative measures taken by governments affected people's access to healthy foods and global agri-food supply chain disrupted which contributed to food insecurity and malnutrition (Jafri *et al.*, 2021).

Impact of COVID-19 on food security

According to Gibson (2012) food security means all the people, all the times, having physical, social and economic access to sufficient, safe, and nutritious food which meets their food preferences and dietary needs for active and healthy life. Food security has four pillars they are availability, accessibility, utilization and stability.

For a durable food security in India, the requirements of all these four pillars should be fully met. Jafri *et al*. (2021) stated that COVID 19 pandemic adversely affected food availability and accessibility, altered dietary practices and worsened food insecurity situation.

Agriculture ensures food security

Agriculture improves availability of food and help in achieving food security (Wegren and Elvestad, 2018). It is Indispensable and have direct relationship with food security and it also have special importance in development of human.

Impact of COVID-19 pandemic on agriculture

In an effort to stop the spread of covid-19, Government of India announced lockdown on March 24, 2020 due to which agri-food supply chains disrupted on a large scale like

1. Impact of COVID-19 on pre-farm gate operations

1.1 Impact on agri-inputs availability

1.2 Impact on availability of labors

1.3 Impact on availability of machinery

1.1 Impact of COVID-19 on availability of agricultural inputs

Crop inputs had impacted during pandemic due to

a. Disruption of raw material supply

b. Disruption of freight/cargo and transport services

c. Shortage of labor

This led to unavailability of seeds & planting materials, unavailability of fertilizers & manure, shortage of plant protection chemicals /botanicals / bio control agents and shortage of feed for livestock & poultry.

India and many developing countries depend on pesticide and fertilizer imports from other countries like China. Boarder closures and transportation restrictions halted exports and imports which hampered timely application and supply of agricultural inputs. COVID 19 pandemic affected the availability of Cartap, Acephate, Buprofezin (Weearasekara, 2021) and other agrochemicals in Indian markets.

According to NABARD (2020) restrictions imposed on movement and closure of shops reduced availability of agricultural inputs like seeds (-9.2%), fertilizers (-11.2%), pesticides (-9.8%), fodder (-10.8%), etc.

1.2 Impact of COVID-19 on labor availability

Countries with labor-intensive production and peak seasonal labor demand experienced shortage of labors in agricultural industries because of restrictions on people's migration across borders and lockdowns. Labors demand was increased whereas the supply reduced due to many reasons. The migrant workers head back to their homes and some laborers were denied in going to farms due to fear of coronavirus. Reverse migration combined with poor transportation caused labor shortage. Due to labor shortage labor demand increased but labor supply decreased due to this wage rates increased. (OECD, 2020).

- **Case study - labor shortage delayed crop harvest**

Severe scarcity of labor imposed a serious challenge to crop procurement and threatening to leave a long-lasting impact on agriculture as harvest of winter-sown crops delayed, particularly wheat, which in turn delayed the planting of the next crop (Krar *et al*., 2021).

1.3 Impact of COVID- 19 on availability of machinery

Peak harvest with no labor procurement

In India many crops like wheat, gram, lentil, mustard, etc. (including paddy in irrigated tracts) were at a harvestable stage during pandemic and it was also time for farm harvests to reach mandis for assured procurement operations by designated government agencies**.** Because of lockdowns and travel restrictions farmers were inaccessible to machinery, drivers and labors due to lack of transportation

- **Case study- Kollam District of Kerala (KSM, 2020)**

In Mugathala block of Kollam district JGL with 7 acres of paddy was affected due to unavailability of harvesting machines. Even though they availed extra labor and harvested it, they incurred loss.

2. Impact on Agri-value chain

2.1 Impact on Agriculture Producers

Farmers are important producers of India's food value chain. lockdown resulted in scarcity of manpower and equipment as migratory workers in India typically migrate to rural areas during harvest, and smallholder farmers mostly rent equipment used in agriculture rather than purchase it. Another cause of uncertainty is the availability and accessibility of seeds, fertilizer, and insecticides for the upcoming crop season. However, the disruptions induced by COVID-19 lowered farm input production capacity and raised prices, making these resources inaccessible to the small and marginal farmers. Another issue that faced by farmers is unavailability of transportation for his ready crops, it is reported that truck drivers are denied their duty due to two major problems, -all restaurants and road side Dhabas were closed during lockdown so they are unable to get food. Another is strict restrictions imposed by states government is border areas were sealed off. This is likely to have an impact on agricultural product demand, labor dislocation, and supply chain disruption (Sapna, 2021).

2.2 Impact on Retailers and Consumers:

The novel pandemic has changed the enterprise practices of retailers also and made them face many confrontations in doing business. All the retailers faced the shrinkage in their business volumes, the consumption pattern of the consumers had also changed. Retailers had to manage the supply chain disruptions, restriction in the footfall of the stores due to the social distancing, hygiene improvements as per the local governance, reduction in promotional campaigns so as to avoid over crowd etc. During the lockdown, this fixed cost was balanced against the low income produced by retailers, which resulted in business closure (Sapna, 2021).

3. Impact of COVID-19 Pandemic on Post-farmgate operations

3.1 Impact on Agricultural marketing

3.2 Impact on storage & transportation

3.3 Impact on processing

3.1 Impact on Agricultural marketing

Functioning of mandis:

- When the lockdown was first announced, a huge number of agricultural mandis shut down.
- The sudden installation of the lockdown disrupted supply networks, as farmers were unable to transport their produce to wholesale markets
- Haats, and traders were unable to visit villages to purchase produce.
- On March 27, five days after the first-round lockdown, the government exempted agricultural mandis from the restrictions. Due to restrictions on the number of farmers allowed into the mandis and the amount each farmer could sell on any given day, there were long lines of farmers waiting outside the mandi gates for hours and days.

3.2 Impact of COVID-19 on storage and transportation

- Unavailability of cold storage resulted in rotting of perishables
- Closure of godowns and warehouses.
- Restriction on transportation resulted in supply chain disruption.
- Shut down of govt and private procurement agencies
- **Case study -fish/vegetable trade in Kerala**

For fish and vegetable trade the biggest problem is that the supply is not available. Vendors have been restricted by the government due to district and state-level limitations on border movements, as well as a shortage of transportation infrastructure. The majority of the vegetable and fish vendors were poor families that relied on daily income for their basic necessities. Vegetables and fish were not being sold in huge quantities by wholesalers. The high price of vegetables in the market was also a problem for vegetable trading businesses. lack of cold storage to store excess vegetables and fish resulted in the rotting of certain stock. (KSM ,2020)

3.3 Impact of COVID-19 pandemic on processing

In India food processing business accounted for 32 % of entire countries food market. Processing industries had faced challenges at two stages one at product production stage and another at the product marketing stage. At this product production stage due to lack of availability of raw materials and availability of labor product was not synthesized. At product marketing stage

due to travel restrictions both inside and across borders finished products did not reach markets and consumers. (OECD, 2020).

- **Case study -Flourmill units in Kerala**

As lockdown prevented flour mills from marketing or delivering their products, most flourmill units are suffering with deterioration of completed goods and raw materials. Since the lockdown began, there has been no business activity and many previous orders were cancelled by customers due to a shortage of transportation and finance. Entrepreneurs had a difficult time dealing with perishable foods. (KSM, 2020)

4. Positive impact of COVID-19 pandemic (Kalogiannidis *et al*., 2020)

4.1 Rising demand for local food

Demand for organic and local food has risen dramatically due to various regulations and growing health concerns. In comparison to other products, demand for regional and local farmed products was higher. By direct selling farmers could get best price for their hard work. Many people in cities started growing crops on terrace and homesteads which led to the flourishing of Urban farming / nutrition gardens. Travel restrictions increased the demand for import substitution.

- **Case study from African women**

COVID-19 pandemic resulted in the acute food shortage for 7.1 million people in Nigeria and 265 million globally. During pandemic demand for yam bean has risen in Africa due to its special nutrient status, which was a forgotten crop due to global trend of crop uniformity and westernized diet. (FAO,2020)

- **Case study-Marigold farmer set as a Model**

N.K. Krishnan Nair cultivating marigold in 40 cents reported that during lockdown he sold flowers to traders in Kozhencherry and Chengannur, when supplies from Tamil Nadu and Karnataka dried up. Mr. Nair claims that customers prefer locally grown flowers, with a rise in COVID-19 cases in Tamil Nadu and Bengaluru. (Kuttoor ,2020).

4.2 Opportunity for small farmers

During lockdown, local farmers grouped together to gain better market prices. This strategy has proven to be beneficial to small farmers in diverse places. When travelling restrictions were eased, wholesalers wanted large quantities of vegetables mainly

due to customer stockpiling. As a result, local farmers worked together to meet the demand for vegetables at a reasonable price. (Morsy *et al.*, 2020). During the lockdown, demand for dried veggies including mushrooms and peas, as well as frozen vegetables, spiked dramatically. Farmers took advantage of this situation, avoiding the income loss from vegetables and agriculture. Milk and associated items were in high demand as well. Due to an increase in demand for milk products and immune booster meals, livestock farmers had a tremendous opportunity during COVID-19. (Farell *et al.*, 2020).

4.3 Modernizing Agriculture Sector

The authorities has given serious consideration to transform agriculture when COVID-19 devastated the country. China, for example, is investing in drones, autonomous unmanned vehicles, and other agricultural improvements in order to reduce human involvement. Mobile phones are enhancing access to business sectors, expenses, and climatic information in Africa, as well as encouraging cash transfers to aid in the modernization of rural areas. (Lal, 2020).

5. Innovative agri-solutions during COVID-19

E-book documents on **"Innovative agri-solutions during COVID-19"** contain various works done by KVK's during pandemic period from across the country (ICAR, 2020).

5.1 Online Advisories and Consultations

Due to restrictions on people's movement during lockdown, farmers were unable to access farm advisory and solution centres such as KVKs and other such organizations. Farmers, on the other hand, have the option of contacting extension agents via telephonic chat. In this case, various ICT choices proved useful in resolving farmer issues. Photos and videos were used to explain the issues, and online solutions were supplied for all crop and livestock-related issues.

- **Case study- KVK Alappuzha**

It used conference calls, audio visual aids, social media, tele-training, and other ICT technologies to communicate with member farmers. During the months of March and April 2020, four teleconference sessions were held at weekly intervals to impart skills for proper honey gathering and storage. Online tele-trainings on colony management throughout active honey flow season, post active honey flow season, and hygienic preparations for sale were conducted with the use of custom-made video clips. During this time, each farmer could collect up to 2 kg honey each box valued Rs.700/-, resulting in a total return of Rs.21000/-

5.2 Mechanization Solutions for Tackling Labor Shortage

The COVID-19 lockdown impacted country's most vital agricultural enterprises, wheat harvesting and selling. As a result, seasonal agri labour migration inside the country has become impossible. Farmers began to notice significant issues with their wheat harvesting and post-harvest activities. The country's agricultural extension system looked at a variety of solutions to this problem, including making farm machines available to as many farmers as possible to ensure smooth wheat harvesting and post-harvest operations.

- **Case study -Doorstep service of farm implements during COVID-19 period**

Rajasthan's Jhunjhunu district has became hotspot and red zone towards the end of March, coinciding with the primary grain harvesting season. KVK Jhunjhunu encouraged these farmers to use "JFARM SERVICES" which provides free doorstep service of various farm implements to farmers during COVID-19 shutdown through WhatsApp group, messages, and other social media.

5.3 Innovative Marketing Initiatives

Disruption of marketing channels, particularly on the consumers' side, was one of the most conspicuous problems emerged in the lockdown due to the COVID-19 in India. Subsequent to the closure of retail shops for consumers the wholesale prices of perishables such as fruits and vegetables fell drastically. Agricultural extension system in the country acted promptly to safeguard farmers' interest by suggesting them innovative methods of marketing their produce.

- **Case study- Digital Marketing of GI-Tagged Alphonso: NICRA Village showed the pathway**

In Ratnagiri, Maharashtra, GI-tagged Alphonso is the only crop that generates foreign cash. Konkan sells over 50,000 tonnes of Alphonso mangos globally. During the March-April lockdown, harvesting and marketing of 'high value-high perishable' mango was a challenge. Mango exports were halted due to the closure of international shipping ports.

Conclusion

All economic activities and supply networks impacted as a result of the lockdown imposed during COVID-19. The direct and indirect effects of pandemic are likely to persist for more than two years. It has affected both food security and agriculture drastically due to travel restrictions,

social distancing, border closures and curfews. It has affected global exports & imports of agricultural goods, sowing to harvesting and supply chains like marketing of agriculture commodities from its place of production to the ultimate consumer. The current shortcomings in the agriculture industry necessitate structural reforms, technological adoption, and infrastructure investment. Investing in the food processing business will help the agriculture sector flourish. To response to the issues in the food supply chain, the infrastructure should be strengthened to make the food supply chain more flexible. So, as many pandemics may hit again, necessary strategies must be devised to combat their impacts on agriculture and food security.

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Beaver Fever: A Neglected Zoonoses

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Abstract

Beaver Fever is characterised by stomach pains, nausea, bloating, and bouts of watery diarrhoea. It is also known as Giardiasis. *Giardia* infection is caused by a micro parasite that is present all over the world, particularly in places with inadequate sanitation and contaminated water. The parasites have been detected in rural streams and lakes, as well as public water supplies, whirlpool spas, swimming pool and wells. Food and person-to-person contact can both spread *Giardia* infection. Infection is removed within few weeks. However, even after the parasites have been removed, affected person experience digestive difficulties. Several medications are usually successful against *Giardia* parasites; however, they do not work for everyone. The best defence is prevention.

Introduction

Giardiasis is a protozoal enteric infection caused by the protozoa *Giardia duodenalis*. It causes a greater incidence of gastrointestinal diseases (giardiasis, often known as beaver fever) around the world; health consequences include diarrhoea, which leads to malabsorption and restricted growth in children. It is a prevalent condition in low-resource settings and is characterised by flatulence and watery diarrhoea. Globally, an estimated 280 million individuals are infected each year, with 1.2 million new cases recorded in the United States each year. In the western Canadian province of British Columbia, 627 new cases are recorded each year on average (BC). The disease is most commonly observed in international travellers, wilderness travellers, and day-care employees in the United States. Patients may have strong enough symptoms to cause dehydration and weight loss, even though they are asymptomatic. The prevalence rate of *Giardia* infection in India ranges from 0.4 percent to 70 percent in diarrhoeic patient, and asymptomatic cyst passage has been shown to be as high as 50% in rural southern India (Laishram *et al*., 2012). The World Health Organization (WHO) has officially classified *Giardia* as a significant food-borne infection. The WHO's Neglected Diseases Initiative has also included giardiasis, with the purpose of offering more knowledge into protozoan biology, infection epidemiology, and host-parasite interactions (Tsui *et al*., 2018). Organism is flagellated and discovered by Leeuwenhoek in 1681.

Etiology

Giardia spp. are flagellated protozoan parasites that may affect humans and animals' gastrointestinal tracts. *Giardia intestinalis*, a protozoal parasite of the *Hexamitidae* family (order Diplomonadida), causes giardiasis. *Giardia lamblia*, *Lamblia intestinalis*, and *Giardia duodenalis* are all names for this bacterium. The organisms isolated from domestic animals, wild animals and humans appear to be identical; although, *G. intestinalis* might be a complex containing several distinct species or subspecies. Individuals are known to be the primary source of infection for other humans. *G. intestinalis* interspecies transmission has been observed, and zoonotic transmission is suspected. However, the significance of animal reservoirs for human disease is debatable. Other *Giardia* species can be found in birds, amphibians, reptiles, and rodents. There is no data that these organisms are zoonotic. *Giardia muris* has been detected in rodents, birds, and reptiles. *Giardia agilis* may be found in amphibians.

Giardia cysts may live in the environment for long periods of time in cool, wet environments and for several months in cold water. It has been demonstrated that they can survive in water for 1 month at 21°C and 2 months at 8°C. Some cysts may last for two weeks if freezing at –13°C. Desiccation and direct sunshine are both destructive to *Giardia* cysts.

Transmission

Transmission can occur in three ways: water, food, person to person. There are two stages of parasite: cysts and trophozoites. Surface waters are especially likely to be contaminated from faeces from both human and animal sources. Cysts may infect humans as well as wild and domestic animals. In the small intestine, ingested cysts release one or two trophozoites, that multiply and most of those dividing trophozoites are transported to the colon, where they encyst. When the cysts are passed in the faeces or shortly thereafter, they become infectious. Trophozoites can also be detected in the faeces of an infected human or animal, particularly diarrheic faeces, and can contaminate water or food. Anal intercourse is a mode of transmission among humans.

Among wild animals, the beaver has received attention as an important source of *Giardia* contamination. Beavers (*Castor canadensis*), a water-dwelling animal, have been related to giardiasis transmission via water. Since beavers can excrete cysts in faeces directly into surface sources of animal and human drinking water, including lakes, rivers, and streams, zoonotic transmission of *Giardia* from beavers to humans has been suggested (Erlandsen *et al*.,

1988). People become infected after ingesting *Giardia* and can carry the parasite in their body for several weeks to months.

Pathophysiology

The etiology of symptoms in giardiasis is unspecified. Trophozoites have a ventral cycle that they utilize to attach to intestinal epithelial cells. The protozoa, according to researchers, alter small intestine epithelial cell connections as well as brush border enzymes. Patients who are affected may have altered gastrointestinal motility. Thiol proteinases and lectins are released by the protozoa and have a cytotoxic impact. The combination of these actions improves permeability while decreasing saccharide processing ability.

Infection in animals, *G. intestinalis* can be found in many wild and domestic animals, including dogs, cats and ruminants. Infections are infrequent in horses and pigs. Beavers might be a source of contamination in rivers. Incubation period is 5 - 14 days. The majority of infections, especially in older animals, are asymptomatic. Acute, chronic or intermittent diarrhoea may be seen in some puppies and kittens. The clinical signs can include diarrhoea or soft stools, a poor hair coat, flatulence, and weight loss or failure to gain weight. The stools are typically light-coloured and mucoid, and may contain undigested fat. Blood is rarely seen. Similar gastrointestinal symptoms have been described in other species, such as calves and lambs (Campbell, 2016).

Diagnosis

Microscopic examination of the stool is the most established diagnostic technique and remains a valuable technique in the evaluation of the patient with diarrhoea or suspected giardiasis. Microscopy sensitivity can be enhanced by collecting three stool samples on different days. Because standard ova and parasite laboratory testing does not necessarily include *Giardia* testing, the CDC recommends providers to explicitly request *Giardia* testing when submitting stool samples. There are stool antigen detection assays and nucleic acid amplification tests (NAAT) available, which are often faster, more sensitive, more specific than microscopy. Because the differential diagnosis for giardiasis includes other parasitic diseases, microscopy should be done even if antigen or NAAT tests are positive.

Treatment

Metronidazole (Flagyl) is a drug that is used to treat giardiasis. It given in doses of 250 mg three times a day for 7 days for adults and 5 mg/kg three times a day for 7 days for children. Cure rates are in the range of 85 to 95%. Side effects are rare, but they may include: convulsions, confusion, hallucinations, rash, nausea, metallic taste, dark or cloudy urine,

vomiting, and drowsiness. Metronidazole has the potential to interact with alcohol dehydrogenase, an enzyme that breaks down alcohol. As a result, drinking should be avoided throughout therapy. **Tinidazole (Tindamax)** works as well as metronidazole and often treats giardiasis in single dose. It is given to adults as a single 2gm dose and as a 30 to 35 mg/kg single dose to children. It has side effects too. **Nitazoxanide (Alinia)** Because it comes in a liquid form, nitazoxanide may be easier for children to swallow for three days. Side effects may include nausea, gas, yellow eyes and brightly coloured yellow urine. **Paromomycin** has a reduced risk of causing birth abnormalities than other antibiotics, but pregnant women should avoid taking any giardiasis medicine until after delivery. This medication is given at 500 mg, 3 times a day for 5-10 days (Lebwohl *et al*., 2003).

Prevention

- Good hygiene, such as hand washing, can help prevent infection. It also keeps giardiasis from spreading to others.
- People suffering from giardiasis should avoid swimming in recreational water for at least two weeks after their symptoms have subsided.
- *Giardia* cysts are more resistant to chlorine treatment than other microorganisms, and outbreaks have been associated to polluted mains drinking water, paddling pools and swimming pools. Adherence to guidelines for swimming pool management reduces the risk of giardiasis to a minimum (Minetti *et al*., 2016).

Conclusion

It is a universal problem that affects individuals of any age but especially the young. Although *Giardia* often does not cause symptoms, diarrhoea is a common symptom, although patients may have less dramatic symptoms of dyspepsia or symptoms that mimic an irritable bowel syndrome. Although not a common cause of non-ulcer dyspepsia, it is eminently treatable. Microscopy or immunologic procedures in faeces, or microscopy of duodenal aspirates or duodenal biopsy specimens, are used to identify the organism. The disease is widespread enough to be considered a public health concern. An EIA is the most useful stool screening test. Endoscopy needs microscopic analysis of biopsies or a duodenal aspirate for diagnosis.

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Strategies to Reduce Feed Cost in Small Scale Aquaculture

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Abstract

Feed cost for small scale aquaculture is a major constraint. In a typical small scale aquaculture practice, aquafeed costs contribute around 60-80% of total production cost. Rising aquafeed cost has emerged as a bottleneck for small-scale aquaculture farmers, as they are having limited resources. Adopting appropriate feed management strategies is instrumental in ensuring that feed use is optimized and that the highest economic returns are available to the farmer of small-scale aquaculture.

Introduction

Due to the global expansion of aquaculture over the last six decades, there is an increased demand for processed feed and an increased cost of feed ingredients over the years. In the aquafeed industry, there is high volatility in the supply of major aquafeed ingredients like fish meal, fish oil, Soyabean meal, etc. In addition to these prices of aquafeed is affected by petroleum price and other transportation costs. All these factors finally resulted in the skyrocketing price of aquafeed.

Also, the profitability of aquafarming operations is of paramount importance to the farmer. Adopting appropriate feed management strategies is instrumental in ensuring that feed use is optimized and that the highest economic returns are available to the farmer of small-scale aquaculture (FAO, 2010). Hence there is an urgent need for research towards strategies to reduce the feed cost.

What is small-scale aquaculture?

Small-scale aquaculture (SSA) can be defined as; System involving limited investment in assets, some small investment in operational costs, including large family labour and in which aquaculture us just one of several enterprises or System in which aquaculture is the

principal source of livelihood, in which the operator has invested substantial livelihood assets in terms of time, labour, infrastructure, and capital. (Bondad-Reantaso et al ,2013)

Possible cost-cutting strategies for aqua feed used in small scale aquaculture

1. **Maximum Utilisation of natural food chain in aquaculture pond.**
   - To utilize the natural food chain at maximum, it needs to increase the productivity of the pond by fertilization. For price-cutting points, farmers can use organic manure locally available at a cheap price.
   - Natural food contains various types of phytoplankton, zooplanktons, microbes, yeast, and bacteria, which have unique vital ingredients for fish growth and development.
   - A thorough understanding of these complex dynamics is central to improving nutrient retention in the farmed species and the culture system, improving feed formulation, reducing feed costs, and improving the efficacy of feed management systems.
2. **Changing feeding patterns.**

Changing feeding patterns from the usual one can help to reduce feed costs. It includes

➢ Optimum feeding

Optimum feeding means giving feed according to fish requirements. For example, during early developments, fish needs more feed (6-8%body weight) than grow out ones (2-3%). So, farmers can reduce feed during the grow-out phase. During the winter season fish metabolic rate is reduced and usually takes less food. Hence farmers can reduce feed to the required amount.

➢ Mixed feeding schedules

Mixed feeding schedule means altering feed of 2-3 days of high protein diets with one day of low-quality protein diet without affecting growth rate and yield. It is also useful in the reduction of nitrogenous input to the system that prevents possible eutrophication in the pond. This strategy can also be useful in the reduction of feed cost without affecting the growth of fish and yield.

➢ Feeding on alternate days.

By feeding fish on alternate days, fish farmers can effectively cut feed costs in half while dramatically improving the feed conversion ratio (FCR) of the fish crop. This strategy helps to reduce feed cost along with organic loading around net pens and decreases the eutrophication that can occur with intensive marine aquaculture.(Bolivar, Jimenez, and Brown 2006)

It is possible that the improved performance attained by alternate-day feeding is a result of reduced feed waste, either through more complete consumption of or improved nutrient absorption from available feeds.Experimentation to date does suggest that there are limits to the degree that feeding can be reduced without compromising crop value, as a combination of the first two feed reduction strategies proved less profitable than either strategy alone.

3. **Use alternative feed ingredients locally available at cheap prices.**

While making farm-made feed small-scale farmers can utilize alternative feed ingredients locally available at cheap prices. There are various kinds of alternative feed ingredients like legumes, root crops, cereals and its byproduct, oil bearing seeds and their by-product animal origin.

4. **Use of locally produced feed or farm-made feed.**

Small scale farmers can use locally produced feed or farm-made feed which is easily accessible and affordable as compared to commercial feed.

5. **Improving farm-made fish feed by process of palletization.**

The farm-made feed can be improved by the process of palletization. Because palletization helps to

- Prevent leaching of nutrients
- Reduce pollution
- Add palatability
- Reduce FCR
- Reduce feed cost with optimum growth

6. **Use of technology and innovation in feeding practice.**

Small scale farmers can substantially reduce feed costs for long-term perspectives with a small investment in technology and innovation. Feed waste and feed costs can be minimized by the use of technology like

- **Automatic feeder**

  The automatic feeder has many advantages like It is inexpensive as compared to other methods of feed distribution and the fish feed can be applied to the pond system at suitable times by adjusting the feeder properly. It does not require any sophisticated components or expensive materials and will be reasonably simple to construct and operate.

- **Demand feeder**

  Demand feeders are controlled by the fish themselves according to their appetite. Some species of fish learn very rapidly to use demand feeders but they are usually unsuitable for small fish which are unable to operate them. The fish touch the rod connected to a plug or plate in the bottom of the feed hopper. This plug normally closes the hopper so that feed does not fall out. When moved by the movement of the bait rod, a small quantity of feed is released.

- **Use of Check tray**

  A check tray consisted of basically a net with a square or round iron frame with an edge height of not more than 5cms. The feeding tray usually has an area of 0.4-0.6 m2. The check tray is used to check the uneaten feed, health, and survival rate of shrimps and also to check the pond bottom condition.

7. Other strategies.

- **Installation of low-cost grinding mill, mixer, and pelletizer.**

  The farm-made feed can be upgraded to pelleted feed by small investment on the low-cost grinding mill, mixer, and pelletizer.

- **Installation of the small-scale feed mill.**

  Installation of small-scale feed mills can be done as a one-time investment by small-scale farmers to produce pelleted feed in large quantities.

- **Use of Feed formulation software**

  Making of a nutritionally balanced feed for fish required a balanced feed formulation for which feed formulation software can be used.

- **Semi-biofloc culture**

  The system is based on the use of mixotrophic organisms and the generation of biofloc. This system can be effectively used to reduce FCR and feed costs by efficiently utilizing the feed and animal wastage into nutrient-rich biofloc.

- **Integrated fish farming**

  This involves the integration of fish farming with agriculture, horticulture, and livestock culture. The system utilizes the nutrient efficiently and thus requiring less fertilization and feeding.

Conclusion

In developing nations, a small-scale aquaculture is an essential tool for creating food security and income-generating opportunities for the poor. By providing small-scale fish

farmers with alternatives to purchasing expensive feeds, it could help vulnerable populations combat the rising costs of fish feeds and ultimately to build pathways out of poverty for poor fish farmers throughout the world.

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Transgenesis: Catalyst to Improve livestock

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Abstract

For improvement of livestock production and human health care products, the advent of DNA recombinant technology and the possibility of gene transfer between organisms of distinct species, or even distinct phylogenic kingdoms, has opened a wide range of possibilities. Transgenic animals are routinely used in the laboratory as models in biomedical research. Over 95 per cent of those used are genetically modified rodents, predominantly mice. They are important tools for researching human disease, being used to understand gene function in the context of disease susceptibility, progression and to determine responses to a therapeutic intervention.

Introduction

Over centuries animal breeding practices were performed to improve the genetic potential of animals and to introduce new traits, through genetic selection. But the number of gene combinations achieved through this process has limitations, since breeding is only possible between animals of same or closely related species. Transgenesis is a revolutionary technology which introduces new genes to a species, which belong to an entirely different species. A **transgene** is a gene that has been transferred by any genetic engineering techniques, from one organism to another. The introduction of a transgene, in a process known as transgenesis, has the potential to change the phenotype of an organism. *Transgene* describes a segment of DNA containing a gene sequence that has been isolated from one organism and is introduced into a different organism. This non-native segment of DNA may either retain the ability to produce RNA or protein in the transgenic organism or alter the normal function of the transgenic organism's genetic code. In general, the DNA is incorporated into the organism's germ line. For example, in higher vertebrates this can be accomplished by injecting the foreign DNA into the nucleus of a fertilized ovum. This technique is routinely used to

introduce human disease genes or other genes of interest into strains of laboratory mice to study the function or pathology involved with that particular gene.

History:

- First transgenic animal was a "Supermouse" created by Ralph Brinster (U Pennsylvania) and Richard Palmiter (University of Washington) in 1982. Created by inserting a human growth hormone gene in mouse genome, offspring was much larger than the parents.
- In 1997, the first transgenic cow, Rosie, produced human alpha-lactalbumin -enriched milk at 2.4 grams per litre.
- A New Zealand research group developed a genetically modified dairy herd capable of producing 'medicinal milk' containing recombinant human lactoferrin (rhLF) by transgenic technology.
- In 2000, AgResearch generated their first transgenic cows. These cows produced modified or 'designer' milk. AgResearch's first transgenic cows had extra bovine (cow) kappa casein genes inserted in their genome. This resulted in increased kappa casein in their milk as the transgenic cow had their 2 naturally occurring kappa casein genes along with the inserted kappa casein gene(s). This research was the first proof that transgenic technology could be used to modify milk composition in cows.
- In 2001, two scientists in Canada spliced spider genes into the cells of lactating goats. The goats began to manufacture silk along with their milk and secrete tiny silk strands from their body by the bucketful. By extracting polymer strands from the milk and weaving them into thread, the scientists can create a light, tough, flexible material that could be used in such applications as military uniforms, medical micro sutures, and tennis racket strings.

Different steps in transgenic animal production:

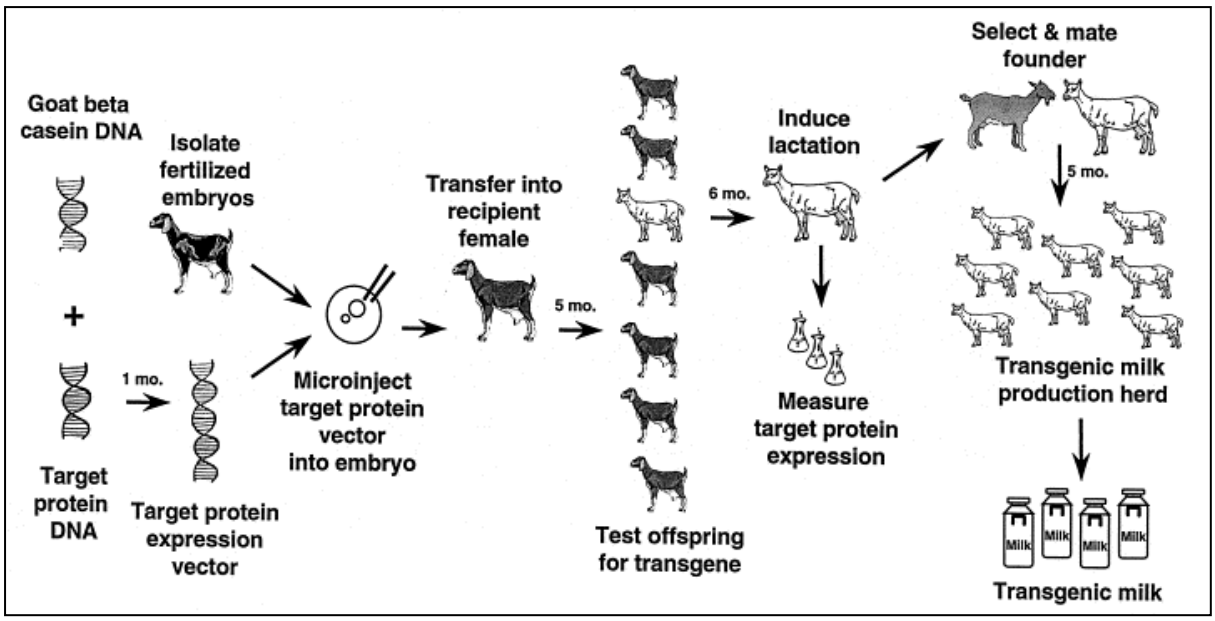
1. Gene of interest is isolated in a strand of DNA.

2. DNA is cut specific points by restriction enzymes. The enzymes recognize certain sequences of bases on the DNA strand and cut where the sequences appear.

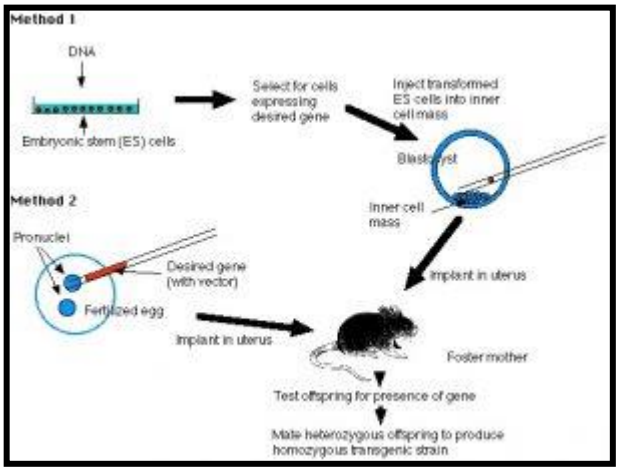
3. The cut DNA is jointed with a vector, which may be a virus (e.g.Retro viral vector) or a plasmid. The vector carries the gene of interest into organisms that will produce the protein.

4. When the genes are transferred in this way they get expressed in the desired organ of animals.

5. In addition to vector method, direct microinjection of nuclear material into invitro fertilized (IVF) embryos, and genetically modified embryonic stem cell transfer are effective techniques for transgenic animal production. Among these methods, transgenic animal production through stem cell transfer is very specific in locating the organ of desired action.



- **Embryonic Stem Cell-Mediated Gene Transfer:** In 1981, the term embryonic stem cells (ES cells) were used to denote a cell line isolated directly from mouse embryos while, the term embryonal carcinoma cells (EC) were derived from teratocarcinomas. Embryonic stem cells (ES cells) are harvested from the inner cell mass (ICM) of mouse blastocysts. They can be grown in culture and retain their full potential to produce all the cells of the mature animal, including its gametes as shown:



- Using recombinant DNA methods, build molecules of DNA containing the structural gene you desire (e.g, the insulin gene), vector DNA to enable the molecules to be inserted into host DNA molecules, promoter and enhancer sequences to enable the gene to be expressed by host cells.
- Transform ES cells in culture to expose cultured cells to the DNA so that some will incorporate it.
- Select for successfully transformed cells.
- Inject these cells into the inner cell mass (ICM) of mouse blastocysts.
- Embryo transfer.

- Prepare a pseudopregnant the stimulus of mating elicits the hormonal changes needed to make her uterus receptive.
- Transfer the embryos into her uterus.
- Hope that they implant successfully and develop into healthy pups (no more than one-third will).
- Test her offspring.
- Remove a small piece of tissue from the tail and examine its DNA for the desired gene. No more than 10- 20% will have it, and they will be heterozygous for the gene.
- Establish a transgenic strain
- Mate two heterozygous mice and screen their offspring for the 1:4 that will be homozygous for the transgene.
- Mating these will found the transgenic strain.

- **Retrovirus mediated gene transfer**

Transgenic mice produced by retroviral transduction of male germ line stem cells. Male germ line stem cells have ability to self-renew and genetic modification of these cells would help to study the biology of their complex self-renewal and differentiation processes and to generate wide range of transgenic animal species. A retrovirus is a virus that carries its genetic material in the form of RNA rather than DNA. Retroviruses used as vectors to transfer genetic material into the host cell, resulting into a generation of chimera (an organism consisting of tissues or parts of diverse genetic constitution). Chimeras are inbred for as many as 20 generations until homozygous (carrying the desired transgene in every cell) transgenic offspring are born. The method was successfully used in 1974 when a simian virus was inserted into mice embryos, resulting in mice carrying this DNA.

- **Nuclear Transfer Method**

In this method, the transgenic goats were produced by nuclear transfer of fetal somatic cells. Donor karyoplasts were obtained from a primary fetal somatic cell line derived from a 40-day transgenic female fetus produced by artificial insemination of a non-transgenic adult female with semen from a transgenic male. Live offspring were produced with two nuclear transfer procedures.

Oocytes at the arrested metaphase II stage were enucleated, electro fused with donor somatic cells, and simultaneously activated.

In the second procedure, activated in vivo oocytes were enucleated at the telophase II stage, electro fused with donor somatic cells, and simultaneously activated a second time to induce genome reactivation.

There was generation of three healthy identical female offspring. Genotypic analyses confirmed that all cloned offspring were derived from the donor cell line. Analysis of the milk of one of the transgenic cloned animals showed high-level production of human antithrombin

III. The nuclear transfer application may be more useful and beneficial for agricultural is the ability to efficiently produce a large number of identical offspring derived from a particular mating. Therefore, nuclear transfer using a embryonic cell lines derived from that mating maybe more attractive.

- **Transfection of Gametes**

The first transfection procedures occurred in the early 1960s and experiments with different cell types and tissues has now become widespread. Different transfection methods have been employed:

1. The in vitro procedure when foreign genes are introduced into cultured cells or tissues.
2. The in vivo method, when genes are directly introduced into the tissue (by injection, aerosol, etc).
3. The ex-vivo system, in which cells are transfected in vitro and then introduced into a living organism.

Gametes are incubated during short time periods in a solution containing the gene constructions and then they are checked for transfection, used for inseminations or for in vitro fertilization procedures. In several cases naked DNA was employed successfully, but DNA-Liposome complexes or electroporation procedures have been also used. In the case of the female gamete in vitro transfections using liposomes or retroviruses have been applied successfully. As well as, electroporation, high velocity microprojectiles or particle gun methods have been also employed. The localization of the foreign gene in spermatozoa has been done using fluorescent in situ hybridization, autoradiography or immunocytochemistry. After using the in vitro or in vivo transfection procedures high percentages (80%) of spermatozoa appeared transfected. These results usually showed that the foreign gene appeared into the nucleus of spermatozoa and molecular procedures (Slot-Blot, PCR, Southern Blot and gene sequences) have shown the presence of the transgene in the DNA of the gametes.

- **Artificial Chromosome Mediated Gene Transfer**

A group of nuclei injected with transgene DNA, the eggs are transferred in medium of incubation and visual evaluation within next few hours. An individual animal develops after receiving the transgene DNA is referred as founder of a new transgenic lineage. Also, Yeast Artificial Chromosomes (YACs) transgenic mice are generated by using pronuclear microinjection and represents latest generation of vectors which have the great advantage of large insert size. This method succeeded in mice and rabbits.

- **Testis cell transplantation method:** Testis cell transplantation method is shown in figure 2 and its steps are as follows:

(A) A single-cell suspension is produced from a fertile donor testis.

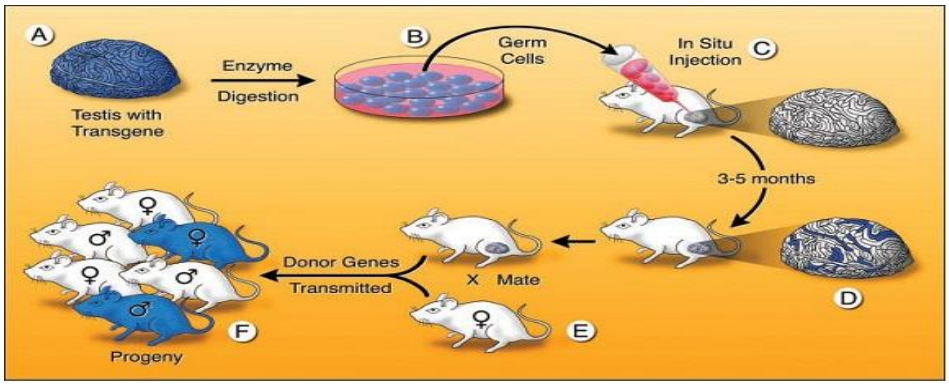
(B) The cells can be cultured

(C) Microinjected into the lumen of seminiferous tubules of an infertile recipient mouse.

(D) Only a spermatogonia stem cell can generate a colony of spermatogenesis in the recipient testis. When testis cells carry a reporter transgene that allows the cells to be stained blue, colonies of donor cell-derived spermatogenesis are identified easily in recipient testes as blue stretches of tubule.

(E) Mating the recipient male to a wild-type female

(F) Produces progeny, which carry donor genes.



Recent methods for production of Transgenic Animals

Lentiviral Transfer of Oocytes and Zygotes

This method is used to overcome previous limitations of viral mediated gene transfer, containing the silencing of the transgenic locus and low expression levels. Example including, generation of transgenic cattle by lentiviruses requires microinjection into the oocytes. Recently H. M. Sang from Roslin Institute has reported a different approach to overcome the problem associated with retroviral vectors. This study employed lentiviral based vectors. These vectors have several advantages compared to the conventional retrovectors in that they can infect non-diving cells, can carry large amounts of transgene ~ 10kb, and can show stable expression in the tissue where they are introduced. The technique was successful in showing about 100 fold increases in the level of transgenesis.

Chimera Generation by injecting the Pluripotent Cells

Embryonic stem cells with pluripotent cells have ability to participate in organ and germ cell production after injection into the blastocysts. Embryonic stem cells are important one for generating the gene knockins, large chromosomal rearrangements as well as gene knockouts. As like embryonic stem cell, the another type of cells such as primordial germ cells are used for production of no. of farm animals and chimeric animals without germ line contribution have been reported in swine.

Conclusion

Different methods are being used to produce transgenic animals which not only help in study of human disease but also to produce products from transgenic animal eg milk. Other than breeding, transgenesis is a revolutionary tool which form a totally different strain. It holds a great potential in many different fields like agriculture, medicine and food industry.

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Phytochemicals: promising alternative molecules to fight against SARS-Cov-2 infection

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Abstract

The current pandemic coronavirus disease-2019 (COVID-19) has spread as wild fire globally by severe acute respiratory syndrome novel corona virus 2 (SARS-CoV2) and is probably the most convulsive global event in the history of mankind. There is a lack of effective antiviral agents for many coronavirus strains. Naturally existing phyto-molecules in plants provide a wealth of chemical diversity, including antiviral activity, and thus may have utility as therapeutic agents that can fight against coronaviral infections. This communication provides an insight about various phytochemicals which possess anti-SARS-CoV activity. The most commonly available dietary sources which contain phytochemicals (flavonoids) like quercetin, chrysin, rutin, curcumin possess antiviral. Several studies confirmed the antiviral activity of these phytochemicals against enveloped viruses including present SARS-CoV- 2.

Keywords: COVID-19 (SARS-Cov2), phytochemicals, quercetin, antiviral

Introduction

SARS (CoV-2) which caused coronavirus disease-2019 (COVID-19) is one of the most serious pandemics with widespread morbidity and mortality witnessed globally. Till date there is no effective vaccination and cure against SARS-CoV-2 though few vaccines proved in the containment of deaths. The COVID-19 pandemic has underscored the limitations of the current pool of approved antivirals and has emphasized the need for further discovery and development of therapeutic and prophylactic agents. Developing antiviral drugs is a challenge for the scientific community and pharmaceutical industry.

Repurposing of existing antiviral, anti-inflammatory or antimalarial drugs is an alternative for controlling SARS-CoV-2 with drugs in the present situation of COVID-19 pandemic. Further plants have been utilized throughout human history for a variety of

ailments and are considered inexhaustible sources of novel pharmacologically active compounds against viral, parasitic and protozoan infections. Several phytochemicals and their derivatives have already been approved for both viral and non-viral disease states in recent past. The Ministry of Ayush (India) also started clinical trials for COVID-19 with four Ayurvedic herbs: ashwagandha (*Withania somnifera* (L.) Dunal), guduchi (*Tinospora cordifolia* (Willd.) Miers), yasthimadhu (*Glycyrrhiza glabra* L.), and pipli (*Piper longum* L.) (Ministry of Ayush).

Several natural products have shown anti-SARS-Cov 2 activities both *in vitro* and *in vivo*. Phytochemicals or phytonutrients are plant secondary metabolites produced by the plants which possess therapeutic effects and beneficial to humans in treatment of diseases. Extensive biological investigations have revealed a broad spectrum of pharmacological and physiological activities such as anti-inflammatory, antioxidant, and anti-cancerous that led to its use in the formulation of promising drugs for the treatment of different diseases (Zhang *et al*., 2015).

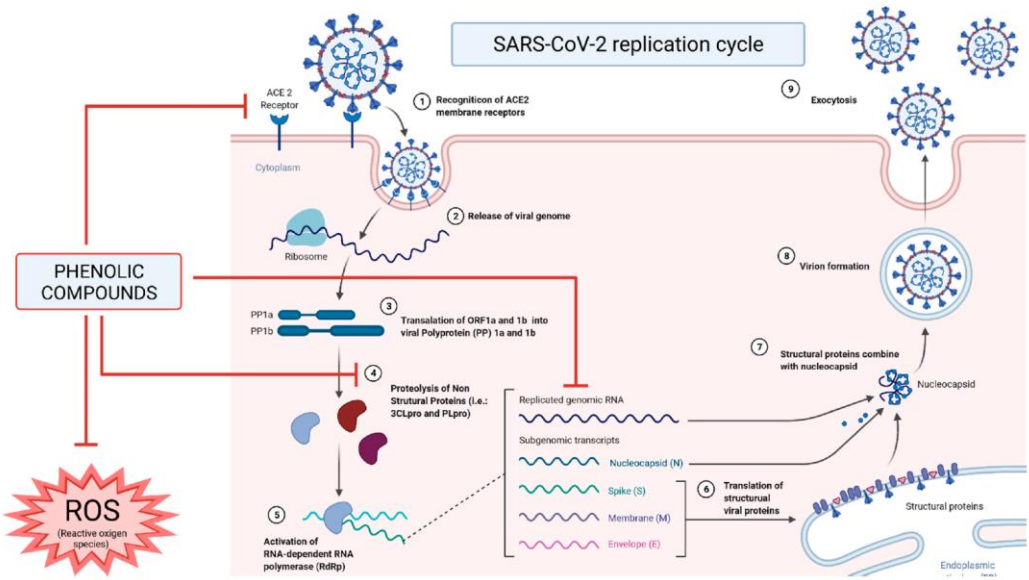

Figure 1. Mechanisms of action and inhibition of phenolic compounds against severe acute respiratory syndrome of coronavirus 2 (SARS-CoV-2) on its replication cycle and in the host's immune response (https://doi.org/10.3390/foods10092084)

The phytochemicals possessing antiviral properties include alkaloids, polyphenols, polysaccharides, flavonoids, lecithins, proteins, terpenes, lignans, coumarins, fructans, saponins, quinones, proanthocyanidins, steroids, thiosulfonates etc. Many of these bioactive compounds are known to active against MERS-CoV, SARS-CoV, and SARS-CoV 2 based

on their potential to destroy proteases of coronavirus structural proteins and polymerases essential for replication machinery of these viruses (Khaerunnisa *et al*., 2020).

SARS-Cov 2 binds to angiotensin-converting enzyme 2 (ACE2) on the host cell surface membrane via a viral spike protein that recognizes ACE2 (Ni *et al*., 2020). The major druggable targets of SARS-CoV-2 include 3-chymotrypsin- like protease (3CLpro), papain like protease (PLpro), RNA-dependent RNA polymerase, and spike (S) proteins (Wu *et al*., 2020). Based on current information on mechanism and disease cycle, various therapeutic targets were identified to develop effective treatments against this novel virus. Therefore, the present communication summarizes phytochemicals which are abundantly present in human diet and available in Indian subcontinent as a source of antiviral agents and brings insights in the potential application of phytochemicals and their derivatives, which could help researchers to develop safe drugs against SARS-CoV-2.

Primary mode of action for phytochemicals includes the inhibition of virus entry into host cell by binding with the specific receptor sites in targeted cells and/or halting the replication process of these viruses by destroying viral polymerases and proteases essential to perform important task in viral replication (Fig. 1). Phytomedicines have also proven to boost up immunity against novel coronavirus. The list of commonly available phytochemicals with their probable mechanism of action reported is presented in Table 1.

Table 1: Phytochemicals with potential as anti-SARS-CoV-2 agents

Sl.No	Phytochemical	Inhibition (Target in Virus)	References
1.	Apigenin	$3CL^{pro}$	Ryu *et al*., 2010
2.	Chrysin	Restrict viral entry	Bhuiyan *et al*., 2020
3.	Curcumin	$3CL^{pro}$	Wen *et al*., 2007
4.	Ellagic acid	RdRp inhibitor, TMPRSS2 inhibitor	Xu *et al*., 2021
5.	Gallic acid	RdRp inhibitor, TMPRSS2 inhibitor	Singh *et al*., 2020
6.	Glycyrrhizic acid	Virus replication	Hoever *et al*., 2005
7.	Hesperetin	$3CL^{pro}$	Lin *et al*., 2005
8.	Kaempferol	M^{pro}	Khan *et al.* (2021)
9.	Naringenin	M^{pro}	Abdallah *et al.* (2021)
10.	Quercetin	PL^{pro}	Abian *et al.* (2020)
11.	Rutin	PL^{pro}	Pitsillou *et al.* (2020)
12.	Saikosaponin B2	Restrict viral entry	Cheng *et al*., 2006

Conclusion

Plants provide a vast array of candidates for the treatment of COVID-19. Concerted efforts are needed to maximize resources, including phytochemicals, for the development of treatment agents for COVID-19 and other viral diseases to ease the blow of large viral outbreaks in the future. Phytochemicals are promising alternatives to fight against important viral diseases like SARS-Cov2.

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Indigenous Method of Panchagavya Preparation

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Abstract

Indigenous farmers have developed various techniques to improve or maintain soil fertility. Traditional practices of biological pest control have recently been the subject of increasing scientific interest among the people. Traditional farmers developed a multi storey farming system in which they practised fallowing, intercropping and selective weeding. Traditional agriculture is characterised by its great diversity of genetic resources. According to the basic principles of organic agriculture, livestock are kept as a part of the farming system and their nutrition has to be based on home-grown feeds. Cow was the central theme of Indian Agriculture which kept the production and productivity to sustainable levels. The cow dung, rich in favourable micro-organisms was the key fertilizer base which kept the ideal C/N ratio in soils. Thus, preparation of panchagavya which is one of the best organic fertilizers known by the farmers has been detailed.

Keywords: Panchagavya, organic fertilizer, indigenous method of preparation

Introduction

Panchagavya, an organic product has the potential to play the role of promoting growth and providing immunity in plant system. Panchagavya or Panchagavyam is a concoction prepared by mixing five products of cow. The three direct constituents are cow dung, urine, and milk; the two derived products are curd and ghee. These are mixed in proper ratio and then allowed to ferment. The Sanskrit word Panchagavya means "mixture of five products," and it has been used in traditional Indian rituals throughout history. It is also called as cowpathy treatment based on products obtained from cows used in Ayurvedic medicine and of religious significance for Hindus. Panchagavya is also used as fertilizers and pesticides in agricultural operations.

Raw Materials Required for Panchagavya Preparation

MATERIALS	20 lit of Panchagavya
Fresh cow dung	5 Kg
Cow's urine	3 litres
Cow's milk	2 litres
Cow curd	2 litres
Cow ghee	½ kg

Requirements: Plastic Barrel, Measuring Cylinder, Khada Cloth.

Preparation

- Collect fresh Cow dung, mix it with ghee and keep it in a plastic barrel separately for 3 days.
- On the same day, mix the other ingredients (Cow's urine, cow's milk and cow's curd) in a plastic barrel separately.
- On the 3rd day, mix the contents in a barrel and keep it 15 days.
- Stir the contents with a wooden stick twice a day.
- Cover the mouth of the barrel with the wire net or khada cloth.
- After 19 days, filter the product with a khada cloth / Terracotta (TC) cloth and store it in closed containers, (Pierce small holes in the cap of the containers to prevent Bursting).

Physico Chemical and Biological Properties of Panchagavya

Chemical Composition		Microbial Load	
pH	5.45	Fungi	38800/ml
Ec dsm2	10.22	Bacteria	1880000/ml
Total N (ppm)	229	Lactobacillus	2260000/ml
Total P (ppm)	209	Total anaerobes	10000/ml
Total K (ppm)	232	Acid formers	360/ml
Sodium	90	Methanogen	250/ml
Calcium	25		
IAA (ppm)	8.5		
GA (ppm)	3.5		

Physico-chemical properties of panchagavya revealed that they possess almost all the major nutrients, micro nutrients and growth hormones (IAA & GA) required for crop growth. Predominance of fermentative microorganisms like yeast and lactobacillus might be due to the combined effect of low pH, milk products and as substrate for their growth. The low pH of the medium was due to the production of organic acids by the fermentative microbes. Lactobacllus produces various beneficial metabolites such as organic acids, hydrogen peroxide and antibiotics, which are effective against other pathogenic microorganisms besides its growth.

Beneficial Effects of Panchagavya on Commercial Crops

Generally, Panchagavya is recommended for all the crops as foliar spray at 3 per cent level (3 litre Panchagavya in 100 litres of water).

Recommended Dosage

Spray System

3 per cent solution was found to be most effective compared to the higher and lower concentrations investigated. Three litres of Panchagavya to every 100 litres of water is ideal for all crops. The power sprayers of 10 litres capacity may need 300 ml tank. When sprayed with power sprayer, sediments are to be filtered and when sprayed with hand operated sprayers, the nozzle with higher pore size has to be used.

Flow System

The solution of Panchagavya can be mixed with irrigation water at 50 litres per hectare either through drip inrigation or flow irrigation.

Seed/Seedling Treatment

3 per cent solution of Panchagavya can be used to soak the seeds or dip the seedlings before planting. Soaking for 20 minutes is sufficient. Rhizomes of Turmeric, Ginger and sets of sugarcane can be soaked for 30 minutes before planting.

Seed Storage

3 per cent of Panchagavya solution can be used to dip the seeds before drying and storing them.

Periodicity of Foliar Spray

Pre-flowering phase	Once in 15 days, 2 sprays
Flowering and pod setting stage	Once in 10 days, two sprays
Fruit/pod maturation stage	Once during pod maturation

Time of Application of Panchagavya

Crops	Time schedule
Rice	10,15,30 and 50 DAT
Sunflower	30,45 and 60 days after sowing
Black gram	Rainfed: 1st flowering and 15 days after flowering Irrigated: 15,25,30,40 and 50ndays after sowing
Green gram	15,25,30,40 and 50 days after sowing
Castor	30 and 45 days after sowing
Groundnut	25 and 30 days after sowing

Effect of Panchagavya

Leaf

Plants sprayed with Panchagavya invariably produce bigger leaves and develop denser canopy. The photosynthetic system is activated for enhanced biological efficiency, enabling synthesis of maximum metabolites and photosynthates.

Stem

The trunk produces side shoots, which are sturdy and capable of carrying maximum fruits to maturity. Branching is comparatively high.

Roots

The rooting is profuse and dense. Further they remain fresh for a long time. The roots spread and grow into deeper layers were also observed. All such roots help maximum intake of nutrients and water.

Yield

There will be yield depression under normal circumstances, when the land is converted to organic farming from inorganic systems of culture. The key feature of Panchagavya is its efficacy to restore the yield level of all crops when the land is converted from inorganic cultural system to organic culture from the very first year. The harvest is advanced by 15 days in all the crops. It not only enhances the shelf life of vegetables, fruits and grains, but also improves the taste. By reducing or replacing costly chemical inputs, Panchagavya ensures higher profit and liberates the organic farmers from loan.

Drought Hardiness

A thin oily film is formed on the leaves and stems, thus reducing the evaporation of water. The deep and extensive roots developed by the plants allow withstanding long day periods. Both the above factors contribute to reduce the irrigation water requirement by 30 per cent and to ensure drought hardiness.

Conclusion

Panchagavya is an organic product that can be used as organic manure. It increases the immunity of plants to resist pests and diseases caused by them. The nutrient content of panchagavya helps in plant growth. It also contains vitamins, aminoacids, gibberellins and auxins which regulate the growth of plants.

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Application Of Nanotechnology In Animal Nutrition

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Nanotechnology has a wide range of applications in biological research, therapeutics, and environmental concerns. Nanotechnology is a new and growing technology with enormous potential to transform the agriculture and livestock sectors in India and around the world. Nanoparticles can carry a wide range of components in a variety of environments. The process of reducing these bigger molecules to microscopic ones alters the underlying material's inherent physical and chemical properties. Mineral antagonism in the intestine or at the cellular level in animals and livestock causes mineral imbalances in absorption, transit, and excretion. As technology advances to the Nanoscale, qualities change fundamentally and unpredictably in comparison to bigger scales. Nutrition, diagnostics, pharmaceuticals, biotechnology, vaccine production, chemical industries, and other sectors appear to benefit from such improvements. The end product of this technology includes unique qualities such as increased penetrability, reactivity, surface area, and quantum properties that can be used in a variety of scientific domains.

Nanotechnology is mostly used in animal/poultry nutrition in the form of Nano-minerals. This area is important because it improves trace mineral absorption by minimizing the antagonistic interaction between bivalent cations. This unique technique could be used in livestock and poultry nutrition to increase nutrient uptake and improve feed and supplement usage. Nanotechnology is mostly utilized in animal nutrition to prepare Nano-minerals, particularly trace minerals with low bioavailability. Furthermore, minerals in form of nanoparticles minimize intestinal mineral antagonism, resulting in less excretion and contamination. According to studies, feeding nanoparticles to livestock and poultry enhanced digestive efficiency, immunity, and performance.

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Properties of Nano minerals

Mechanisms of action

1. Longer chemical residence time in the gut due to nanoparticles tend to enhance the surface area for improved interaction with biological support
2. Lessen the impact of gastrointestinal clearance processes
3. Enable cells for efficient absorption
4. Effective distribution of functional substances to target areas and hence greater bioavailability
5. Penetrate deep into tissues via fine capillaries
6. Cross epithelial lining fenestration

Effect of Nano mineral Feeding on health and performance

Several studies have proved that feeding of nanoparticles improved the digestive efficiency, immunity and performance in livestock and poultry. In piglets and poultry, Nano ZnO has been demonstrated to promote growth and feed efficiency. Animals' immunity is improved by Nano Zn. Supplementation with micro ZnO resulted in a decrease in somatic cell count in a subclinical mastitis cow and an increase in milk production. In comparison to a standard dose of 15 ppm of organic and inorganic Zn, adding 0.06 ppm of Nano Zn to the broiler's basal diet will help in boosting immunity.

Nano Zn has also been observed to influence the fraction of volatile fatty acids generated in ruminants' rumen fermentation kinetics. In vitro, Nano ZnO supplementation improved ruminal microorganism growth, ruminal microbial protein synthesis, and energy utilization efficiency in the early stages of incubation. After calving, Nano antioxidants can help avoid retained placentas and other reproductive issues, as well as improve infertility.

Nanoparticles could be a viable alternative to antibiotics and could help keep diseases out of animal production facilities. In medicine and dentistry, silver is currently utilized to prevent wound infections and biofilm formation on catheters and dental equipment. Copper is frequently added to feeds because of its antibacterial characteristics as well as its potential to boost animal development and performance. Copper nanoparticles have been shown to pass through intestinal mucosa more easily than microforms, facilitating absorption. When compared to controls fed 60 ppm zinc oxide, Zhao *et al*. (2014) found that supplementing broilers with 20 ppm Nano zinc improved weight gain, feed efficiency, total antioxidant capability, and SOD and catalase activity. Ahmadi *et al*. (2013) found that supplementing broilers with zinc nanoparticles reduced LDL, TG, and cholesterol levels while increasing HDL levels. Uniyal, S. (2015) found that the group

supplemented with 20 ppm commercial zinc Nano particles had considerably higher overall gain and average daily gain than the other groups. When compared to control, Wang et al. (2009) found that supplementing the avian broiler with Nano Se (0.2 and 0.5 ppm) and sodium selenite (0.2 ppm) results in better daily weight gain and survival rate, as well as lowered feed conversion ratio, liver Se content, and GSH-Px enzyme activity. At particular inclusion levels, Joshua *et al*. (2016) found that Nano versions of zinc, copper, and selenium provided the best feed efficiency. Dietary supplementation of nano-Se at the rate of 0.3 ppm showed an increase in the final body weight and average daily growth in male goats. Supplementation of chromium (Cr) as chromium nanocomposite (CrNano) at the dose rate of 200 μg in finishing pigs reduced serum levels of glucose, urea nitrogen, triglyceride, cholesterol and non-esterified fatty acid. It also had appreciable effects on carcass characteristics, pork quality, skeletal muscle mass and increased tissue chromium concentration in selected muscle and organs.

Demand for dairy products has been steadily increasing. This is because milk is a good source of nutrients, and its use has an impact on people's health and well-being. It's vital to note that the amount of minerals (particularly micronutrients) in milk is determined by the number of minerals in the feed, that's why it is critical to utilize high-bioavailability preparations, such as Nano minerals.

So far several types of research on the use of Nano minerals in ruminant nutrition have been conducted. Those researches were conducted to see how Nano minerals affect animal health, digestibility of feed ingredient, and odor reduction (L. Shi *et al*., 2011). Rajendran *et al*. (2013) fed Nano-zinc to dairy cows and found that the usage of this Nano mineral lowers the number of somatic cells in cow's milk with subclinical mastitis. In these experiments, they also found that feeding Nano-zinc to dairy cows boosts milk output when compared to conventional zinc sources.

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Pig Farming- A Declining Remunerating Business in Assam

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Abstract

Animal husbandry and livestock sectors are crucial for rural livelihood development of a developing country such as India. Among the all-other domesticated species, pig farming or hog farming finds a new increasing demand in socio-economically weaker sections particularly in Assam and north eastern states due to its better potential to contribute in faster economic return to the rarer. In Assam pig is rear in urban area pig in intensive system and in rural as well as semi urban area pig rear in open system. Now a days, piggery farming get great importance because pig has highest fertility, highest fecundity, better-feed conversion efficiency, short generation interval and require small investment and low input.

Introduction

Animal husbandry and livestock sectors are crucial for rural livelihood development of a developing country such as India. India possesses one of the fastest growing livestock sectors, increasing agricultural domestic product. Among the all-other domesticated species, pig farming or hog farming finds a new increasing demand in socio-economically weaker sections particularly in Assam and north eastern states due to its better potential to contribute in faster economic return to the rarer. Pig farming requires low maintenance and exhibits inherent traits like highest fertility, highest fecundity, better-feed conversion efficiency, short generation interval and require small investment and low input. As per Livestock census 2019, total pig population of the state of Assam is 16,36,022 which is about 15.89% of total pig population of our country. Out of total population, 70% is traditionally raised in small farms. The share of meat production from pig is 18,730 tonnes against state's total meat production of 46,870 tonnes during 2016-17 while total requirement is 3,63,000 tonnes (Integrated Sample Survey 2016-17). There are 19 Breeding Farms under AH & Veterinary Department, Assam out of which 16 farms are functional. The objective of the "Pig Development Project for the state of

Assam (2019-2024)" is to increase the income of the Pig rearing farmer/ entrepreneur/ NGO/ Cooperative Society, etc. so as to achieve the Honorable Prime Minister's plan for doubling farmer's income. But proper implementation of the project is still missing. In nutshell, the pig earing is still unorganized venture that requires science and technological applications to make it rise in global market.

The total pigs in the country have been declined by 12.0% over previous Livestock Census (2012). The reasons might be due to reluctance by the entrepreneurs to start a hog farm because of socio-cultural inhibition and inadequate availabilities. But in the 20th livestock census it has increased by 28% which marks a positive rise of pig farming in Assam.With increasing demand for human feed hunger and changing trends of consuming meat, thereby, posing a great challenge for piggery industry to produce that bulky pork requirement. But the situation has even more worsened due to poor maintenance of the pig farms and low productivity per animal. Thus, to increase the pork meat production per animal, cross breeding with improved germplasm can be a key source to achieve the vision.Farmers in Assam fear threat to existence of local pigs in the state in the wake of spread of African swine fever (ASF) which has currently affected pigs in 10 districts. Doom, an indigenous breed, has a population of around 4,000 in the state. Their population is largely concentrated in Dhubri district though some of them can be found in Bongaigaon and Kokrajhar districts. It has been reported that around 5,000 of 15,000 pigs that had died across Assam were of Local breed. And as the effect of ASF has caused huge losses, so commercial farms have started rearing the exotic breeds due to their high productivity.

Management of pigs:

1. Housing Management:

Housing plays an important role in the production of a good number of piglets per sow and also in prevention of a large number of infectious and zoonotic diseases. The basic objectives of housing are – Providing a good working environment for the employees working in the farm, Providing a healthy disease-free environment for the pigs and the piglets and Integration of feeding, breeding, watering, and manure handling systems.

2. **Location of building:**

The pig sites should be directed towards North – South. The structures should be on a raised and well drained. Bedding material should be comfortable and light and protect the pigs against cold. The boundaries should be properly fenced. Adequate water supply must be ensured. Sunlight and proper ventilation should be provided.

Sl. No.	Name of farm and location	Functional/ Non-functional	Nos. of Animal at present	Land area (Bigha)	Animal Holding Capacity
1.	Base Pig Breeding Farm, Rani, Guwahati	Functional	83	15	80
2.	Dirpal Pig Breeding Farm, Gogamukh, Dhemaji	Non functional	Nil	22	10
3.	Small Pig Breeding Farm, Khanikar, Dibrugarh	Functional	37	111	36
4.	Govt. Pig cum Poultry Farm, Diphu, Karbi-Anglong	Functional	42	122	110
5.	Sonaigaon Pig Breeding Farm, Udalguri	Functional	23	10	18
6.	Govt. Pig cum Poultry Farm, Sontila	Functional	64	35	100
7.	Pork production cum Pig Breeding-Farm, Dongkamoham, Karbi-anglong	Functional	80	25	100
8.	Pig Shed Farm Production Project, Chotto-Lakhindong, Karbi-Anglong	Functional	24	100	50
9.	Pig Breeding Farm cum Demonstration Farm, Sonapur, Kamrup	Functional	39	5	36
10.	Pig Breeding Farm, Bhatarmari, Kokrajhar	Functional	24	5	20
11.	Govt. Pig Farm, Kathiatoli, Nogaon	Functional	36	122	100
12.	Nucleus Base Pig Breeding Farm, Morigaon	Functional	36	34	80
13.	Base Pig Breeding Farm, Bajalbari, Jorhat	Functional	24	3	24
14.	Kuchdhowa Pig Breeding Farm, Goalpara	Functional	12	50	30
15.	Kapahtoli Pig Farm, Halowating, Sivasagar	Non functional	Occupied by CRPF, stock shifted to Pig Farm, Khelua	5	12
16.	Govt. Pig Farm, Gargaon, Sivasagar	Non functional	Damaged	13	24
17.	Base Pig Breeding Farm, Khanapara, Guwahati	Functional	30	-----	38
18.	Pig Farm, Khelua	Functional	62	7	120
19.	Pig Farm, Denyangmukh, Dima Hasao	Functional	24	7.5	30

3. Building systems

Three types of building systems are employed specifically –All in one / Birth to market building system – During all phases of their life span, the pigs are enclosed within one building system only. It requires low maintenance and it is budget friendly too. But the major disadvantage of this system is that there's high prevalence of infections, two – building plan – Two types of buildings are included under this plan: farrowing shed and the growing and the finishing shed. The piglets aged between birth to weaning remains in one building and the adult ones are then later on shifted to another building and three building system – Three types of buildings are included under this plan: farrowing shed, growing and finishing shed. It is the best system to prevent infections but it requires high maintenance.

4. Environmental requirements of pigs

Temperature – It gradually decreases with age. New born piglets require 30-35°C whereas growing pigs require 18-22°C and adult pigs require 16-20°C, Humidity – Humidity above 85% is considered to be critical for pigs. The optimum humidity range should be between 60-80% and Ventilation – Three types of ventilation can be followed: (a) Natural and roof ventilation (b) Forced draft ventilation (c) Exhaust ventilation

5. Constructional details –

Floors: Should be sloping and easy to clean. Three types of floors are used – solid, partially slotted and totally slotted. Solid floors are made of concrete but manure handling is difficult in this system. In Partially slotted floors, a little bit of cleaning is required whereas totally slotted floors do not require manure handling, Walls: Height of wall should be between 0.93 to 1.22 m, Roof: Can be made of asbestos sheets, tiles or corrugated sheets and should be a bad

conductor of heat and Doors: Width should be 75-90 cm and height 90 cm. Can be prepared from metal rods.

Management of different categories of swine:

1. **Care and management of pregnant pigs:**

Proper nutrition and ration should be provided. Records of farrowing date from the date of breeding should be maintained properly. A separate, non-slippery and clean sty with non-slippery floor should be provided for farrowing. The amount of feed given to the pregnant sow should be increased during 70-90 days of gestation. Proper bedding should be provided with chopped straw under the covered area. Deworming must be undertaken for the pregnant females 2 weeks before farrowing.

2. Care of sow at farrowing time:

The farrowing sheds should be cleaned and disinfected properly. Should be kept vacant for week. Amount of ration should be reduced by 1/3rd till farrowing. Withdraw feed 12 hours before farrowing. Fresh drinking water should be accessible.The sow must be kept comfortable at a temperature below 24°C.

3. Care of sow after farrowing:

The sow must be cleaned with lukewarm water as well as should be given to suckle her young ones. Oxytocin injection must be given in case there is no letting down of milk. Her first meal after farrowing must be given after 12 hours and the ration must be as earlier, i.e., bulky. Ration amount must be increased 200-300 g daily until she is fully fed. Regular monitoring of sow's rectal temperature in the first 2-3 days is important. Sows must be kept under cooler conditions. The udder and teats of sow should be dry and swabbed with a saturated solution of ferrous sulphate, zinc sulphate, and copper sulphate to prevent piglet anemia.

4. Care and management of gilts and sows:

Flushing (feeding liberally) should be carried out 2-3 weeks before breeding. Heat period of sow lasts for 2-3 days and should be bred on the second day of heat. Their breeding ration must

contain 16% crude protein, cereals and oil cakes along with adequate proportion of vitamins and minerals. The breeding shed temperature should be maintained at a lower temperature of 16° C.

5. Care of piglets at birth:

The breathing passage of the piglets must be cleared. The piglets must be mucous free and dry.

The navel cord must be cut at a distance of 2.5 cm away from the body with sterilized scissors, cord clamp should be applied and disinfected with tincture iodine. After farrowing, the piglets must be transferred to a warm area of about 25-30° C temperature. Bedding material must be clean, dry and hygienic. New born piglets' temperature must be maintained by providing infrared lamps. After 4-5 days, temperature is lowered to 26-29° C by raising the height of lamps.

6. Care and management of suckling pigs:

The 'needle ' teeth should be clipped so not to cause injury to the sow. Identification of piglets is important. It can be done by painting with silver nitrate solution and later by permanent marking methods such as tattooing or ear notching. To prevent piglet anemia, iron dextran injection should be given on the 4th and 14th day. At only about one and a half weeks old, they start nibbling feed. When they reach the second week, dry feed consumption can also be provided. Those male piglets not required for breeding are castrated at 2-3 weeks of

age.Conventional weaning can be done at 8 weeks or early weaning at 4 weeks or split weaning before 4 weeks can be adopted.

7. Care and management of young stock:

Birth weight of the piglets must be recorded. Record of their weekly body weight must be maintained properly too.

Deworming must be done at 5-6 weeks old age and again one month later. Ectoparasitic infestation should be controlled and eliminated. Vaccination against important diseases must be undertaken at regular intervals.

Vaccination schedules of Swine –

Diseases and Vaccine	Age	Dose and Rout	Duration
Swine fever (Freeze dried vaccine)	3-6 weeks	1 ml I/M	One year
Swine Erysipelas	2 months	1ml S/C	One year
FMD (Tissue culture Vaccine	2 months	2 ml S/C	One year
Brucellosis	2 months	2ml S/C	Life Long
Swine Influenza	At any stage	1 ml S/C	6 Weeks

Source: Vaccines for Veterinary application. Peter A.R. (2006)

8. Care and management of growing and finishing pigs:

The males, females and castrates can be fattened for meat purpose. Upto 15 pigs can be put together in a pen. Coolers can be provided during summers. Separation of poor growers can be done at the earliest. Deworming must be done at a regular interval of 2 months.

Expected live weight gain per month

Age in months	Live weight (kg)
1st month	4
2nd month	10

3rd month	20
5th month	50
7th month	85
9th month	120

9. Care and management of boars:

Should be at least 10-12 months of age before put to service. Boar: sow ratio must be 1:20. Each boar should be housed separately and provided with 1.5-2.2 square metre of sleeping area. Optimum number of services for boar is 2-4 per week. Hand mating should be generally practiced. Coolers must be provided during hot weathers If temperature exceeds above 27°C, mating in early morning or late in the morning must be done. Breeding areas must not be provided with slippery floors. Fertility checkup routine must be maintained. Must be dewormed before breeding.

10. Pig breeding:

Selection of Breeding stock:

Breeding of indigenous (Local) pigs with other exotic or improved breeds depends on the production of pig's population of the country. The local pigs are less prolific but well adapted to local environment and production systems. Indigenous pigs are small in size, poor in litter size, birth weight, daily weight gain, carcass weight and feed conversion efficiency. Fancy traits like coat color and other traits of least importance can be avoided during the selection procedure of the breeding stock. The animal should be free from disease and physical defects or any genetic defects. The piglets should be healthy and should be related to each other. Selected piglets should be away from sows which is consistently farrowed and weaned large litters (More than 8) and have reached market weight in minimum time.

Selection of the Boar:

Male piglets should be preferably one month older than that of the female. The selected boar must be an offspring of a better producing gilts and should have a good pedigree history.

Boar should have a good testicular development (Two equal sized testicles) with good temperament and docility. It should express good performance traits required for breeding. The piglets should have sound and strong feet and legs.

Selection of Sow/Gilt:

Sow must be selected from other pigs having good mothering ability with quite behavior. Sow should have well developed udder with 12-14 functional teats and at least 6 teats in each row evenly distributed on belly side. The gilts should have adequate length and depth of the body, thick, well-muscled hams and should have a prominent neck. The sow must be ready for repeated breeding after the end of lactation. The sows must have sound feet and legs. The sow must be free from all abnormalities.

Mating:

The average length of estrous cycle is 21 days (18-24). The length of the estrous period is 2-3 days. During estrous, the female shows following as heat signs: Frequent urination, low appetite, erection of ears and restlessness. Characteristic grunt or roar associated with heat. Swelling, reddening of vulva and mounting on pen mate. Valvular discharge and immobility (Standing reflex) when normal pressure is applied on the back. Allotted boar should be placed on either 2nd or 3rd estrous cycle. Best time for service is 2nd half of the 1st day and 2nd day of heat. The female should be double served at 10-12 hours interval and boar should be taken out from the female room. Mating can take 3-7 minutes. The gestation period is 114 days and can be rebreed after 1 month of the weaning by avoiding post-partum heat. The boar can be effectively used up to 18 months of age while female can be replaced after 4th farrowing. The normal boar: sow ration is 1: 15-20 sows

One commonly used method for mating without boar is the Artificial Insemination, a process in which semen is collected from male animal, processed in the laboratory and finally introduced to the sow under heat with the help of instruments for the purpose of making female animal pregnant. The best time of insemination in pig is after 4-6 hours of showing standing reflex (immobility) when normal pressure is applied at the back. Second insemination is successive after 10-12 hours of the first.

Marketing:

The demand for pork meat in assam is indefinite and the meat plays a major part in catering to the demand. Pork has its own high economic viability and pork business can be started with very low investment. During the festival times, the demand for meat rises up to 7 folds so pig farming can be proved as profitable business in Assam. Moreover, hog farming has created employment as a supplementary activity to the youth of Assam.






Conclusion

Pig farming business is no doubt can prove to a profitable market in Assam. However, there is a huge gap between the demand and production which need to be lesser for better and blissful future. Stakeholders of pig farming should develop serious concern to aware about its success to financially deprived sector of the society. The region's protein requirement cannot be fulfilled only by the common sources. As a result, pork processing and production has huge demands in the state. Pork is still a dominant meat among the economically and socially deprived communities under intensive management. Therefore, there is a huge scope of pork meat business in Assam. So conservation of different pig breeds can serve as a very important economic asset globally.

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Clean Milk Production: A Wide Role in Livestock Production & Management

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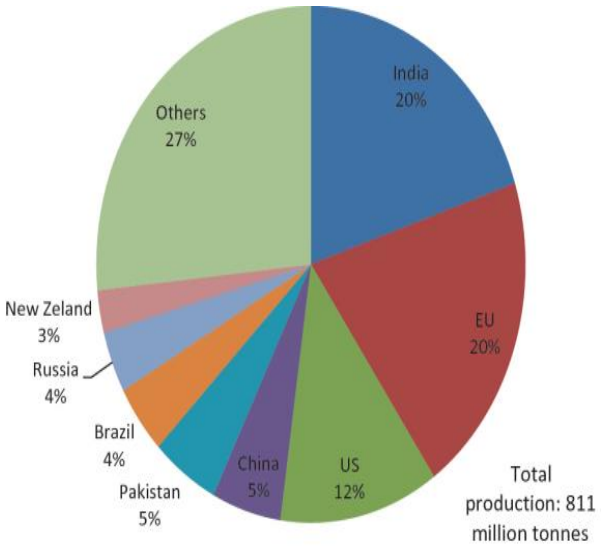
The milk quality is examined by aspects of composition and hygiene of milk, where management of healthcare, breeding, feeding, fodder production, and many such facts mainly influence the compositional quality. India stands on the first rank in milk production in the world. India contributes 20% of the total milk production in the world. The annual production of milk in India is 198.44 million tonnes (BAHS, 2020-21) with annual growth of 5.69 % over the previous year. The per capita availability of milk in the country was 176 grams per day in 1990-91 which has increased to 406 grams per day in 2020-21 whereas the recommendation of ICMR is 280 gm/day/capita. This article was conducted to know the level of knowledge and practices of dairy farmers regarding clean milk production.

Clean milk: Milk obtained from healthy milch animal, having a normal taste, containing permissible limits of bacteria and essentially free from adulterants, pathogens, various toxins, abnormal residues, pollutants, and metabolites, such milk is called as clean milk.

Clean milk production and its importance: milk is normally sterile when it comes from udder of healthy animal. It is highly nutritious and contains protein, lipid, lactose, mineral etc. due to its susceptibility to microbial as it serves as an ideal medium for rapid proliferation of harmful micro-organism. Therefore, there is need to protect it from all possible sources of contamination.



Milk demand-supply		
Year	Total milk production (Million tonnes)	Per capita availability (gm/day)
2010-11	121.8	281
2011-12	127.9	289
2012-13	132.4	296
2013-14	137.7	303
2014-15	146.3	319
2015-16	155.5	333
2016-17	165.4	351
2017-18	176.3	370
2018-19	187.7	390
2019-20	198.4	406
2020-21 (Provisional)	209.95	-

(Source: Basic Animal Husbandry Statistics, 2021)

Sources of milk contamination: milk contamination can be broadly categorized into internal and external factors.

Internal factors

- Udder mastitis or udder tuberculosis can lead to contamination by several micro-organism.
- Many infectious disease agents are also secreted in milk when animal get diseased with them, hence to produce clean milk production it is must to maintain good animal health.
- Foremilk of animal i.e., first few streams of milk may have a higher bacterial load as a result of bacterial that enter the udder through the teats so care must be taken to discard first few milk.

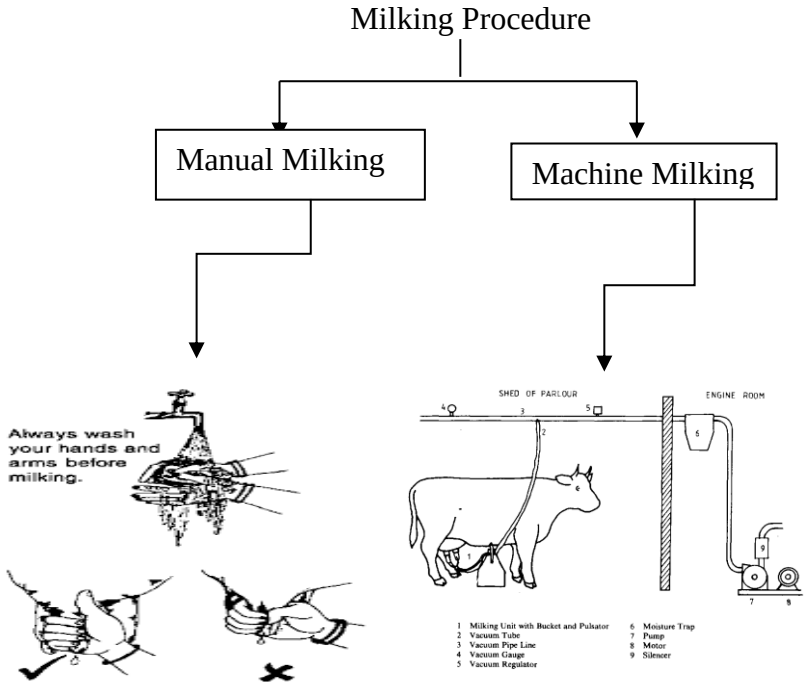
External factors

- Milker hygiene is important as milker should be healthy and equally should have good habits.
- Milk storage facility and utensils should be clean and dry
- Method of milking: feed and water used in daily routine should be clean, properly stored and easily accessible to animals. Feed ingredients should be stored in moisture-free conditions and should be free from industrial and environmental contaminants, pesticides, insecticides, fungicides, fumigants, aflatoxins as well as heavy metals.

- Milking environment should be dirt/dust free and mosquito/flies free. Regular washing and cleaning of milking parlour should be done routinely with proper disinfectants.

Unwanted changes in milk by pathogens

1. *Streptococcus liquifaciens* causes rapid milk coagulation and protein decomposition at low acid levels of milk due to renin.
2. *Bacillus coagulosus* and *Bacillus collidolactis* are heat-resistant bacteria that survive in pasteurized milk and grow at high temperatures and coagulate the milk.
3. The *E. coli* bacterium creates an offensive taste and a sticky layer.
4. *Pseudomonas fragi*, *Pseudomonas fluorescence*, *Achromobacter lipolyticum*, *Achromobacter lipidus*; are bacteria that break down fats and cause undesirable colors in the milk.
5. Milk and milk products contain yeast and molds which produce acid and gas.



Benefits of producing clean milk

1. Protection against milk-borne diseases.
2. Safe for human consumption.
3. Better keeping quality.
4. High commercial value.
5. Helps to produce good quality dairy products.

6. Ease of transport over long distances.

Management Practices for Production of Clean Milk:

1. Dietary Management

Good nutrition affects the quantity and quality of milk. Dusty and very fine food should not be given during milking. Milch animals should be fed one hour before milking. Silage and wet crop residues should not be put at the milking site as they may give a foul smell to the milk. The animal feed should be free from anti-nutritional factors and toxins. The feed used for milch animals should be free from a fungicide, herbicide, insecticide, fumigant, heavy metals, etc. Minerals, or supplements, should be determined by the other component of the diet. Vitamin E and Selenium must be added to the feed of milch animals.

2. Habitat Management

Animal house should be ventilated. Bedding materials such as sand or sawdust should be laid in cold weather or damp or swampy floors. Wall cracks in the animal house should be filled. Tie the animals at such a distance that they cannot lick each other. Each animal should be provided with enough lodging area in the shed. The animal house should have a proper drainage system. The collection of urine in the pit should be outside the animal house. Animal dung should be collected and disposed of away from the animal home. The animal house should be cleaned daily. Before milking, the milking area should be completely cleaned.

3. Health Management

The milch animals should be regularly examined by the Veterinarian against tuberculosis and brucellosis diseases. Milking animals should be regularly vaccinated against the foot and mouth disease, strangulation disease, and brucellosis. Animals suffering from infectious diseases should be kept separate from healthy herds. Appropriate dry cow therapy should be promoted in dairy farms. Inappropriate or prophylactic use of antimicrobial agents should be minimized. Coliform counts on bulk milk tanks should be done regularly to check for fecal contamination of milk. Animals should be sorted based on the animal body's condition score. Swelling of udders should be detected based on counting the number of somatic cells. An udder quarter is considered healthy if it has a Somatic Cell Count is less than 100,000 cells/ml and if free of mastitis pathogens.

4. Post milking care

Raw milk quality encompasses criteria relating to composition (fat, protein, lactose, milk solids etc.) and hygiene (total bacterial count and SCC). If the post milking care is not done

carefully then the benefits of producing clean milk will not be available. The animal should stand for at least 15 minutes after milking. To maintain the quality of milk, it should be cooled to a temperature below 5 °C in the refrigerator as soon as early possible. The sooner it is cooled after milking, the better its quality. Cooling the milk within 2 hours of milking slows the growth of bacteria. The distribution of milk to the consumers should be regular.

Challenges in the production of clean and safe milk:

1. Lack of technical knowledge about clean milk in the farmers.
2. The specialty of Indian dairy is that most of the producers here have 1-3 milch cattle which is a village-based activity.
3. The quality of the milk produced is compromised due to the lack of adoption of hygienic milk production practices.
4. Dairy innovations are not adopted on a large scale by dairy farmers due to a lack of extension services.
5. India has a unique pattern of milk production, processing, consumption, and marketing which cannot be compared with any developed country.
6. Ignoring the pricing policy of milk in India.

Conclusion

At present clean milk production has not been fully adopted by the milk producers. Most of the farmers have a moderate level of knowledge and adoption in various aspects of the clean milk production system. There are many flaws in our management policy for clean milk production which should be considered and rectified. Efforts should be made to convince dairy farmers to adopt clean milk production. Clean milk production should be motivated through organizing training and demonstrations at the field level. The public should be made aware of the health hazards associated with contaminated and raw milk so that consumption of unhygienic raw milk can be avoided. Local livestock development officers, livestock supervisors, and extension workers should make efforts in this direction. Also, clean milk should be marketed efficiently at a good price.

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Difference between A1 and A2 milk: Risk of A1 milk

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Abstract

Milk is a primary source of nutrition for infants after the birth and also for human beings. Generally, milk is either from humans (women) or from cattle origin they contain various types of proteins, vitamins, minerals and so on. Components in milk show various beneficial actions in beings and some of the studies found that metabolites of it show severe adverse effects like SIDS in the case of infants, gastrointestinal problems, cardiac problems and some other life threatening effects. They are various types of milk based on some strategy, not all categories of milk do cause harm but based on genetic variation in their chain shows its cause action, ,why this change has occurred in milk among them and action of the dangerous metabolites is explained In conclusion, the role of β-casomorphin in physiological functions remains controversial and more research with improved diagnostic techniques is needed to unravel the mechanism and study physiological functions of β-casomorphin and variation of the cow breads in world.

Keywords: SIDS, Casian, GLUP-2, BMC-7

Introduction

Humans depends on milk of cow mostly when we compare with that other being in early 19th century some of the researchers has found that some substance in milk which is from cow is causing problems to the human beings later in the end of 19th century some other analyst has found that milk is of various categories among them some commonly A1 and A2 is observed and they are mostly consumed by humans when we compare this two types of milk main difference between this 2 variants are position of amino acids in their chain. Mostly A2 milk breed cows are found in Asia mainly in south-east Asia especially in India and few regions of African region and A1 breed are found in the European, American and some others coming to the action of them when

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the milk is taken generally its gets break down into proteins and in case of the A1 milk in children causes SIDS and also some others chronic disease whereas the A2 milk from the Indian spices do produce but they gets hydrolated when it compares in this aspects A1 do possess 4 times higher than that of the A2.[1] A1 milk is produced by Holstein Friesian, Karan swiss, jersey and some other breeds which are common in European, American, Australia and A2 milk are produced by bos-indicus breed cows like Sahiwal, gir, red sindhi and some other.

Studies has found when milk is consumed orally they gets metabolized and gets fragmented into the pieces and it get absorbed into the cells some among them are not harmful whereas some of them are with the potentiality to cause harm such as beta-casomorphin which is a seven numbered amino peptide which is mostly formed due to the A1 milk actually this happens due to some special enzymes which cut them from normal chain but in case of A2 this does not happened [2] actually this metabolites action has found recently because previously experimental studies has been done on the rabbits, rats and so on but that in most of the animal studies, BCM-7 was not administered orally, as humans would be exposed to it, but rather was given to animals by injection into spinal cord or brain and in sometimes even directly into peritoneal cavity , this makes studies not supporting for understanding how BCM-7 might affect humans. BCM-7 can also be created during the process by which cheese is made or fermentation of milk; those same processes can also destroy BCM-7.

Some demographics studies have confirmed that consumption of A1 milk leads to some effects like diabetes mellitus type 1, arteriosclerosis, coronary heart disease, schizophrenia and some other conditions.

Formation of BMC-7

When milk is consumed it goes into the stomach and there it breaks into fragments of proteins and amino acids they are absorbed into the intestine when we compare with various types of milk that are A1, A2, and humans. when we compare difference between A1 and A2 variants the position of amino acids in their chain is change that is in case of A1 67th place there will be histidine and in case of A2 proline will be where as humans and A2 milk will be almost same and they don’t show any changes whereas A1 milk is taken into account they gets converted into the BCM-7 [3] which is a very potent substance.

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Impact on Diabetes mellitus type 1

DMT1 is an insulin dependent diabetes mellitus in this case insulin is not produce in the body It may be due to the destruction of beta cells of the pancreas actually pancreas is the main gland in the production of the insulin to maintain the sugar levels in the body.

In the case of A1 milk, the product which is formed that is BMC-7 which is an opioid it shows the cross reactivity with that of the epitope of the pancreatic beta cell glucose transporter GLUP-2 as autoantibodies to GLUP-2 it leads to the destruction of beta cells of the pancreas. Whereas in the case of the prediabetic patients it causes some gut-related immune response and causes damages in some conditions it can treat with an opioid antagonist (naloxone). [4]

Impact on SIDS

Sudden infant death syndrome is a condition in which infants of below 12 months will death in their sleep it may be due to apnoea or may be related to apparent life-threatening events like the change in skin color, coughing, gagging. Actually, the reason behind this is BCM-7, a peptide which is having an amino acid sequence of Tyr-Pro-Phe- ProGly-Pro-Ile are primarily depraved by DPP4. DPP (dipeptidyl peptidase 4) is a protease that removes the N-terminal dipeptide from that of the peptides containing a Pro or Ala at the second position.DPP-4 is expressed on T lymphocytes.[5] [6]

A study on infants confirms that infants with life-threatening apnoea had markedly elevated BCM-7 levels whereas the DPP4 activity is lowered when it is compared with normal healthy infants [7] [8].

Impact on gastrointestinal tract

In most of the GI cases, BCM-7 acts as the μ- opioid receptor agonistic this causes the gastric motility, releases of hormones, constipation and so on. Some studies has said that BCM-7 causes the destruction of the gut immune system by damaging the lamina propria lymphocytes however this study has been opposed by some investigators**[**9**],[**10**],[**11**]**

BCM-7 shows the immunoreactivity towards the immunoglobulins-IgE, IgG. Recently few studies in 2014 have identified that immunoreactivity of the BCM-7 cause Food protein-induced enterocolitis syndrome (FPIES) [12] [13]

Recently in 2014, a study was conducted in order to identify the role of IgA and TGF-beta

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specific to casein into milk a gastrointestinal hypersensitivity disorder in children. The study showed the minimal titer levels for IgG and IgA and absence of TGF-beta levels stating tGF beta as a possible biomarker whose lowering levels may indicate the person being affected by (FPIES). [14]

Impact in case of atherosclerosis

Effects of the A1 & A2 milk in human actually this study has been conducted in rabbits where the A1 milk has fed to some rabbits and A2 milk is given to some group of rabbits later reports has shown that the rabbits which have been fed with the A1 milk have shown fatty contents on the walls of blood vessels which may progress and causes severe cardiac problems like angina and etc. Whereas the A2 milk has does not shows such effects. A1 milk also has the potentiality to increase the number of low-density lipoproteins and to decrease the number high-density lipoproteins which is referred as the good cholesterol. Fatty traces are made up of foam cells while in the case of normal atherosclerosis develop from macrophages that have taken up ox-LDL. [15] In a damaged vessel.

The devouring of beta casein leads to aggravation of symptoms related to the autism and schizophrenia.[16]–[17] but These effects were imputed by the opioid activity of BCM-7 and to oxidative stress,[18] that leads to the neurological deficits that materialize as symptoms of autism and schizophrenia.[19]

(A) No hump, small ears, smaller flat forehead, small neck, table top hind legs posture

(B) Hump present, long and pendulous ears, convex forehead, round hind legs posture

The European Food Safety Authority reviewed some scientific literature based on the BMC-7 concept and published a review article in 2009 saying about the variations in milk and problems in it. Even through BCM-7 contains some useful effects but less

Actually, this problem has been occurred due to the mutation in the cow before thousands of years ago and cattle has been taken to western countries where the proline is replaced with histidine at position 67, spreading widely throughout the herds of the western world through breeding till now.[20] Whereas the Asian especially in sub continental countries like India are with A2 milk producing breeds till 18th century only a few amounts of cows in India used to produce A1,but this has been changed in this century it may be due to increase the demand for milk in India, many of the herdsmen has shown interest in A1 milk producing breed cows like jersey, Karan

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swiss, Holstein breed cows especially this breed cows do produce more amount of milk when compare with that of A2 breed cows which happened with the help of White Revolution it introduced foreign cow breeds to India which are capable of producing bulk amount of milk and replaced the Indian cow.

In New Zealand and Australia now they started finding a solution to these problems by pushing the people to drink the A2 milk which may be a high cost for them.

Difference between A1 and A2 Milk

A1 Milk	A2 Milk
Contains A1 beta Casein	Contains A2 beta casein
Genetically mutated to produce 15-20 litres of milk per day	Naturally produces 3-9 litres of milk per day
Has low nutrition	Has Cerebrosides which increases brain power
Causes Bloating, Stomach Ulcer, Gas	Has Storntiom which enhances body immunity
Most people are A1 protein intolerant, not lactose intolerant	Naturally easy to digest
Given growth harmone injections, antibiotics or GMOs	Cures irritable bowel symptoms
Have no hump that stores Vitamin D	Has Omega 3 that cleans up cholesterol deposits
Treated as Milk Making Machine	Has colostrum like "human Mother's milk"
Kept in unnatural and highly stressful conditions	Has hump on back which absorbs Vitamin D
Confined to small pieces	Cows, bulls and calves grow together as a family
Boosted in quantity to meet high demand of milk	Calves are fully fed first
Causes Autism, Type 1 Diabetes, Sudden Infant Death Syndrome, Cardiac disease, Schizophrenia	No use of growth harmone injections, antibiotics or GMOs

Conclusion

Awareness programs need to be conducted and educate the herdsmen regarding the A2 breed cows. More studies, case reports and including randomized controlled trials, observational cohort studies, are needed to confirm the potential clinical benefits of reducing A2 beta casein

Milk Consumption. The government needs to take preventive measure for this.

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Layout of poultry farm

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Housing means giving shelter to the poultry birds to a particular confinement house for getting better performance (egg, meat etc).

Advantages of housing:

- To provide more comfortable environment.
- To protect the birds from inclement climate (rain, sunshine, storm etc.)
- To protect the birds from thieves.
- To protect the birds from insect, pest, predators.
- To protect the birds from parasites.
- To protect birds from infectious & contagious diseases.
- It helps a close supervision.
- Easy treatment procedure.
- Easy to follow vaccination schedule.
- Individual care is possible.
- To make birds more docile.
- Easy management procedure.
- It is easy to supply feed and water to the birds.
- Desire breeding is possible.
- Easy to collect eggs
- Easy to clean litter.
- Less labor cost.
- Reduces per unit production cost of egg and broiler.
- Increases work efficiency farm employees.
- Saves unnecessary land wastage.

- Easy to maintain farm records.
- Easily identify diseased birds.
- To protect birds from adverse climatic conditions
- To ensure easy and economic operation
- To ensure scientific feeding in a controlled manner
- To facilitate proper micro-climatic conditions in a near vicinity of bird For effective disease control measures
- To ensure proper supervision

Selection of location

- Poultry house should be located away from residential and industrial area.
- It should have proper road facilities.
- It should have the basic amenities like water and electricity.
- Availability of farm labourers at relatively cheaper wages.
- Poultry house should be located in an elevated area and there should not be any water-logging.
- It should have proper ventilation.

Layout of poultry farm

A small size poultry farm doesn't require any special layout as it involves construction of only one house. The medium and large size farms require special considerations for placement of building in the farm premises. The basic principles to be observed for layout are

- Layout should not allow visitors or outside vehicles near the birds.
- The sheds should be so located that the fresh air first passes through the brooder shed, followed by grower and layer sheds.
- This prevents the spread of diseases from layer houses to brooder house.
- There should be a minimum distance of 50-100 feet between chick and grower shed and the distance between grower and layer sheds should be of minimum 100 metre.
- The egg store room, office room and the feed store room should be located near entrance to minimize the movement of people around the poultry sheds.
- The disposal pit and sick room should be constructed only at the extreme end of the site.

Different types of poultry houses

Brooder / chick house-It is used to brood and rear egg-type chicks from 0 to 8 weeks of age.

Grower house-It is used to grow egg-type birds from 9 to 18 weeks of age.

Brooders cum grower house-Here, the birds are reared from 0 to 18 weeks of age (entire brooding and growing period of egg-type chicken).

Layer house-In which birds over 18 weeks of age are reared, usually up to 72 weeks of age.

Broiler house-In which broilers are reared up to 6 weeks of age.

Breeder house-In which both male and female breeders are maintained at appropriate sex ratio.

Environmentally controlled (EC) house-In which, entire environment is manipulated in such a way that is optimum for the bird's growth.

Optimal environmental conditions for rearing broilers

Temperature - 22-300C (70-850F)

Relative Humidity - 30-60 %

Ammonia level - Less than 25 ppm

Litter moisture - 15-25%

Air flow - 10-30 metres/minute

House Orientation (Direction): The poultry house should be located in such a way that long axis is in east-west direction. This will prevent the direct sunshine over the birds.

Size: Each broiler require one square foot of floor space while a layer requires two square feet of floor space under deep-litter system of rearing. So the size of the house depends on the number of birds to be reared.

Length: The length of the house can be of any extent. The number of birds reared and availability of the land determines the length of poultry house.

Width: The open sided poultry houses in tropical countries should have a width not more than 22 to 25 feet in order to allow ample ventilation and aeration at the mid-portion. Sheds wider than this will not provide adequate ventilation during the hot weather. If the width of the shed is more than 25 feet, ridge ventilation at the middle line of the roof top with proper overhang is a must. Hot air and obnoxious gases which are lighter than air move upward and escape through ridge ventilation. In environmentally controlled poultry houses, the width of the house may be even 40 feet or more since the ventilation is controlled with the help of exhaust fans.

Height: The height of the sides from foundation to the roof line should be 6 to 7 feet (eaves height) and at the centre 10 to 12 feet. In case of cage houses, the height is decided by the type of cage arrangements (3 tier or 4 tier).

Foundation: Good foundation is essential to prevent seepage of water into the poultry sheds. The foundation of the house should of concrete with 1 to 1.5 feet below the surface and 1 to 1.5 feet above the ground level.

Floor: The floor should be made of concrete with rat proof device and free from dampness. The floor of the house should be extended 1.5 feet outside the wall on all sides to prevent rat and snake problems.

Doors: The door must be open outside in case of deep-litter poultry houses. The size of door is preferably 6 x 2.5 feet. At the entry, a foot bath should be constructed to fill with a disinfectant.

Side walls: The side wall should be of 1-1.5 feet height, and generally at the level of bird's back height. This side wall protects the bird during rainy days or chill climate and also provides sufficient ventilation. In case of cage houses, no side wall is needed.

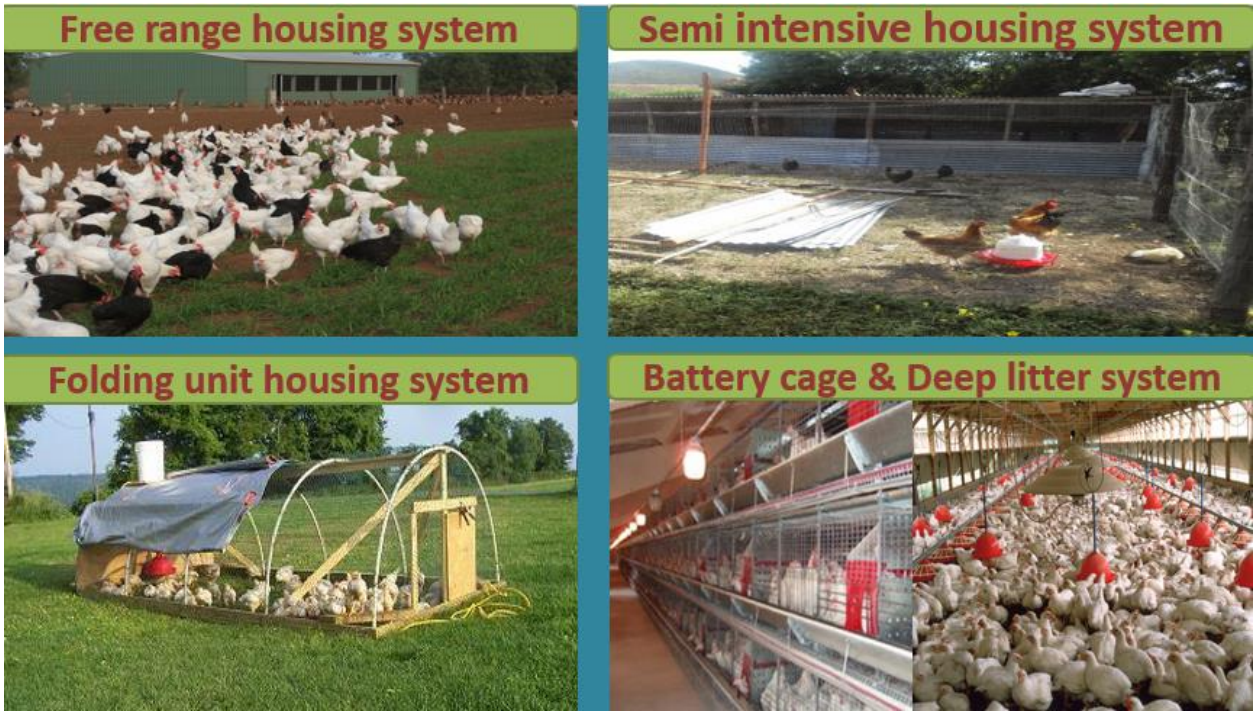
Roof: The roof of the poultry house may be thatched, tiled, asbestos or concrete one depending upon the cost involvement. Different types of roofs are Shed, Gable, half-monitor, full-monitor (Monitor), Flat concrete, Gambrel, Gothic etc. Gable type is mostly preferred in tropical countries like India.

Overhang: The overhang of the roof should not be less than 3.5 feet in order to prevent the entry of rain water into the shed.

Lighting: Light should be provided at 7-8 feet above the ground level and must be hanged from ceiling. If incandescent bulbs are used, the interval between two bulbs is 10 feet. In case of fluorescent lights (tube lights) the interval is 15 feet.

Systems of Poultry Housing

Poultry can be housed under different systems based on following factors,



1. Availability of land

2. Cost of land

3. Type of farming activity

4. Climatic condition

5. Labour availability

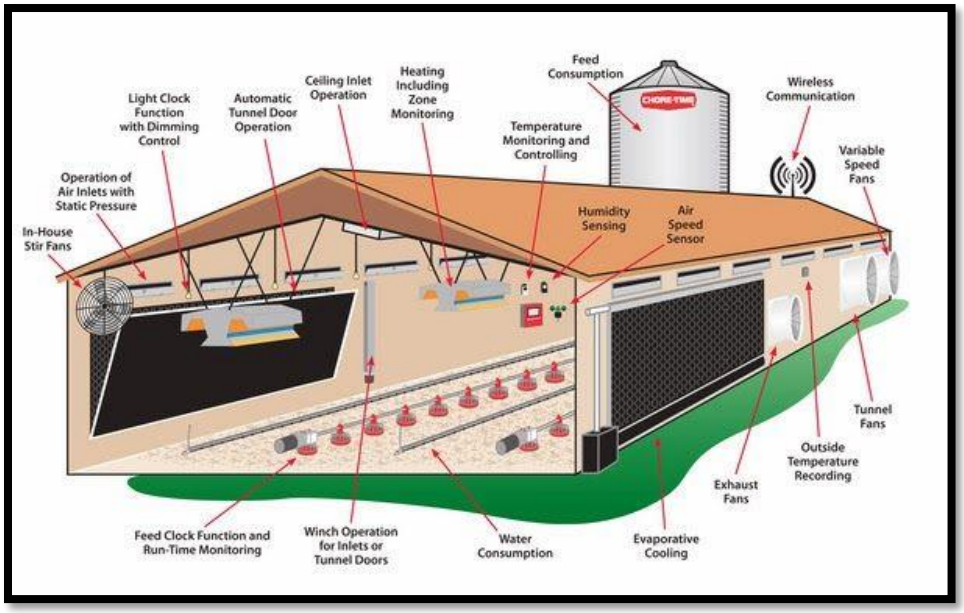
Broadly, poultry housing systems are classified into three systems:

1. Free range or extensive system

2. Semi-intensive system

3. Intensive system

a. Deep-litter system
b. Slatted floor system
c. Slat cum litter system
d. Cage system



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Present scenario, future need, issues, challenges and strategies on livestock sector of Odisha

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Ever increasing population around the globe demands cheaply available livestock products to meet the future nutritional security which onus on animal husbandry to intensify the animal production and productivity on a war-foot basis in near future. Besides, Livestock sector plays an integral part for sustainable economic development among the rural communities in India, where nearly more than 70 percent people live in rural areas. In Odisha, majority of people thrive on livestock income for meeting their basic needs like purchasing inputs for farming, repaying the education fees of their children in schools, casing untoward medical expenses, giving dowery during girl child marriages etc. Livestock plays an integral part in the rural life of Odisha, serving as a movable asset / capital reserve which can be cashed / exchanged to meet the urgent needs of the family either at medical exigencies and / or wedding as well as rituals. Livestock provides an important source of organic manure for enhancing crop production without harming the soil quality. Manure may be used as domestic fuel thus minimizing the over use of limited resources of non-renewable energy. Simultaneously, these livestock are blamed for various emerging and re-immerging outbreaks, world-wide rise in temperature so to say culprit for producing methane resulting global warming.

Livestock comprises of animal husbandry, dairy and fisheries which are considered as income generating and employment providing sectors which plays a pivotal role in mitigating poverty and augmenting the rural household income. India, the most rapidly developing

agrarian country is a home for good numbers of livestock resources due to its climatic and geographical conditions as compared to other parts of world. People of Odisha used to experience a series of cyclones and other natural calamities every year where excess dependency on agriculture or crop production is perilous. Livestock sector should be given due importance with better strategic way to give income round the year for the people even during crop failure and natural calamities. Government of Odisha as well as India must formulate quick strategic plan as Livestock sector can provide income sustenance to the people living even in hilly and drought prone areas. Value addition to various livestock products with encouraging various entrepreneurial start-ups under the banner of "*Atmanirbhar Bharat*" may be the need of the hour to boom the economic stability of the poor marginal as well as landless farmers. Export of various animal products could increase the foreign exchequer of the nation.

Rapid urbanization and gradual improvement of the economic stability of the rural house hold as well as changing lifestyle of the people now showing a positive impact on meat and meat products industry in country. The slaughter rate for different animal species such as cattle, buffalo, pigs, sheep and goats are recorded a newer height such as 20%, 41%, 99%, 30% and 40% respectively.

Livestock population of India and Odisha as per 20th livestock census

Species	Population in Millions (India)	Population in Millions (Odisha)
Cattle	192. 48	9.9
Buffalo	109.85	0.46
Sheep	74.26	1.28
Goat	148.88	6. 39
Pig	9.06	0.14
Poultry	851.81	27.44

Production parameter	Production in India in 2019-20	Production in Odisha 2019-20
Milk	198439.57 thousand tonnes	2370.09 thousand tonnes
Egg	114 billion	23814.02 lakh nos
Meat	8599.40 thousand tonnes	204.68 thousand tonnes

SWOT Analysis of meat industry in Odisha

1. Strength

a) Livestock resources
b) Variety
c) Organic farming/meat
d) Price competitive
e) Cheap labour

f) Free from zoonotic diseases e.g BSE for cattle, Avian influenza
g) Encouragement for meat export
h) Round the year availability of raw materials
i) Availability of huge man power
j) High animal protein diet at lower price
k) Vast domestic market

2. Weakness

a) Prevalence of animal diseases
b) Lack of facilities of abattoirs
c) Lack of effective centralised and uniform meat inspection
d) Productivity and practices
e) Lack of cold chain system
f) Lower slaughter rate
g) Lack of grading systems
h) Low value addition/processed meat
i) High capital cost of abattoirs and processing plants
j) Religious and ethnic groups
k) Poor utilisation of slaughter house by products
l) Lack of food retail chains
m) High requirement of working capital
n) Low availability of new reliable and better accuracy instruments and equipment
o) Lack of availability of trained and skilled personnel
p) Inadequately developed linkages between R&D labs and industry

3. Opportunities

a) Huge availability of raw materials in the state offers vast potential for processing activities and value addition in the meat.
b) Collaborative and integrative approach with quick developments in electronics, computer sciences, biotechnological interventions offering a great scope for industry automation and value chain management
c) Globalization leading to open the doors for worldwide markets might equip the farmers to export and import its products as per will thus facilitating quick and better returns on investment as well as more employment opportunities.

d) Investment prospects: Formulation of easy to adopt government guidelines for encouraging new start-ups in setting of ultra-modern abattoirs, cold chain units and mini or large poultry processing units by the rural youths. Industry-academia interface may be done on regular basis for finding newer prospects on cutting edge technologies and potential areas such as shelf-stable frozen meat, easy to cook nutritious animal products etc. Buffalo meat in surplus in the country may be used for advanced processing for encasing more foreign exchequer.

4. Threats

a) Prevalence of animal diseases

b) Lack of meat breeds

c) Lack of cold chains

d) Lack of quality assurance systems

e) Lack of good manufacturing practices

f) Lack of ante mortem and post mortem examinations

g) Promotion of publicity

i) Quick migration of skilled manpower to other industries with better working environment

Challenges

a) Poor processing and marketing conditions
b) Profitable disposal of adult birds
c) Microbiological problems e.g Salmonella and other organisms
d) Quality deterioration due to biochemical changes
e) Bio-insecurity of products, e.g antibiotics, pesticides, etc
f) Green fodder cultivation- Farmers are un-willing for cultivating the fodder due to less irrigation scenario in the state /country
g) Medical expenses- For the treatment of animals, it is very cost effective.
h) Marketing of livestock products- Important step for sustainability of any business.
i) Government organisation structure and manpower- KVKs play important role for any kind of technical guidance. This is hardly reaching to service of farmers.

Strategies for augmentation of meat industry in Odisha

a) Ensuring the production of wholesome and safe meat which can be accomplished by implementing, uniform code of meat inspection (ante-mortem and post-mortem inspection) and hygienic measures throughout the country.

b) Regularisation of disease control programmes and to set up control points for restricting animal movements

c) There is an urgent need for the technology up gradation, sanitary measures and modernisation of our existing slaughter houses and meat processing plants. A nationwide research survey on sanitary and hygienic status of fresh meat production and marketing chain including other factors effecting wholesomeness, safety of meat and by-products should be undertaken. Improvements suggested for quality assurance and safety programmes should be implemented.

d) Research and development programme should be established to focus on post harvest technology and value addition of meat and meat products for higher returns

e) Commercial farming of meat animals should be encouraged in an organised manner with appropriate animal husbandry practices and healthcare services.

f) Improvement in the infrastructural facilities such as fast track refrigerated road and rail transport of commodities.

g) Development of meat breeds for different species which will give better yield and healthy animals for wholesome meat production.

h) There is a strong need for R&D in engineering inputs for the sector as the meat production and processing facilities are capital intensive

i) The marketing of meat and meat products in domestic as well as international markets should be deeply studied and socio economic impact of the growth of the sector may be analysed from time to time.

j) The role of biotechnology in processing and preservation of meat and egg products including development of newer, safe and healthy value-added products should be explored on priority.

k) Genetic improvements through cross breeding programmes for intensive meat production. Development of genetically modified meat and meat products with various nutritional and health positives

l) Development of modernised meat industry operating on technologies in abattoirs, processing, preservation, packaging and marketing of meat and meat products.

m) Development of healthy meat foods with natural preservatives, ingredients and bio active compounds.

n) Extension of shelf life of meat and meat products with innovative packaging materials and methods with special emphasis to bio-active edible films.

o) Application of nanotechnology for improvement in the quality of meat and meat products.

Steps for augmentation of livestock productivity and utility in Odisha

a) By increasing the number of crossbred populations in the state for higher productivity and popularisation of genetically improved varieties of different food animals

b) Popularisation and development of fodder farms in unused government lands

c) Increasing the growth in population of improved broiler breeds of poultry

d) Better nutritional and management practices taken for enhancing the productivity of animals and birds.

e) Needs for diversification of poultry farming with improved and popular alternate poultry species.

f) Rearing lambs and kids to larger weights which would contribute towards doubling meat production.

g) Popularisation of the advantages of slaughter of animals at its optimum age.

h) Promoting hygienic transport, storage and distribution of livestock products.

i) Skill up gradation and capacity building training programme for the rural youths

j) Creating efficient marketing channels that will help in providing remunerative prices to the producers.

k) Strengthening human awareness regarding marketing of packaged livestock products.

l) Need for development of infrastructure for processing and storage.

m) Need for development of consumer awareness programmes for further processed value added livestock products to increase the consumer demands.

n) Establishment of organised slaughter house for different livestock in different parts of the state.

o) Hygienic meat production in rural, urban and semi urban areas.

p) Development of convenient and variety of livestock products available to greater mass of people with less cost which will increase the demand from consumers.

q) Establishment of improved and modern slaughter houses in urban areas.

r) There should be licensed marketing sector for selling of quality animals in Odisha.

s) Popularisation of small-scale entrepreneurship to take up the project for converting raw/fresh livestock products by adding value to it to a more convenient, nutritious and palatable product.

Major Constraints

a) Regional imbalance in poultry production.
b) Mix of small/medium/large poultry farms.
c) Exorbitantly high feed costs.
d) Rising animal/poultry costs.
e) Shrinking profit margin.
f) Demand-Supply mismatches (5% increase in supply leads to 25% decrease in price and vice versa).
g) Inadequate infrastructure (Small/Medium scale processing equipment, cold chains, Quality assurance, Measures of domestic markets/ Sales promotion, Disease diagnostics laboratory etc.).

Conclusion

The potential of livestock resources of Odisha can be utilised in a better manner to get more financial benefit to strengthen the economic condition of the state as well as it can provide a better platform for alleviating unemployment in young youths and can provide a better nutritional security also. So, entrepreneurship in livestock sector should be encouraged in the state to get better return from the livestock sector.

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Bio Pesticides: An Eco-Friendly Approach for Integrated Pest Management - A review

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INTRODUCTION

Insect pests of Veterinary importance, such as flies (biting, non-biting), fleas, lice (biting, sucking), ticks (soft, hard) and mites (burrowing, non-burrowing, follicular) cause harmful effects such as,

Direct effects:

- Annoyance, worries and nuisance through painful bite,
- Blood and tissue fluid loss,
- Skin inflammation and pruritis,
- Toxic and allergic reaction
- Secondary bacterial infection of wounds caused by the larvae of *Gastrophilus* in horse, *Oestrus ovis* in sheep, blow fly myiasis, may lead to septicaemia and death.

Indirect effects:

- Decreased feed conversion efficiency,
- Reduced milk, meat, wool and egg production,
- Weight loss,
- Act as vectors for many bacterial, viral, protozoan and rickettsial diseases.

Important diseases transmitted by insect as vectors

Insects	Important diseases
***Culicoides* spp.**	Bluetongue, African horse sickness &Epizootic haemorrhagic disease
Musca domestica	Bacterial diseases-cholera, typhoid, paratyphoid, tuberculosis, salmonella dysentery, and leptospirosis,Viral diseases-poliomyelitis and infectious hepatitis and Protozoan diseases - amoebic dysentery and giardiosis.

Mosquito spp.	Dengue, Chikungunya, malaria, dog heart worm, yellow fever
***Simulium* spp.**	Eastern equine encephalitis, vesicular stomatitis, *onchocerci gibsoni*
Phlebotomine sandflies	Visceral and cutaneous leishmanioses.

Use of insecticides to reduce or eliminate insect pests is therefore often required to maintain health and to prevent economic loss in food animals. The introduction of synthetic insecticides, like Organochlorines in 1940s, organophosphates in the 1960s, carbamates in 1970s, pyrethroids in 1980s and later neonicotinoids, dominated many natural control methods, such as using of botanicals, predators, and parasitoids. After twenty years of organochlorines introduction, came to know that synthetic insecticides induce widespread environmental contamination, toxicity to non-target organisms, development of resistance against insecticides, and negative effects on animal and human health (Pretty, 2009).

Hence, alternative means of controlling harmful insects have been gaining popularity in the current climate of environmental awareness and public concern. The word bio insecticides came to era of present world to control insect pests.

A. Biorational insecticides- Referring to insecticides that have limited or no adverse effects on the environment, non- target organisms including humans.

B. Biochemical insecticides- botanicals, insect growth regulators, insect pheromones, photoinsecticides, and inorganics

C. Biological insecticides- parasitoids, predators, nematodes, and pathogens (virus, bacteria, fungi, or protozoa)

D. Transgenic insecticides- Genetically modified plants or organisms.

In developing countries, bio pesticides offer unique and challenging opportunities for exploration and development of their own bio insecticides. Nanotechnology has become one of the most promising new technologies in the recent decade for protection against insect pests. The interest in bio insecticides is based on the advantages associated with such products such as:

- Inherently less harmful and less environmental load
- Designed to affect only one specific pest or, in some cases, a few target organisms
- Often effective in very small quantities and often decompose quickly, thereby resulting in lower exposures and largely avoiding the pollution problems and
- When used as a component of Integrated Pest Management (IPM) programs, bio pesticides contribute greatly.

Biochemical Control:

Botanical insecticides

Plants produce toxic substances as natural defences against pests, such as

insects and pathogens. These substances can be extracted from plants and used in the production of commercial insecticides. The use of plants, plant material (bark, leaves, roots, seeds, and stem) or crude plant extracts as sources of insecticidal substances. Traditionally used botanical insecticide products include nicotine, rotenone and pyrethrum.

Essential oils (EO) are complex mixtures of volatile organic compounds produced as secondary metabolites in plants; they are constituted by hydrocarbons (terpenes and sesquiterpenes) and oxygenated compounds (alcohols, esters, ethers, aldehydes, ketones, lactones, phenols and phenol ethers). Some monoterpenes such as a-pinene, cineole, eugenol, limonene terpinolene, citronellol, citronellal, camphor and thymol are common constituents of EO. Their composition may vary considerably between aromatic plant species and varieties, and within the same variety from different geographic areas.

Among EO-producing plants, some genus such as *Cymbopogon spp. Eucalyptus spp.* and *Ocimum spp*. have been widely studied. The rapid action against some pests is indicative of a neurotoxic mode of action, and there is evidence for interference with the neuromodulator octopamine (Enan, 2005) or GABA-gated chloride channels (Priestley *et al*., 2003).

Azadirachta indica- neem tree

Azadirachta indica, also known as neem, nimtree, ineem and Indian lilac is a tree in the mahogany family Meliaceae. It is a native to India and the Indian subcontinent including Nepal, Pakistan, Bangladesh and Srilanka.

Active ingredient: Azadirachtin

Mode of action : Antifeedency, Insect growth regulator, Oviposition deterrence &fecundity reduction, Repellent activity

Curcuma longa- Turmeric:

It is a perennial plant with roots or tubers oblong- palmate, and deep orange inside. In fresh state, the roots have an aromatic and spicy fragrance, which by drying gives way to a more medicinal aroma. The origin of turmeric is from South East Asia or South Asia.

Active compound & action

The yellow-orange color of turmeric comes from yellow pigment found in the rhizomes called **curcumin**. It has well-known insecticidal and repellent effects on insect pests. The concentration of another important component ***ar*-turmerone** harvested from rhizomes was 0.32% (dwt).

Allium sativum-Garlic

It is a bulbous plant. It grows up to 1.2 m (4 ft) in height. It occur in China, India, South korea, Egypt, Russia etc. The garlic plant's bulb is the most commonly used part of the plant. Active compound- **allicin** (2-propene-1-sulfinothioic acid S-2-propenyl ester. Activity has been reported against a number of dipteran, coleopteran, lepidopteran and hemipteran pests.

Eucalyptus spp. (Gum tree)

It is a diverse genus of flowering trees and shrubs in the myrtle family, Myrtaceae. *Eucalyptus* is one of three similar genera that are commonly referred to as "eucalypts", the others being *Corymbia* and *Angophora*. Members of the genus dominate the tree flora of Australia, and include *Eucalyptus regnans*, the tallest known flowering plant on Earth.

Cymbopogon citrates (Lemongrass)

The essential oil of *Cymbopogon citratus*, known as “lemongrass”, is commonly used by folk medicine in many countries. Native from India and Southeast Asia, it is distributed in numerous tropical countries, including Brazil. Active ingredient are **citral and 1.8 cineole** and they have important repellent and insecticide activity. The citral constitute total of 97.92% from Brazil (Pinto *et al*.,2015).

Pyrethrin- Oldest and safest insecticides

The ground, dried flowers of *Chrysanthimum cinerariaefolium* (Asteraceae) were used in the early 19th century to control body lice during the napoleonic wars. Pyrethrum contains three esters of chrysanthemic acid and three esters of pyrethric acid. Among the six esters, those incorporating the alcohol pyrethrolone, namely **pyrethrins I and II**, are the most abundant and account for most of the insecticidal activity. Technical grade pyrethrum, the resin used in formulating commercial insecticides, typically contains from 20% to 25% pyrethrins.

Mechanism of Action of Pyrethrin

Pyrethrin effect the insect on contact, creating disturbances in the nervous system which eventually result in convulsions and death. Pyrethrin acts on insects with phenomenal speed causing immediate paralysis, notably in flying insects, some of which are immobilized within 1 sec. It blocks voltage-gated sodium channels in nerve axons.

Insect growth regulators

Insect growth regulators (IGRs) are chemical compounds that alter growth and development in insects. They don’t directly kill insects, but interfere with the normal mechanisms of development, resulting in insects dying before they reach adulthood. IGRs are classified into two general categories based on mode of action:

1. Substances interfering with the action of insect hormones and
2. Chitin synthesis inhibitors.

1. Substances interfering with the action of insect hormones

Growth and development of insects are regulated by hormones, such as

1. **Prothoracicotropic hormone** controls the secretion of the molting hormone (ecdysone) from the prothoracic gland.
2. **Ecdysone** is responsible for cellular programming
3. **Juveline hormone (JH)** is one of the most pleiotropic hormones known and functions in various aspects such as embryogenesis, molting and metamorphosis, reproduction, diapause, communication, migration/ dispersal, caste differentiation, pigmentation, silk production, and phase transformation. The major function of JH is the maintenance of larval status or the so- called juvenilizing effect.

Juvenile hormone analogues (JHAs)

In 1967 Carrol Williams proposed that the term ‘‘third generation pesticide’’ be applied to the potential use of the insect juvenile hormone (JH) as an insecticide. Methoprene, the first compound introduced into the market. Many naturally occurring JHAs, also called juvenoids, have been isolated from plants such as the ‘‘paper factor’’ from the balsam fir tree (*Abies balsamea*), and juvocimenes from the sweet basil plant (*Ocimum basilicum*). During coevolution, the plants probably developed these JHAs to defend themselves against insects.

Action

Treatment of the larva in its last instar with JHA severely interferes with normal metamorphosis and results in various larval–pupal intermediates that do not survive. JHAs block embryonic development at blastokinesis and act as ovicides. JHAs induce sterility in both sexes of adult tsetse flies (Langley et al., 1990).

Chitin synthesis inhibitors:

Over the past three decades, the chitin biosynthetic pathway has proven to be important for developing insect control agents that selectively inhibit any of the chitin synthetic steps in insects. Chitin synthesis inhibitors act on the larval stages by inhibiting or blocking the synthesis of chitin which represent 30-60% of the insect exoskeleton structure. Two types of insect regulatory chitin synthesis inhibitors (CSI) have been developed and used as commercial compounds for controlling insect pests: The Benzylphenyl ureas (BPUs), and Triazine/pyrimidine derivatives.

1. Benzoylphenyl ureas:

It was in the early seventies that the first chitin synthesis inhibitor, a benzylphenylurea, was discovered by scientists at Philips-Duphar BV, (now Crompton Corp., Weesp, The

Netherlands), and marketed as Dimilin by the Uniroyal Chemical Company (Crompton Corp. Middlebury, CT) in the USA. Studies with diflubenzuron, the most thoroughly investigated compound.

Action:

On developing larvae its ruptures, the malformed cuticle act as ovicides, reducing the egg laying rate or hindering the hatching process by inhibiting embryonic development or failure of hatchability**.** It alters cuticle composition, especially inhibition of chitin, resulting in abnormal endocuticular deposition that affects cuticular elasticity and firmness, and causes abortive molting Inhibit the transport of UDP-GlcNAc across biomembranes Block the binding of chitin to cuticular proteins resulting in inhibition of cuticle deposition and fibrillogenesis

Inhibit the formation of chitin due to an inhibition of the protease that activates chitin synthase, and activation of chitinases and phenoloxidases, which are both connected with chitin catabolism

Affect ecdysone metabolism, resulting in ecdysone accumulation that stimulates chitinase, which in turn digests nascent chitin. Blocks the conversion of glucose to fructose- 6-phosphate and Inhibit the DNA synthesis (Oberlander and Smagghe, 2001).

Triazine/pyrimidine derivatives

Cyromazine

Cyromazine (Larvadex ®, Trigard®), is an IGR with contact action interfering with molting and pupation. Cyromazine may inhibit growth or expansion of the body wall (or both) sufficiently to prevent normal internal growth, producing the observed symptoms and leading to abnormal development.

It fed to poultry or sprayed to control flies on animals, in manure of broiler and egg producing operations. It controls blowfly infesting sheep and persist for up to 13 weeks (O'Brien & Fahey, 1991) after a single pour-on application, or longer if applied by dip or shower.

Dicyclanil

Dicyclanil (ZR ®, ComWin ®), a pyrimidine derivative, is highly active against dipteran larvae and available as a pour-on formulation for blowfly control in sheep in Australia and New Zealand providing up to 20 weeks' protection.

Safety

CSIs consider as soft insecticides

Low mammalian toxicity

Ease of their synthesization

their pest selectivity

No accumulation in soil and water

Typically "safer" to use around humans, pets, and natural enemies and

Effective when applied in very minute quantities.

Drawback

Sensitive to UV light

Some insects acquired resistance against some IGR

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

Semiochemicals subdivided into allelochemicals and pheromones these allelochemicals further subdivided into

1. Allomones
2. Kairomones
3. Synamones
4. Antimones

Pheromones: These are best known**,** intensively studied group of Semio-chemicals pheromones can be classified as follows

1. Arrestment / Assembly pheromones
2. Attraction Aggregation Attachment pheromone (AAAP)
3. Sex pheromones each of which mediates different aspects of courtship process

a. Attachment sex pheromones

b. Mounting sex pheromones

c. Genital sex pheromones

4. Oviposition pheromones

Biological control

In biological control natural enemies have been utilized in the management of insect pests for centuries. However, this last 100 years has seen a dramatic increase in their use as well as our understanding of how they can better be manipulated as part of effective, safe, pest management systems.

Biological control includes four categories:

1. Microbes or pathogens (such as viruses, bacteria, protozoa, nematodes and fungi);
2. Predators (such as lady beetles and lacewings); and
3. Parasitoids (wasps and some flies).
4. Bio chemicals

Microbial insecticides

Bacteria

***Bacillus thuringiensis* (Bt)**: It is a widely occurring gram-positive, spore-forming soil bacterium that produces parasporal, proteinaceous, crystal inclusion bodies during sporulation. *Bt* is a member of the *Bacillus cereus* group. Bt is occur in soil, leaf litter, leaf surfaces, insect feces, and as a part of the flora in the midguts of many insect species.

There are several insecticides based on various sub-species of *Bacillus thuringiensis* Berliner (*Bt*), such as

B thuringiensis israelensis (Bti), with activity against mosquito larvae, black fly (simuliid), fungus gnats, and related dipterans species

B thuringiensis kurstaki (Btk) and *B thuringiensis aizawai* (Bta) with activity against lepidopteran larval species

B thuringiensis tenebrionis (Btt), with activity against coleopteran adults and larvae; and

B thuringiensis japonensis (Btj) strain *buibui*, with activity against soil-inhabiting beetles.

Bacillus sphaericus: Its control mosquito larvae, particularly *Culex* and *anopheline spp.*, especially those breeding in polluted water. It controls also black fly, *Simulium* sp., the vector of river blindness disease. Registered *B. sphaericus* product is **Vectolex CG** (Valent BioSciences).

Mode of action

The insecticidal properties of Bt are largely a function of the presence of extra-chromosomal plasmids in the cell. The major determinants of BT insecticidal properties are

the delta-endotoxins. These end toxins form two multigenic families, cry and cyt. **Cry proteins** is a parasporal inclusion protein from *B. thuringiensis* that exhibits toxic effect to a target organism, or any protein that has obvious sequence similarity. More than 200 different cry genes have been isolated.

Upon ingestion by an insect, the crystal proteins (cry) are solubilised and the insect gut proteases convert the original protoxin into smaller toxins. These hydrolysed toxins bind to the insect's midgut cells at high-affinity and specific receptor binding sites where they interfere with the potassium ion dependent, active amino acid symport mechanism decreasing absorption of minerals and nutrition from midgut and finally death of the columnar cells. This disruption causes the formation of large cation-selective pores that increase the water permeability of the cell membrane. A large uptake of water causes cell swelling and eventual rupture, disintegrating the midgut lining. The toxin stops feeding, this action hinder further damage caused by the feeding larva, and do not directly kill insects, but young larvae may starve to death and may die from bacterial infection over a longer period.

Virus

Insect viruses have traditionally been associated with biocontrol of insect pests, and since the 1980s. Entomopathogenic viruses are obligate disease-causing organisms that can only reproduce within a host insect. There are presently more than 20 known groups of insect pathogenic viruses, which are classified into 12 viral families.

MdSGHV virus

Salivary gland hypertrophy virus of house flies (MdSGHV) is one of three members of the hytrosaviridae, a recently described family that includes pathogens of adult house flies, tsetse flies (*Glossina* spp.), and the narcissus bulb fly (*Merodon equestris* Fabr.) (Lietze *et al*., 2011). The virus an enveloped, double stranded, circular DNA virus with a 124,279 bp genome. MdSGHV was first discovered infecting flies at a dairy farm in central Florida in the early 1990’s.

The most conspicuous feature of infection is the presence of greatly enlarged (hypertrophied) salivary glands with a blue-whitish appearance that often dominate the abdominal cavity of the fly when dissected. Both sexes can be infected, with somewhat higher prevalence rates in males. Viral replication and morphogenesis is restricted to salivary gland cells, although complete virions are also found in asymptomatic tissues such as midgut, ovaries, fat body and brain. Infected flies of both sexes have reduced mating success and shorter life spans than healthy flies.

Infected females deposit ca. one million virus particles each over a period of seconds when they feed on solid foods (Lietze *et al*., 2009). Healthy flies can become infected when they are given food or water from cages of infected flies, and even when they are housed in cages from infected flies and given clean food and water supplies. Viable virus particles pass through the alimentary tract of infected flies and are deposited with feces, albeit at low rates (Lietze *et al*., 2009). Further research with new formulations to improve stability, shelf life and adherence to target flies could greatly improve prospects for use of MdSGHV as an operational biopesticide. Deltabaculovirus (dipteran-specific NPVs) (Jehle et al., 2006).

Mechanism of action of Virus

Insect feeding on virus - contaminated foliage

Close up of occlusion bodies (OBs)

Lumen of digestive tract alkaline in condition

Virus particles being released from OBs and attaching to brush border of gut cells

Replication Of virus in insect cell

Virus-Iridescent, cytoplasmic poly hidrosis

Entomopathogenic fungus:

Hyphomycetes

Beauveria bassiana (Bals.) and Metarhizium anisopliae (*Met*.) are two species of entomopathogenic fungi, belonging to the hyphomycetes group, that are natural inhabitants of soil, where they are found infecting a wide range of insect species that spend at least one stage of their life cycle in the soil. They are ubiquitous worldwide and comprise a large number of different strains/isolates which differ in their geographical origin or host specificity. The main infection route is through the integument, although they can also be ingested and enter the organism through the digestive tract, or through the trachea, or wounds. The most common method used has been the immersion of any insect stage (larva, pupa or adult) in a conidia solution, although topic, oral or contact applications have also been tested.

Mode of action

These hyphomycetes can infect and kill insects without being ingested. The spores of the fungi, called **conidia**, attach to the insect's external tegument in a passive and non-specific way and subsequently germinate and penetrate the cuticle. Once in the hemocoel, the mycelium grows throughout the host, forming hyphal bodies called blastospores. The fungi produce **destruxins** causing paralysis and insects die between 3-14 days after infection, depending on

species, size and fungal isolate. Under suitable conditions hyphae can emerge from the cadaver and produce conidia on the exterior of the host which can be dispersed by wind or water.

Nematodes

Nematodes from the families steinernematidae and heterorhabditidae have proven to be the most effective as biological control organisms to control a wide range of insect pests including filth flies, cat flea.

Action

The life cycle of most nematodes includes an egg stage, four juvenile stages, and an adult stage. The third juvenile stage, dauer, is the only infective and free living stage which is capable of surviving in the soil; its function is to locate, attack, and infect an insect host through its breathing holes, mouth, or anus, but some species are capable of penetrating thin areas of the insect's cuticle. After that, the nematodes release special bacteria into the insect. The toxins produced by the bacteria kill the insect after a few days. The bacteria multiply inside the body of the insect and the nematodes eat the bacteria. The nematodes mature, mate, and multiply inside the insect. Eventually, the insect's body becomes filled with nematodes. Infective stage nematodes then exit the insect body searching of other insects to infect.

The nematode bacterium relationship is highly specific: only *Xenorhabdus* spp. bacteria co-exist with steinermatids, and only *Photorhabdus* bacteria co-exist with heterorhabditids. Under optimal conditions, it takes 3–7 days for steinernemadtids and heterorhabditids to complete one life cycle inside a host from egg to egg. Emergence of infective juveniles from the host requires about 6–11days for steinernemadtids and 12–14 days for heterorhabditids. The ability of any biological control nematode to infect a particular insect can be affected by nematode and insect behavior, physical barriers, and immune responses. Over 30 species of beneficial nematodes have been identified. Seven species have been commercialized worldwide such as *Steinernema carpocapsae, S. feltiae, S. glaseri, S. riobravis, Heterorhabditis bacteriophora, H. megidis,* and *H. marelatus.*

Paraiotonchium muscadomesticae infect housefly larvae and descendants of the nematodes invade and damage the ovaries of adult female flies and are deposited in the larval habitat when the flies attempt to oviposit. Infected adults lived about half as long as uninfected flies. Nematodes were effective in the laboratory but persisted in manure only for 3-7 days.

Predators

"Free- living animal that feeds on other animals (prey); it may attack prey in both its immature and adult stages; usually more than one prey individual is required for the predator

to complete its life cycle." Major types of insects that are predaceous: **dragon flies, damselflies, mantids, true bugs, some thrips, lacewings & relatives, beetles, some wasps, ants & some flies.** Histerid beetles and macrochelid mites feed ravenously on fly eggs and young larvae and have been studied extensively.

Carcinops pumilio (Erichson) (Coleoptera: Histeridae), commonly found in poultry manure, is an important predator of house fly eggs and larvae. The use of this species is considered to be compatible with that of pteromalids such as *Spalangia endius* Walker, because *C. pumilio* feeds on fly eggs and larvae and not on the host pupae, which the parasitoids require. Predacious fishes such as *Poecilia rectculata & Gambusia affins* (guppy fishes) as a larvivorous for control of mosquitoes and for culicoides

Parasitoids

An arthropod that parasitizes and kills another arthropod (insects, mites, spiders and other close relatives) host; a parasitoid is parasitic in its immature stages and free living as an adult. The major types of insects that are parasitoids wasps, flies, some beetles, and mantis and twisted winged parasites.

Action: Adult female parasitoids lay their eggs inside the host by penetrating the body wall with their ovipositor or they attach their eggs to the outside of the host's body.

Transgenic pesticides

Genetically modified organisms

Transgenic organisms are genetically altered by artificial introduction of DNA from another organism and the artificial gene sequence is referred to as a transgene. The development of recombinant DNA techniques improves the efficacy of Bti through combining the most potent insecticidal proteins from Bti, Btj, and Bs into new bacterial strains that are ten-fold more toxic than wild type species of Bti and Bs used in current commercial formulations.

Safety

They are much more environmentally compatible than most chemical insecticides.

Costs are similar to that of new chemical insecticides.

Therefore, recombinant bacterial larvicides will play an important role in controlling pests and vectors in the near future Federici et al (2010).

Transgenic insects/ genetic control of insect pests

A genetically modified (GM) insect is an insect that has been genetically modified, either through mutagenesis, or more precise processes of transgenesis, or cisgenesis.

Motivations for using GM insects include biological research purposes and genetic pest management. Genetic pest management capitalizes on recent advances in biotechnology and the growing repertoire of sequenced genomes in order to control pest populations, including insects. Insect genomes can be found in genetic databases such as NCBI, and databases more specific to insects such as FlyBase, VectorBase, and Beetle Base.

Types of genetic pest management

The sterile insect technique (SIT) was developed conceptually in the 1930s and 1940s and first used in the environment in the 1950s. SIT is a control strategy where male insects are sterilized, usually by irradiation, then released to mate with wild females. If enough males are released, the females will mate with mostly sterile males and lay non-viable eggs. This causes the population of insects to crash, and in some cases can lead to local eradication. Irradiation is a form of mutagenesis which causes random mutations in DNA.

Release of Insects carrying Dominant Lethals (RIDL) is a control strategy using genetically engineered insects that have (carry) a lethal gene in their genome (an organism's DNA). RIDL genes only kill young insects, usually larvae or pupae. This lethal gene has a molecular on and off switch, allowing these RIDL insects to be reared. The lethal gene is turned off when the RIDL insects are mass reared in an insectory, and turned on when they are released into the environment. RIDL males and females are released to mate with wild males and their offspring die when they reach the larval or pupal stage because of the lethal gene.

It also called as Oxitec's technology. The first open field trial by Oxitec was carried out in 2010 in the Caribbean Island of Grahnd Cayman. The trial was successful in reducing the mosquito population by 80%. Similar trials have since been carried out in west Panama, Malaysia and more recently in Brazil with at least 90% reduction in vector population.

Drawbacks

Face contrasting expectations of multiple stakeholders, the management of which will prove critical to safeguard support and avoid antagonism, so that potential public health benefits can be fully evaluated.

Nanoparticles- future trends as bio insecticides in control of insect pests

The potential uses and benefits of nanotechnology are enormous. These include enhancement involving nanocapsules for vector and pest management and nanosensors for pest detection. Nanoparticles are 1-100 nm in diameter. Nanotechnology deals with the targeted nanoparticles which exhibit different physical strength, chemical reactivity, electrical

conductance, and magnetic properties. Nanoparticles help to produce new pesticides, insecticides and insect repellants .

Nanoencapsulation is a process through which a chemical or bio insecticides are slowly but efficiently released to a particular host for insect pest control. Release mechanisms include diffusion, dissolution, biodegradation and osmotic pressure with specific pH.

Velayutham k *et al*., 2013 studied, the larvicidal aqueous crude bark extracts and synthesized Ag NPs of *Ficus racemosa* against the larvae of *Cx. quinquefasciatus* and *Cx.gelidus*. however, the highest mortality was found in synthesized Ag NPs of *F. racemosa* at the concentration of 25 mg/L.

Conclusion

Over the past 20 years, biorational insecticides are gaining importance in control of insect pests and vectors, which affect the livestock animals and humans. Now days, essential oils such as neem, citriodora, eucalyptus, lemon grass, sweat basil, cumin and clove oil are coming slowly into the market by various company, but because of sensitive to UV light, protective effects usually dissipate relatively quickly and most studies are invitro, which makes them less effective. To with stand this drawback, combining active oils of more plants and adding UV protectants. Further research on blends of essential oils and improved formulations and delivery systems could lead to substantial improvements in the performance. Insect growth regulators like methoprene, pyriproxifen & lufenuron are using along with chemical insecticides. Different lure designs releasing synthetic pheromones which are specific such as Z-9-tricosene for attract house flies, carpoic acid – oviposition pheromone attract mosquitoes and methylgermacrene B attract sand flies are studied. For improvement of pheromones, understanding the mechanisms of communication systems of insects, behaviour and mating systems among target insects and non-target organisms is important.

Inspite of safe to environment and non- target organisms, microbial bioinsecticides like *B. thuringiensis, B. bassiana and M. anisopliae* are limited in market due to less field studies, sensitive to local environment in farms, UV radiations, heat and need proper applications. The utilization of microbial insecticides in integrated pest management model requires high scientific study such as systematic surveys on properties, mode of action, pathogenicity, etc. Ecological studies are necessary on the dynamics of diseases in insect populations because the environmental factors play a vital role in disease outbreaks to control the pests. In order to improve mass production technologies contamination should be reduced with the improvement of formulation potency and increase in shelf-life of microbial bioinsecticides. Genetic and recombinant biotechnological tools would lead to the production of strains with improved

pathogenesis and virulence. All aspects study should be done especially; persistence, resistance, dispersal potential, the range of non-target organisms affected directly and/or indirectly in order to solve the problem of regarding the regulatory and registration.

Sterile insect technique and oxitecs technologies should be adopted to other insects to control. Nanoencapsulation delivery system must be encouraged. Remarkable gap between different research institute and such company engaged in commercialization must be avoided

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Piggery Farming in Northeastern Region

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Abstract

Animal husbandry as well as livestock sectors play a vital role for upliftment of rural economy of a developing country such as India. Piggery farming play pivot role in the uplift men of rural economy. North east region 90% people is non vegetarian. The fecundity rate od pig is more compared to the other animal and meat production is more compared to another animal.

Introduction

Animal husbandry as well as livestock sectors play a vital role for upliftment of rural economy of a developing country such as India. India is one of the fastest growing countries in livestock sectors by increasing agricultural domestic product. Among the all-other domesticated species, pig farming finds a new increasing demand in socio-economically weaker sections particularly in north eastern states due to its better potential to contribute in faster economic return to the rarer. Pig farming requires low maintenance. Pig has highest fertility, highest fecundity, better-feed conversion efficiency, short generation interval and require small investment and low input (Kalita *et al.*, 2022). As per Livestock census 2019, total pig population of the state of Assam is 16,36,022 which is about 15.89% of total pig population of our country. Among these population, 70% is traditionally raised in small farms. The share of meat production from pig is 18,730 tonnes against state's total meat production of 46,870 tonnes during 2016-17 while total requirement is 3,63,000 tonnes (Integrated Sample

Survey 2016-17). There are 19 breeding farms under AH & Veterinary Department, Assam out of which 16 farms are functional. The objective of the "Pig Development Project for the state of Assam (2019-2024)" is to increase the income of the Pig rearing farmer/ entrepreneur/ NGO/ Cooperative Society, etc. so as to achieve the Honorable Prime Minister's plan for doubling farmer's income. But proper implementation of the project is still missing. In nutshell, the pig earing is still unorganized venture that requires science and technological applications to make it rise in global market. The total pigs in the country have been declined by 12.0% over previous Livestock Census (2012). The reasons might be due to reluctance by the entrepreneurs to start a hog farm because of socio-cultural inhibition and inadequate availabilities. But in the 20th livestock census it has increased by 28% which marks a positive rise of pig farming in Assam. With increasing demand for human feed hunger and changing trends of consuming meat, thereby, posing a great challenge for piggery industry to produce that bulky pork requirement. But the situation has even more worsened due to poor maintenance of the pig farms and low productivity per animal. Thus, to increase the pork meat production per animal, cross breeding with improved germplasm can be a key source to achieve the vision. Farmers in Assam fear threat to existence of local pigs in the state in the wake of spread of African swine fever (ASF) which has currently affected pigs in 10 districts.

Indigenous breeds are those that belong to India

The indigenous breed of India is Agonda goa, Doomm Ghoongroo, Ghurrah, Niang megha, Tenyl vo and Zovawk. Doom, an indigenous breed, has a population of around 4,000 in the state. Their population is largely concentrated in Dhubri district though some of them can be found in Bongaigaon and Kokrajhar districts. It has been reported that around 5,000 of 15,000 pigs that had died across Assam were of Local breed. Zovawk pig is one of the local pig breeds available in the North eastern states of India. The origin of Zovawk is in different parts of Mizoram state in India. This pig is of scavenging type. The Zovawk pigs are of small size and attain puberty at the age of 2.5 months when they are about 4.5 kg body weight. The first farrowing occurs at the age of 9-10 months when they are of about 40 kg body weights (Mayengbam *et al.*, 2014) and as the effect of African swine fever has caused huge losses, so commercial farms have started rearing the exotic breeds due to their high productivity.

Fig.1. Photograph showing the piglet of Doom Pig.

Advantages of indigenous breeds

They are more resistant to diseases compared to exotic breeds**.** They are well adapted to local climatic conditions whereas exotic breeds might find it hard to adapt in the extremes. They were resistances to adverse environmental condition of north east region like flood, parasitic problem.

Disadvantages of indigenous breeds

They have lower yield production compared to exotic breeds. The fecundity rate of indigenous pig breed was less compared to the exotic breeds.

List of exotic breeds

The exotic breed which was reared in agro-climatic condition of north east region *viz.*, Large white Yorkshire, Middle white Yorkshire, Berkshire, Tamworth, Landrace, Duroc, Hampshire and Chester white.

Advantages of exotic breeds

They give higher yield**.** Their food intake is less and production is more. Their fecundity rate is high compared to the indigenous breeds. They give more meat compared the indigenous.

Disadvantages of exotic breeds

They can't resist high temperatures**.** They need high maintenance. They were less diseases resistances. They cannot bear the adverse climatic condition. They were more prone to parasitic diseases of north east region.

Feeds

Some common good pig contains sufficient energy, protein, mineral, vitamin. Rice bran, broken rice, maize, soyabean, cassina, sorghum. Pigs can't digest a large amount of fiber so they can't handle huge forages. We can provide the hotel wastage. The wastage is cheap compared to the other feed. It has also a good source of carbohydrate and bulky food.

Creep feed (or) pig starter

It is baby piglets feed, mixture of fine rice bran, broken rice, maize grain and drinking water**.** Rice bran has 11% protein and can be used as main ingredient in feeds**.** Rice bran can be mixed with other feed to 30% to 45%. Maize is good source of energy it has 10% of protein content and 65% of carbohydrate and 99% protein**.** It can be mixed with other ration but not more than 40% In mix ration. Maize offal has level of fiber. Wheat offal and cassina is good in energy. Broken rice has 8% protein, it can be mixed up with other feed up to 15 to 20%. Bone meal, fish meal are also good source of calcium, phosphorus, grains, protein supplement and mineral mixture, water feed garbage and surplus garden is also good feed. Don't feed garbage older than 3days**.**Vit C makes pigs grow faster and larger. Different types of feed are mixed and boiled, all the grains can be mixed and given or different raw materials together are boiled and given

Energy sources feeds

The energy sources feeds were Corn, Mico, Wheat, Barrey and Tallow

Protein sources

The protein sources feeds were Soybean, Field pass and Amino acids.

Dry pregnant sows and gilts

Dry sows and gilts need 2.5kg a day of sow and weaner meal provide an extra 1kg day a week before serving gilts and sows and one week after service give lactating sows about 2.5 kg a day of sow and weaner meal for maintenance and 0.25 kg a day extra for each piglet being suckled

Boars

Give boars 2 KG a day if the boar is regularly used, increase this to 2.5 kg.

Piglets

Give creep piglet 0.5 to 1kg a day from 7 up to cleaning time. feed must be mixed with sow and weaner meal the last week

Vaccination schedule for pigs

Diseases and Vaccine	Age	Dose and Rout	Duration
Swine fever (Freeze dried vaccine)	3-6 weeks	1 ml I/M	One year
Swine Erysipelas	2 months	1ml S/C	One year
FMD (Tissue culture Vaccine	2 months	2 ml S/C	One year
Brucellosis	2 months	2ml S/C	Life Long
Swine Influenza	At any stage	1 ml S/C	6 Weeks

Vaccinations are very important in eliminating diseases and to maintain overall performance. Make sure that conventional cleaning, upkeeping and repository of all equipment used for delivering injection will make certain that the correct dose is given to each pig and contamination is excluded (Kalita *et al.*,2022)

Some main steps include: -

Disposing syringes and immediately after use**.** Reusable syringes should be washed with hot water**.** Store syringes in clean and dry place**.** Wipe vials rubber stopper before injecting needle. Frequently check measure of reusable syringes for accurate dose of medication

Biosecurity

Clean footbaths and vehicle baths containing potassium permanganate/limestone/hydrogen peroxide must be installed at entry points**.** Using disinfectants on equipment should be followed**.** Pigs and semen should be brought only from known source**.** Feed and water should be free from pathogens**.** Visitors and staff should use boots and gloves before entering the farms.

Marketing:

The demand of pork meat in north east region as is indefinite and the meat plays a major part in catering to the demand. Pork has its own high economic viability and pork business can be started with very low investment. During the festival times of north east region, the demand for meat rises up to 7 folds so pig farming can be proved as profitable business in north east region

Fig.2. Photograph showing the Vehicle bath for piggery farm

Fig.3. Photograph showing the foot bath for piggery farm.

Moreover, pig farming has created employment as a supplementary activity to the youth of north east region.

Fig.3. Photograph showing the marketing of piglet in Beltola area of Guwahati, Assam.

Fig.4. Photograph showing the marketing of piglet of Hampshire breeds in Beltola area of Guwahati, Assam.

Conclusion

Pig farming business is no doubt can prove to a profitable market in north east region. However, there is a huge gap between the demand and production which need to be lesser for good future.

Fig.5. Photograph showing the marketing of pork of Yorkshire breeds in Beltola area of Guwahati, Assam.

\Stakeholders of pig farming should develop serious concern to aware about its success to financially economically weaker sector of the society. Further pork as dish is very popular in North East region being 90% of the population of the meat eaters. The region's protein requirement cannot be fulfilled only by the common sources. As a result, pork processing and production has huge demands in north east region. Pork is still a dominant meat among the economically and socially deprived communities under intensive and semi-intensive management. Therefore, there is a huge scope of pork meat business in North east region. So, conservation of different pig breeds can serve as a very important economic asset globally.

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Anti-Nutrients- A limiting factor for use of green fodder in livestock feed

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Livestock plays an important role in Indian agriculture and rural economy. Rural population has major livelihood sources and income from livestock and poultry by selling milk, meat and egg. In India the available natural fodders are poor in quality with regards to energy, protein and minerals and vitamins, which leads to reduces production which directly affects farmers income. Although, green fodder, hay and silage contains good nutritional values, but there maintenance, ways of consumption and presence of some toxic material also alarm us. Among the different quality controlling aspects anti nutritional factors are also of prime importance. Anti-nutritional factors (ANFs) are products of secondary metabolism that are produced by normal metabolic process that interfere and affect the feed ingestion, health and production of animals. Green fodder contains these compounds called allelochemicals, which depends upon the system of cultivation (Rainfed, Irrigated or under drought condition) having deleterious or beneficial effects on livestock's.

Anti-nutritional factors

Chemical substances present in the diet which by themselves or their metabolic products arising in the system interfere with the feed utilization, reduce production or affects the health of animal.

Nitrate:

Crops like sorghum, millet, corn and sudan grass are having high levels of nitrate content

and legumes can have excessive levels under certain extreme conditions like drought and harvesting immediately after rain. The above forage crops harvested for green fodder before 50 days and fed with cattle will cause nitrate poisoning. Animals fed with such grasses contains nitrates undergoes a stream of biochemical process in livestock rumen. Initially nitrate is converted into nitrite, nitrite to ammonia, ammonia to amino acids, finally to protein. Nitrite is an intermediate product and when livestock fed with high level of nitrite forages the biochemical process from nitrate to protein cannot be completed. The process will be break at nitrite production stage, it leads to the accumulation of nitrite concentration is more in the rumen. This nitrite is absorbed into blood stream directly, it converts the blood haemoglobin into methemoglobin which cannot carry oxygen molecules. Due to nitrate (nitrite poisoning) animal can dies from lack of oxygen. It is called nitrate poisoning.

Oxalate:

Soluble oxalate present in the grasses (Setaria, and cenchrus) will induce calcium deficiency in grazing animals. Certain grasses namely, guinea grass, bajra and bajra napier contain oxalate content within safe limits. If cattle fed with guinea grass and cumbu napier grass over the extended period of time it may produce toxicity. Functional activity of oxalates is, it will react with calcium affects the absorbed calcium and converted as insoluble calcium oxalate, thus by reducing calcium absorption in livestock body. Cattle and sheep are less affected because of degradation of oxalate in the rumen. Oxalate level is more in early growth stage and younger plants of cumbu napier hybrid than older plants. When the plant matures oxalate content is declined. It is advisable the livestock can be fed with CN grass after 80 to 90 days after planting (DAP). Since CN grass is a multicut, oxalate content is reduced at the increasing the interval of harvesting time. Levels of 2 per cent or more soluble oxalate can lead to acute toxicosis in ruminants. The oxalate content of grasses is highest under conditions of rapid growth with concentrations as high as 6 per cent or more of dry weight

Hydrogen cyanide:

Dry season fodders include forage sorghum, sudan grass, millet have HCN poisoining at young stage and higher its vegetative leaves than older leaves. Sorghum cultivating under dryland or rainfed condition will have higher level of HCN than grown under irrigated condition. Water stress under dry land situation leads to increase the HCN level in vegetative leaves .Under stress condition like drought, frost and cutting and chopping can result in prussic acid poisoning. HCN

is easily absorbed by blood stream and prevents oxygen absorption. Grain sorghum is high in HCN content, Sudan grass has the lowest, and the sorghum-Sudan grass hybrids are intermediate in HCN potential. When the animal is fed with young stage of sorghum grass, the ruminal bacteria degradation can result in HCN poisoning. Post harvesting wilting of green fodder can reduce the risk of cyanide toxicity.

Coumarin:

Gliricidia sepum is a legume tree fodders which capable of fixing atmospheric Nitrogen. It cannot be used as a fodder for many animals because of gliricidia toxicity. It is mainly due to the anti-nutrient called coumarin that is converted into dicoumerol by bacteria during its fermentation. Under normal feeding, leaves are used as a fodder for cattle, sheep, goats and pigs. Palatability is varies depending upon the coil and climatic condition due to presence of aniti nutrient such as phenols and flavonol. It can be good forage for goats and sheep supplementation with rice, sorghum straw or other grass fodder which increasing digestibility. It can be used as energy source when mixed with maize bran and fed with goats.

Mimosin:

It is an alkaloid present in tree leguminous fodder commonly called “Subabul” (Leucaena leucocephala). It is a miracle tree because of its protein rich foliage (25%). It is widely grown in agro forestry systems, field bunds and also grown in non -cultivable land areas. Young and tender leaves contain mimosin which is a non-protein amino acid. To reduce toxicity effect, subabul leaves are sun/air dried. Several experiments stated that the mimosin content in the dried leaves ranges from 2.5-6%. But growing leaves and leaf tip contains upto 12%. It can be reduced with ensilaging methods. Leucaena leaves are soaking or washing in water will reduce their mimosin content. There is no harmful effect of the mimosin on livestock was reported when limited proportion of subabul leaves are fed with animals. More quantity of leaves fed with cattle will leads to loss of appetite, excessive salivation. However, partially dried subabul leaves fed with goats causes no deleterious effects on its health. Silage making and sun drying is the common measure to reduce the toxicity level of anti-nutrients.

Methods to remove:

HCN:

Forage grown on energy stress condition and crop not get proper irrigation, the levels of

HCN are found higher in younger sorghum crop. Thus try to avoid these type of crop for feeding livestock. Post-harvest wilting and drying of Cyanogenic leaves may decrease the effect of cyanide poisoning. Sorghum, Sudan and Johnson grass must be dried at least six hour before its use for feeding to livestock.

Mimosine:

Mimosine problem could be solved by genetic selection of strain of Leucena species containing low mimosine contents. Physical treatment like heat treatment and chemical treatment and supplementation with amino acids or with metal ions such as, and Fe, Al and Zn reduces the mimosine toxicity.

Nitrates:

Annual forages are more susceptible than perennial forage for Nitrates accumulation and toxicity. Adverse climate of drought or wet, dull weather condition are more prone to Nitrate toxicity. Following steps can reduce the risk of nitrate toxicity: Dilute the nitrate content of the total ration by feeding a combination of low and high nitrate feeds. Animal should be fed the ration, three or four times daily rather than just one meal per day. Allow cattle to sensitize with nitrate slowly to increase the nitrate content of the ration. Ensure balanced ration feeding to livestock for the level of production that is expected. Balance concentrate diet should be given along with feed contain nitrate to cattle to reduce toxicity.

Oxalate:

Rumen micro-organisms degrade dietary into formic acid and CO2. Adaptability reduces the toxicity of oxalate in the body. Ruminants adapted to diets with high oxalate content can tolerate oxalate levels that are lethal to non-adapted animals.

Conclusion

Regional wise specific feed and fodder selection and identification of anti-nutritional as well as nutritional factor to optimize all feed resources in order to reach its goal. Various aspects of toxic principals, their effect and its remedial measure are necessary for optimal feed management and utilization of feed and forage for better animal health and production.

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Bio-floc based tilapia farming

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Introduction

Aquaculture, being a youngest and fastest-growing food production venture in recent years, is supplying world's cheapest protein source, but on the other side, many lingering questions have been raised about how long this rapid expansion can be sustained (FAO, 2020). This is because, initially, aquaculture has been practiced as monoculture, which demands large quantity of water, large amount of fishmeal for feed preparation and vast amount of land areas to achieve high production (Boyd et al., 2020). In addition to this, improper disposal of aquaculture waste to the environment has created many negative consequences such as soil and water contamination, pathogen transmission and eutrophication of water bodies. These environmental issues were seriously damaged the long-term viability of aquaculture's industry (Verdegem, 2013). Recently. biofloc-based systems have been proposed and disseminated among the progressive farmers to solve these problems and to ensure the long-term sustainability of this sector (Bossier and Ekasari, 2017).

The biofloc technique (BFT) was initially developed for shrimp farming industry to address the problem of disease outbreaks (Treece, 2019). BFT has now been successfully adopted for many commercial fin fish rearing practices, especially in tilapia culture (*Oreochromis sp*.) (Emerenciano

et al., 2021). Tilapia is one of the world's most widely produced fish species and cultured around more than 114 countries (FAO, 2020). The main concept of BFT is to prevent the accumulation of toxic nitrogen levels in fish tanks through the growth of specific microorganisms which converts this waste into edible protein for fish. BFT is typically performed in a closed system with minimal water exchange, without much complicated filters and minimal discharge of nutrients. The conversion of nitrogen into microbial biomass is accomplished by increased supply of oxygen to the water through aeration and adjusting the water's carbon: nitrogen (C: N) ratio through the supplementation of carbon sources. The added advantages like minimal water usage with better maintenance of water quality, recycling of nutrients with *in-situ* food production and minimizing the disease outbreaks with better immunity of animals making this system as the need of the hour for aquaculture industry.

Tilapia culture in biofloc technology (BFT)

BFT systems are widely used in shrimp farming around the world. However, the success in shrimp farming slowly attracted the fish farmers to adopt this system for better production. Among the various farmed finfishes, tilapia is an excellent choice for BFT based production systems as it is an omnivore-filter feeder. Additionally, it can grow and survive well in dense systems like biofloc system.

In biofloc system, bacteria develop fast and attached to many other organisms and organic particles, forming bio flocs particle sizes ranging from 0.1 to a few mm, which can be quickly harvested and assimilated by tilapia. Tilapia grown in BFT ponds were compared to tilapia reared

in appropriate control ponds, and it was clear that the control ponds' fish had been starving and rushed desperately to the feed granules applied twice a day. In contrast, tilapia grown in BFT ponds ate quietly, indicating that they were not starved before feeding. Smaller fish that struggle to compete with larger fish in regular ponds should benefit from the semi-continuous feeding provided by the bio floc, resulting in better uniform growth of tilapia in BFT ponds.

Tank set-up, biofloc preparation and seed stocking

Biofloc based tilapia can be reared in lined ponds, indoor tanks, concrete tanks and HDPE circular tanks with central drainage system for better maintenance of water quality. Most preferred type of biofloc tank is indoor based circular tanks made up of HDPE sheets (above 540 GSM thickness). In general, 4 m dia circular tanks supported with stainless steel frame and GI poles were used. Initially, bottom is designed with concrete and brick-stone and then it will be provided with central drainage system. For this, either a slope is provided towards the central part of tank or a standing PVC pipe, with holes, is used. Followed by this, outer structures like frame, supporting poles and aeration facilities were provided. Then, HDPE sheets will be laid over this frame. Maximum care should be given while spreading this HDPE sheet.

For biofloc preparation, there are many methods have been adopted by farmers. In the initial days, heterotrophic bacteria were developed using pond soil, with the help organic carbon and vigorous aeration. However, the introduction of various commercial probiotics and efficient microbial products opened the gateway for other viable biofloc production methods. The following table predict the ingredients used in commercial biofloc production by progressive farmers;

Using probiotics (for 10000 L)		Using EM solution (10000 L)	
Salt	10 Kg	Salt	10 Kg
Calcium carbonate	0.5 Kg	Rice bran	1 Kg
Molasses	1 Kg	Jaggery	1 Kg
Probiotics	250 – 300 g	EM solution	1 L

After preparing this initial solution, it will be kept for 2-3 days for floc formation. Once floc is formed, it will be mixed with tank water. After 7-10 days, once biofloc is reached a volume of 20-25 ml/l in Imhoff cone, tilapia can be stocked in biofloc tanks.

Mono-sex tilapia seed purchased from the certified hatcheries can be stocked in biofloc systems. The recommended stocking density is 200-300 seed/m^3 to obtain a production of 20-25 tones/ha.

Feeding of tilapia in bio floc

The proper C/N ratio (10:1 to 15:1) can be achieved through adequate feeding, promoting ammonium uptake from the water. In order to save money, an appropriate strategy of feed that incorporates recycled microbial protein is also required. Feed rations in biofloc based tilapia production systems can be lower than the conventional ponds. In general, feeding pellets with low protein percentage can maintain the recommended C:N ratio or supplement the feed pellets with carbonaceous material (cassava, wheat or other flour, molasses, etc.) to maintain the C:N ratio.

Maintenance of floc in culture system

BFT tilapia culture has a high respiration rate due to the dense fish biomass and the microbial community that metabolizes the organic residues. Therefore, continuous supply of oxygen (> 6mg/l) is essential in biofloc systems. This can be achieved through various aeration systems available in the market, however while selecting the aerator, size of the fish and the biomass of the tank should be taken into account. In addition to oxygen, water ammonia level needs to be checked daily to maintain the C:N ration of 10:1 to 15:1. Based on the level of floc, measured in the Imhoff cone, supplementation of carbon source is recommended.

Intensive tilapia BFT ponds are typically small, ranging from 100 to 1000 m^2, due to the difficulty in mixing a large water body. This type of ponds was also provided with a central drain, in the middle of pond with a standpipe and valve. The drain is usually opened twice in a day, allowing the dark sludge to drain out until clear pond water emerges.

Conclusion

The contemporary challenges faced by tilapia industry could be well addressed by this sustainable production system. Further the feed recycling and reduced water exchange greatly enhance the cost-effectiveness of tilapia production. However, before shifting from traditional fish farming practice to this modern production system, farmer should get at least technical knowledge and minimum field level experience to this system for tasting the success in biofloc system. Government and other policy makers should keep this in mind and work towards the sustainable production of tilapia in the future.

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Management of livestock waste

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Introduction

Excreta, bedding matter, rain or water, soil, hair, feathers, or other debris commonly seen in animal waste management activities are all examples of "livestock waste." Animal husbandry experts used to be concerned about how to reduce the impact of the environment on animals. However, there has recently been discussion about cattle and the livestock industry harming the environment. In fact, cattle and climate have mutual positive and negative interactions of varying intensities, just like any other productive activity. Livestock waste production is inextricably linked to the activity of animal rearing. Intensive livestock farming, in which hundreds of thousands of animals are kept in a small space, produces a vast volume of animal waste. There are two forms of livestock waste: liquid waste or slurry, which includes urine, runoff water, rains, and washing water, and solid waste, which includes animal bedding, feces, and feed wastes. In previous decades, animal waste management was not a major issue, but as livestock numbers, herd sizes, and meat production grow, so does waste production. This has brought to light the importance of waste management, particularly in rational and practical methods.

Consequences for the environment and human health

Although animal dung is thought to be harmless, it can be dangerous to the general populace. Gases can pollute the air, harming both humans and the environment. Farm manure emits large amounts of gases such as hydrogen sulphide, methane, ammonia, and nitric oxide. The unauthorized discharge of animal excrement from leaking lagoons can have an impact on the soil and water systems. In tiny concentrations, phosphorus and nitrogen in manure are beneficial to the

soil. However, increasing the volume can result in major ecological issues such as the extinction of fish and the loss of biodiversity in the ecosystems concerned. Animal manure is frequently stored beneath barns in cattle lines, allowing poisonous gases to enter their confinement thereby causing death.

Importance of waste management

In soil with little organic content, livestock dung helps preserve soil fertility. Adding manure to the soil enhances soil structure and nutrient retention capacity. It also improves the physical condition of the soil by boosting its water holding capacity. Animal dung also helps to improve the climate in soils for microflora and fauna. Dung is sometimes employed as a source of energy. Livestock waste can help with resource management, crop and livestock productivity, and post-harvest losses reduction. Bio-energy sources are gaining traction as a viable energy source that can help address issues such as rising energy demand and rising fuel prices by acting as a substitute for pricey fossil fuels. It reduces the number of infectious agents in the animal and human populations. It aids in the control of vectors and fomites along with reduction of pollution in the environment.

System for waste management

Following is a quick rundown of some of the most essential and innovative waste management strategies utilized in livestock production systems:

Composting

Composting is a viable option for dealing with manure. It is one of the most ancient farming techniques. It's a natural way to manage solid waste by converting organic waste into nutrient-rich compost in the soil. Composting can be done in a number of ways, including the Coimbatore, Indore, and Bangalore processes. Compost enhances soil structure, reduces fertilizer requirements, and reduces the risk of soil erosion through adding organic matter. Composting decreases the weight and moisture content of manure whilst still increasing its stability. Compost is easier to work with than manure, and it stores well without odors or fly issues, reducing pollution and nuisance concerns. Leaching and subsequent ammonia losses are less likely with composted manure. When high-carbon manure/bedding combinations are composted, the carbon/nitrogen ratio is reduced to levels suitable for land application. Pathogens will be reduced if the compost pile is kept at the proper temperature. It is the active management of waste and the controlled decomposition of manure by microorganisms. It commences with the collecting of a waste pile.

Compost is made from waste such as animal dung, manure, animal bedding, poultry litter, sawdust, and used straw beddings. A 1.5-meter-deep trench is used to collect waste (3 cubic meters per adult). The carbon-to-nitrogen ratio varies between 25:1 and 30:1. Organisms function by consuming oxygen and converting it to carbon dioxide, water, and heat. The proximity of surface and groundwater is critical for composting sites. The region should not be prone to leaching, which might contaminate groundwater, or where leachate could run off into surface water. Compost is applied to agricultural fields as a fertilizer, added to improve soil structure, substituted for peat in horticulture and used as a microbial additive to increase enzyme activities.

Biogas

Biogas is a clean, environmentally friendly fuel made from the anaerobic decomposition of animal wastes, home and farm wastes, which are plentiful in the villages. Under anaerobic conditions, biogas is the bacterial breakdown of organic waste to gases. It is one of the most effective trash management solutions. Biogas is a combination of gases created by the decomposition of organic matter in anaerobic conditions. The pH, feedstock temperature and carbon-nitrogen ratio are all factors that influence biogas production from cattle manure (20:1-30:1). Animal dung, with a carbon-nitrogen ratio of 25:1, is thought to be perfect for maximal gas generation. When compared to aerobic waste management, one of the key advantages of biogas generation is that it takes less area, create high-quality renewable fuel and is cost-effective. Biogas is an environmentally beneficial method that promotes long-term agricultural sustainability. Biogas is especially well-suited to residential energy demands because it improves soil conditions as well as cleanliness. Animal waste-based biogas digester systems are environmentally friendly since they absorb and utilize methane directly, reducing overall greenhouse gas emissions from animals.

Vermicompost

The earthworm consumes organic waste and excretes "Vermicompost," which is a small pelleted substance. Earthworms have variety of species such as Eisenia foetida (Red earthworms), Eudrilus eugeniae (night crawler), Perionyx excavates, and others. Because of its fast multiplication rate, the red earthworm is selected because it turns organic waste into vermicompost in 45-50 days. The critical plant nutrients present in the organic waste, such as N, P, K, and Ca, are released and transformed into forms that are more soluble and available to the plants during vermicomposting. Plant growth regulators and other physiologically active compounds are found

in vermicompost. Furthermore, the worms themselves are a source of protein for animal feed. Vermicompost has been proven to be a rich source of nitrogen, phosphorus, and potassium by researchers, however there is a broad array of compositions reported by various workers. Vermicomposting is a new field that has the potential to be very beneficial to farmers and farm businesses. When correctly maintained, vermicompost can play a significant role in many situations.

Lagoons

A lagoon is an underground earthen basin where liquid manure is discharged and digested for a set period of time by bacterial action. The amount of oxygen dissolved in water is determined by the degree of mixing, and so the lagoons are classified as anaerobic, anaerobic, or facultative lagoons. Daily, animal barns are scraped and scrubbed with water under pressure of 75 pounds per square inch and 500 gallons per hour. This water flows into a lagoon, which should retain at least one week's worth of dung at a rate of 20 kg per cow each day. The lagoon is roughly 2 metres deep. The aerobic lagoon is at least 5 feet deep and holds water for 10 to 40 days. The depth of anaerobic lagoons ranges from 6 to 30 feet, with a retention time of 20 to 40 days.

Integrating cattle and fish for profitable manure management

If not managed appropriately, slurry mixed and excrement tainted water from animal farms can be quite dangerous; yet, it also has a lot of promise as a source of nutrients that can be recycled through integrated farming. Several areas have used traditional wastewater recycling practises such as agriculture, horticulture, and aquaculture. Integration of fish with cattle has lately emerged as a viable and long-term option, and is regarded as one of the most effective strategies for organic waste recycling. Cattle dung has recently been a popular source of manure in carp polyculture in India. Integration with algal production is another potential approach for efficiently processing livestock waste through a recycling process while also receiving benefits. Algal biomass may, in some cases, be used as a source of energy. Solid waste contains not just manure and other associated materials, but also animal and bird carcasses. From a socioeconomic standpoint, efficient disposal and use of these solid wastes in livestock farms is critical. The carcasses of dead animals and birds can be composted to produce nutrient-rich compost. Pig corpses can be composted in bins made of treated wood, concrete, or hay bales, all of which are placed on a concrete floor. Similarly, in the livestock farming and management environment, numerous novel

livestock management procedures are emerging that are ultimately targeted in improving farmers's livelihood.

Conclusion

Traditional livestock waste management procedures need and can be appropriately repurposed for human welfare and other reasons in various modern ways to battle growing energy prices, sustainable agriculture, and lessen environmental concerns. The pure biogas can be poured into CNG cylinders and used as a vehicle fuel. Bottled biogas has been discovered to be a viable alternative to crude oil, and so has a promising future. Integrated fish farming in a wallowing pond or waste-fed poultry or duck aquaculture is a very promising venture acting as income generation source for farmer. Vermicomposting is a strong way of recycling organic waste that also has the potential to create jobs, particularly in rural regions. The combined process of composting and vermicomposting, on the other hand, produces a superior substrate in a shorter amount of time. Animal manure is produced in vast quantities in livestock production systems. Manure management as a resource can be advantageous to animal farmers. In soils with low organic content, livestock waste management helps to preserve soil fertility. Efficient livestock waste management improves a developing country's socioeconomic level while also lowering the risk of disease spread through manure.

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SUCCESS STORY

One Stop Solution to All Your Farming Needs

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Mr. Amit Kumar, resident from West Champaran district, Bihar. He Graduated from Agriculture in 2015 from Dr. Rajendra Prasad Central Agriculture University. He worked as an advisor in Kisan Call Center. In 2017 he left the Kisan Call Center. In 2018 along with some agri start up work did MBA in Rural Management from Dr. Rajendra Prasad Central Agriculture University. And at the same time, on 17 April 2020, with the guidance of professor, he put project in Bihar Start-up. He contacted DMI Patna for the establishment of incubation centre on 18 August 2020, but due to Corona protocol, incubation started from December 2020 and got certified on 4 June 2021. On April 2021 he joined Assistant Technician Manager Atma Shivhar District but left the job in December 2021.In the initial phase of agri start-up journey except his family members and friends, society started seeing him as a shopkeeper but never losses hope and distracted from his ambition. Mr. Amit Kumar founder of Pusanow Farmers Solution Pvt. Ltd. (**One stop solution to all your farming needs**) provides a platform to farmers of remote villages in Bihar in accessing, understanding and adopting modern methods of Agriculture and using inputs which will take them one rung above on the ladder of agro-economic development. All this is done by providing services to farmers at the door steps in their villages. The start up with its three-lakh initial capital three manpower earn net profit 10-12 k per month

Pusanow Farmers Solution Pvt. Ltd provides following services to farmers in remote villages in Bihar.

- Start-up provides high quality seed, fertilizer, pesticide, spray machine, green house, drip irrigation system, organic manure, vermi compost and pesticide on one stop shop along with telephone based advisory service with soil health card.
- Provide services of field officer to train farmers on modern scientific farming, high value crops like mushroom, strawberry, capsicum etc., generate demand of agri input.
- Start-up will also develop and established micro processing unit through farmers cluster of 5-10 village.
- Start-ups produce market linkage from farmer's field to market with logo Pusanow FS Pvt. Ltd.

The firm work on producing vermi composed and low-cost Nano liquid organic manure, magic product which act as both fertilizer and pesticides. Through that magic product firm can motivate farmers (mainly backyard farm) towards organic farming and online selling (door to door) organic vegetables, fruits etc.

This start-up works as a rural E-Commerce centre and provide real benefits to farmers by providing its services in terms of multiple input.

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An overview on Sex Sorted Semen

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Abstract

Artificially Inseminating cows with semen, separated by flow cytometry into fractions containing X-or Y-chromosome-bearing populations of sperm, allow scientists to skew the sex ratio of calves up to 90% of the desired sex. The disadvantage of using sexed semen is that we get a small insemination dose of functionally impaired sperm, exacerbated by damage during sorting and the result is reduced fertilising potential. With the commercial introduction of sexed semen, its use has been recommended for the insemination of heifers due to the higher fertility potential in them as compared to the lactating cows. The benefit and the rate of genetic gain would be greater through obtaining additionally high-value offsprings from superior cows using the sexed semen of elite bulls. Studies that have aimed to increase the efficiency of insemination with sexed semen have focused on the use of timed insemination programmes. This overview represents data from studies on sexed semen, factors related to pregnancy rates and the opportunities favouring an increase of pregnancies in dairy and beef cattle breeds.

Keywords- Sex sorted semen, farmers, fertility, chromosomes, production

Introduction

Semen having X or Y-chromosomes bearing sperm to produce progenies of predetermined, desired sex either female or male (80-90% accuracy) is termed as sexed semen. It is an assisted reproductive technology which can help to increase the potency of dairy herds' breeding programs [1].

The sorting process was pioneered by a reproductive physiologist, George E. Seidel of Colorado State University (CSU), US. Further research was done to find out the difference between the X and Y chromosomes [2]. Considering that difference as a hallmark, USDA (United States Department of Agriculture) researchers in Livermore, California, and Beltsville, Maryland developed a technology capable of separating the X chromosomes from Y. Later, which was named as “Beltsville Sperm sexing technology”. A license was permitted to the Sexing Technologies (ST) of Texas and finally in 2001 the commercialization of sexed semen started [3]. After ST, ABS Global (formerly American Breeding Services) came up with a cutting-edge technology that kills ‘Y’ chromosome.

NDDB Dairy Services, a subsidiary of the National Dairy Development Board (NDDB) Anand, has developed indigenous sex-sorted semen technology to ensure birth of only female calves [4].

In March 2019, the country's first sex sorted semen production laboratory was established in Deep Frozen Semen Production Centre, Shyampur, Rishikesh financed by Rashtriya Gokul Mission scheme. Production of sexed semen of cattle (HF, Jersey, Sahiwal, Red Sindhi, Hariana and Gir) and buffaloes (Murrah) has started at the centre[5]. The technical partners in this endeavor is the Sexing Technologies, USA who has the original patent of the technology used.

Objectives of developing Sex Sorted Semen

Government approved Sex Sorted Semen scheme as it will target towards two basic objectives. It will help to increase the

productivity of cow and will indirectly decrease the number of unproductive male cattle because the practice of Amnapratha or

letting loose of unproductive cattle is very common practice in India.

A. India is the leading milk producer since 1998 along with its largest bovine population in the world. Milk production has increased from 17 million tons to 176.4 million tons during the period 1950-51 to 2017-18[6]. Dairy is also an important secondary source of income for many farmers in India. But due to rise in the population, urbanization and increased purchasing power of average population, the demand of milk and dairy products is accelerating. Thus, strategies are needed to be implemented in order to fulfill this demand, initialized by choosing calves of desired sex.

B. The scheme has a potential to provide a permanent solution to stray cattle menace in next 2-4 years, with 90% fall in the number of male calves [7]. It is better not to be born than to lead a life full of sufferings. Many of us must have seen the stray bulls roaming here and there with open wounds on their body, laming or burn wound marks. Also, it’s not easy to restrain them and take them to the nearest veterinary hospitals for treatment because of their massive body size and aggressive behavior towards humans.

C. It will bring down the damage to crops and number of road accidents caused by stray animals. Overall, it will reduce the number of conflicts and deaths among both men as well as the stray cattles.

Technique behind Sex sorted semen

Sperm are distinguished on the basis of chromosomes. The sperm with X-chromosome (female) contains about 3.8% more DNA than the Y-chromosome (male) in cattle. This difference in their DNA content is used to sort the sperm.

Flow cytometry-based sorting is one of the most widely used effective method for sperm sorting. Principle of this method relies on the fact that the X-chromosome bearing sperm contain 3.8% more DNA than Y-chromosome bearing sperm. Before sorting, the sperm cells are stained with a florescent dye (Hoechest 33342) which binds with its DNA content without altering its

motility [8]. Bisbenzimidazole DNA-binding dye could also be used, as it binds with the DNA content of live sperms only [9]. Then these sperms are passed through the flow cytometer as drops of liquid containing a single sperm cell per droplet. X-chromosome bearing sperm shine brighter than Y when exposed to light as they have more DNA content. Then the laser and detector of cytometer will distinguish the sperm cells according to the amount of light they emit. Each sperm cell is then charged with either positive or negative charge. And the defected, damaged or dead sperm remain unchanged. Thus, these charged drops are deflected accordingly and collected. The uncharged droplets go straight.

Free flow electrophoresis [10], Percoll gradient/ Albumin Gradient/ Gradient swim down [11], Centrifugal counter current distribution [12], Identification of H-Y antigen [13], Genetic approaches etc[14]. are some other methods of sorting the sperm but further modifications are required for their commercial use.

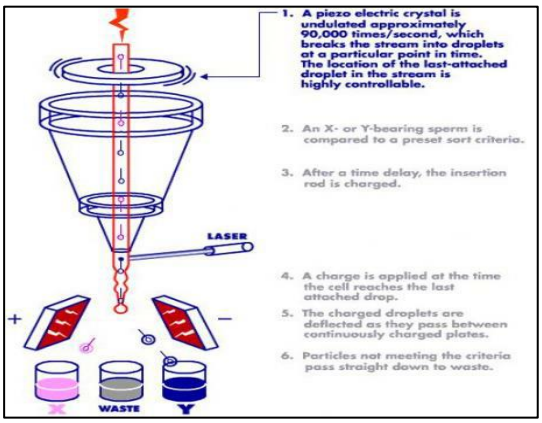

Figure 1: Schematic diagram of sex sorting using flow cytometry
Photo courtesy: Sexing Technologies, USA[15]

It's totally safe to use sexed semen straws for artificial insemination in field. But the concentration of sperm in conventional semen straw is far more than the sexed semen straws. Also, during sorting process some sperm get damaged. Overall, there is 10 to 15% decrease in the conception rates if we use sexed sperm semen as compared to conventional semen [16].

Advantages of using Sex sorted semen

A. Producing only female calves, helps the farmers to save resources that would have been shared with unwanted males calves too.
B. Production of more female calves will also increase the supply of replacement heifers.
C. Increase in the opportunity to sell surplus heifers to other farmers/farms.
D. Speed up genetic improvement:
a. Efficiency of progeny testing (PT) programme is increased
b. Efficiency of embryo transfer and IVF programme is increased
E. Provides an economic and desirable way to increase herd strength without any risk of introducing diseases by purchasing heifers from outside (improves bio-security).

F. Thia technique also enable us to sort out the viable sperm from dead, damaged or dying ones. Hence, the success rate of sorted semen at low concentration is much higher if compared to the conventional semen.

G. By producing more female calves using sexed semen, less difficult births (dystocia) cases were observed, mainly among heifers. It was observed in a report that the cases of dystocia and stillbirth in heifers were 4.3% and 11.3% and for cow 0.9% and 2.7%, respectively by using sex sorted semen. While these values for conventional semen were 6% and 10.4% for heifers and 2.5% and 3.6 % for cows respectively. Hence a decline in the chances of dystocia by 28% in heifers and 64% in cows was seen by using sex sorted semen [17].

Limitations of using Sex sorted semen

A. Technological limitations:

i. Sex sorting machine is costly.
ii. The efficiency and speed attained by flow cytometry sorting is low.
iii. The process of sorting semen requires highly skilled personnel.
iv. Shear force, electrostatic charge, droplet formation and sudden stoppage cause high damage to the sperms [18].
v. By the end of the process the wastage is around 50% of the viable sperms.
vi. The freezing potential of sorted sperm is reduced to some extent [19].

B. Implementation limitations:

i. High cost of the end product which is Rs. 1500-4500/- dose as compared to Rs. 15-20/- dose for conventional semen [20].
ii. The conception rate with sex sorted semen is 10-15% less than the conventional semen. This factor will be more crucial in Indian condition considering low artificial insemination coverage (20-25%) and low conception rate with artificial insemination (25-35%)[21].
iii. No standard operating procedure is available to perform the task of insemination using sorted semen. The concentration of sperm in sexed semen ranges between 2 and 4 million/dose whereas in conventional semen, it is 20 million/dose. Hence, in the field, there is a challenge to manage this lower sperm concentration under Indian conditions [22].

Commercially sex sorted semen is available only for HF and Jersey cattle's breeds in India [23]. Sexed semen is not available for any other Zebu breed of cattle and buffaloes.

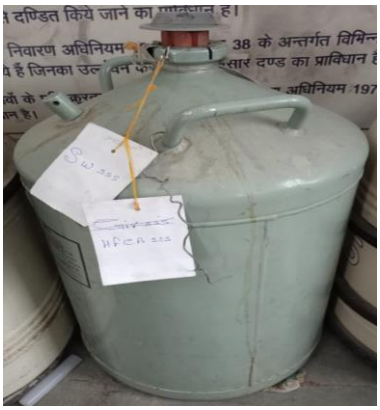

Figure 2: A liquid nitrogen container containing sex sorted semen of HF crossbred in State Veterinary Hospital, Heera Nagar, Haldwani, Uttarakhand.

Success rate of sex sorted semen in Uttarakhand

An experiment was performed in Lohaghat block of Champawat district of Uttarakhand. Flow cytometric sorted sexed semen obtained from Uttarakhand Livestock Development Board

(ULDB), Dehradun, was used to inseminate 70 cows (body weight lying between 300-400kg) in their first or second calving period. 40% cows conceived and out of these, 82.14% were cow calves while rest were bull calves. This clearly depicts that conception rate using sexed semen is low. This is also the reason why sexed semen straws are not the choice of farmers [24].

Conclusion

Science and technology are the double-edged sword. They have both pros and cons. And in this modern, developing and innovative society, science is that propellent which will lead us to the direction of development and well-being. Looking into its positive aspect, use of sex sorted semen will not only help our farmers to increase the productivity but will also help us to decrease the population of unwanted male calves. Farmers can now have the female calves having the characters of their desired sires and dams. But further, more researches are to be done in order to decrease the cost of its production and to improve the fertility rates using it.

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