For Private Circulation Only

Vol. XXXVII (No. 1) June, 2016

ISSN 2319-5762

VET ALUMNUS

.....Official organ of the Alumni Association, College of Veterinary Science, Guru Angad Dev Veterinary and Animal Sciences University, Ludhiana.....

Editor: **Dr. Amarjit Singh**

Associate Editor: **Dr. Jaswinder Singh**

CONTENTS

Note : Authors are sole responsible for the contents given in articles

ANIMAL WELFARE AND VETERINARIANS AS A CONTRIBUTOR TO NATIONAL FOOD SAFETY AND SECURITY

RAVDEEP SINGH AND RAJESH KASRIJA

Department of Veterinary and Animal Husbandry Extension Education, GADVASU, Ludhiana, Punjab.

Animal welfare is not just absence of cruelty or unnecessary suffering. It is the bell being of animals both in physical and mental state. Animal must met five basic requirements of well being. These are: *Freedom from pain, injuries and diseases*: - Animal pain and suffering are clinically important conditions that adversely affect an animal's quality of life and their welfare. *Freedom from hunger, thirst and malnutrition*:-Animals should have an easy access to clean and fresh drinking water and good diet to maintain proper health and vigour. *Freedom from discomfort*:-Animals should get proper and suitable environment for their life. They should be provided with clean, dry and comfortable resting area. Animal should get sufficient space in their shelter for the free movement. *Freedom from fear and distress*:-Animal should be free from any type of fear and distress and it is done by ensuring the conditions which avoid mental suffering. *Freedom to express normal behaviour*:-Each and every animal should have freedom to express normal pattern of behaviour in a particular environment. It can be followed by ensuring the conditions that will not put any impact on the animal's normal behaviour. These five freedoms are now modified as the five basic needs of animals, relating to proper and sufficient food and water, adequate shelter, the ability to display normal behaviour, physical handling that minimizes distress, protection and rapid diagnosis of injury or disease. Decisions regarding animal care, use and welfare shall be made by balancing scientific knowledge and professional judgment with consideration of ethical and societal values. Animals shall be treated with respect and dignity throughout their lives.

The health and care of dairy animals is an essential part of good animal husbandry and a welfare program. Main pillars of any animal welfare programme are the freedom from pain, injury and disease. Pain can be prevented by using appropriate ethical measures approved by government, injury can be prevented with careful handling of the animals wherever they are and diseases can be prevented by adherence to herd health, nutrition, management programs and proper veterinary care that enhance well- being. If there is occurrence of a disease, rapid diagnosis and treatment can be instituted. Animals should have access to feed and water on a daily basis, in a consistent manner, on a regular schedule and according to their specific requirements. Rations should provide the required nutrients for maintenance, growth, lactation, and pregnancy (based on an animal's life stage). Nutritional management is greatly improved when producers take the time to observe their animals to maintain uniform groupings and give attention to animals that are lagging behind. Judicious management of the environment enhances the production performance of animals and minimizes animal disease, death loss, and behavioural problems. Facilities like housing, handling techniques and trained handlers, feeding, breeding, health care, veterinary care and pastures availability should be provided as far as safety and well-being of the animals is concerned. Decisions regarding animal care, use, and welfare shall be

made by balancing scientific knowledge and professional judgment with consideration of ethical and societal values. Conservation and management of animal populations should be humane, socially responsible, and scientifically prudent. The Veterinary profession shall continually strive to improve animal health and welfare through scientific research, education, collaboration, advocacy and the development of legislation and regulations. Health of the dairy animals can be maintained by appropriate nutrition, housing, disease prevention, and detection along with well-designed treatment programs and Herd Health Plans (HHP). An effective HHP emphasizes prevention, rapid diagnosis, and quick decision-making on necessary treatment of sick or injured dairy animals. A licensed Veterinarian or other appropriately trained consultant can help producers in the development and implementation of a routine Herd Health Plan. These programs and plans should be developed through consultation with a qualified Veterinarian. The contemporary roles of veterinarians go far beyond these more visible tasks. As the world is becoming more interconnected and more complex, so are the various obligations and responsibilities that Veterinary professionals must undertake. Broadly speaking, veterinarians are involved in more than administering vaccines, cleaning wounds, treatments, and inspecting animal food products. Veterinarians have transformed themselves as like multifunctional professionals. Now, a Veterinarian is acting as a doctor, a teacher, a manager, a planner, an evaluator and utmost important as an extension agent. Over the years Veterinary professionals have played significant and contributory roles in animal and human health welfare, food quality, food safety and food security. This helps the societies and its animals to stay healthy and productive. It is now widely acknowledged that healthy and productive livestock make important contributions to food production, food safety, food security, income generation, job creation, economic growth, and poverty alleviation. It is therefore not surprising that veterinarians and animal welfare is directly linked with national food security and safety.

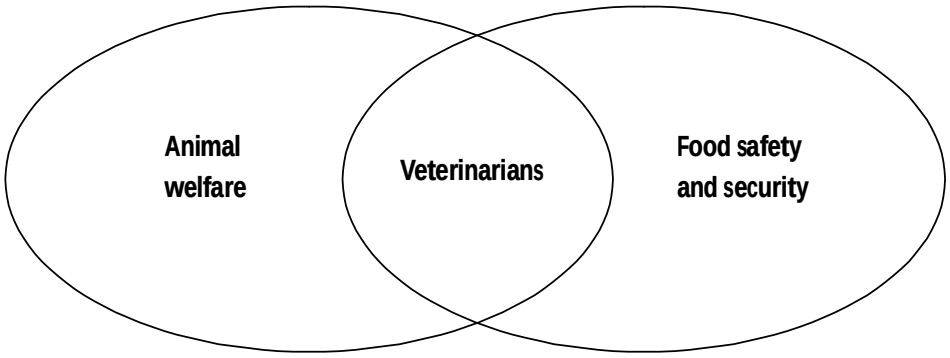
In this regard, the roles of farm-oriented Veterinary professionals are to advise farmers and owners of livestock production systems to practise the herd health management practices by undertaking housing, nutrition, cleaning, disinfection of premises and environmental sanitation on preference according to their specific agro-ecological contexts. The correct and judicious use of all these practices may reduce dependency on the usage of veterinary medications and therefore reduce input and labor costs, which in turn positively influence farm productivity and profit margins for the farmers.

Food safety and security is a topic of concern in a populous country like India were about 194.6 million people were undernourished in 2014-15 which was approximately 15.2% of its population (dnaindia.com-national newspaper report, 2015). Agriculture and allied sector shares 17.01% in GDP (Planning Commission, Government of India). The increased contribution of livestock is hinting towards a structural shift in the agricultural sector in the country. The policy makers are now recognising livestock as the engine of agriculture growth. Both livestock and fisheries components have been growing faster than the crops component for a decade. Livestock now controls a quarter of the agriculture Gross Domestic Product (GDP). So it is very important to improve food security beyond short-term responses by protecting and promoting people's livelihoods over the longer term, with agriculture and livestock subsector.

Healthy and productive livestock produces a wide variety of food products for direct

and indirect human consumption. These products include eggs, meat and meat products, milk and dairy products and a variety of by-products such as brain, ears, feet, skin, testicles and tongue, etc. The food and income from healthy animals empower farmers of all scales to embrace the advantages, education, opportunities, and strengths they need to produce more food and income to feed an ever-increasing population. Also, animal food products from healthy and productive livestock improve farmers' access to both domestic and international markets.

It is for this very reason that the provision of veterinary services by national and regional agencies is a key component of efforts supporting sustainable production of food from animal origins and to the success of farm operations. The lack of proper animal health practices reduces farm efficiencies, decreases food production levels, and impacts potential profits. Many ongoing studies from different parts of world have demonstrated that there is a direct correlation between the quality of livestock production and the provision of veterinary services. Other contributions to food security can be done through the multidimensional approach by eradicating various infectious, managemental and zoonotic diseases. Whenever zoonotic diseases strike any given geographical location, veterinary professionals are the primary source of information for governments, the media, civil society organizations and for others. They are the first line of defence that society counts on against agroterrorism and bioterrorism.



In sum, veterinary professionals are key players on bio-defence and thus for national security and welfare. The veterinary profession shall continually strive to improve animal health and welfare through scientific research, education, collaboration, advocacy and the development of legislation and regulations.

SUGGESTIONS TO REDUCE COMMON ERRORS DURING FROZEN SEMEN HANDLING AND ARTIFICIAL INSEMINATION PROCEDURE

A K SINGH AND S P S GHUMAN

Department of Veterinary Gynaecology and Obstetrics, GADVASU, Ludhiana

The use of artificial insemination (AI) can greatly enhance the production potential of breeding buffalo bulls. However, improper semen handling techniques and equipment maintenance during the breeding process can lead to decreased conception rates and diminish the chances of a productive AI season. Semen quality can be damaged during storage, thawing and handling prior to insemination. Usually, errors made in the handling of frozen-thawed semen are small; however, mistakes in semen handling are frequently add-on. Mentioned below are the areas which often lead to semen handling errors during an AI program.

1. Liquid nitrogen storage tank: Always store the tank away from direct sunlight in a cool, clean, dry, dust-free and well ventilated environment. Accumulation of thick and icy frost in and around the neck of tank, caused by liquid nitrogen evaporation is the first indication of ineffective insulation system of tank resulting in fast evaporation of liquid nitrogen. Monitor the level of liquid nitrogen in the tank with a dip-stick once in a week, and keep a simple log to detect any drastic changes in nitrogen levels. The rule of thumb is that, refill the tank before the liquid nitrogen level falls below 2 inches. The semen is stored in liquid nitrogen at -196^{o}C in the tank. Maintaining correct temperature is important, as a temperature rise and subsequent re-freezing will damage semen.

2. The AI kit: A well maintained insemination kit should always be clean and free of dirt, dust and manure and reduces the chances of introducing infection into a sterile uterus. The kit should contain the following:

- Scissors
- Thermometer
- Thawing tray
- Forceps
- Singly packed sheaths
- AI Gun
- Plastic gloves
- Clean towel
- Thermos / flask with hot water
- Apron
- 1.5 / 2 liter cryocan with desired semen straws
- Tissue paper
- Spirit swab in small plastic jar

Any deviation from this basic AI equipment will hamper a technician from proper semen handling techniques. Always check to ensure that the AI kit is completely stocked before proceeding with thawing the semen.

3. Proper semen handling

(i) Improper retrieval of frozen straws from a liquid nitrogen tank: Always keep the canister below the frost line when locating a straw of semen. Avoid lifting the canister too high or too long during this process. If the straw cannot be located within 5-10 seconds, drop the canister back into the tank and try again. Keep a frequently updated semen inventory with the tank for quick location of bull numbers.

(ii) Using bare hands to retrieve straws from liquid nitrogen tank: Use small size forceps rather than fingers to pull semen from goblet. This is primarily for the safety of the technician because liquid nitrogen can cause severe cold burns or frostbite.

(iii) Improper thawing temperature and thawing time for frozen semen: Time and temperature are two critical factors in proper thawing of frozen semen. Thaw semen straw in warm water (32-37^{o}C) for 40-45 seconds. Thawing above 40^{o}C may cause it to overheat. Always check the temperature in the thawing tray before pulling a frozen straw from the liquid nitrogen tank. Monitor thaw time with a watch. Never thaw semen in the shirt pocket. Once thawed, straws must not be re-frozen.

(iv) Improper drying of straws after removal from warm water: Always wipe the straw completely dry with a clean tissue paper before loading it into the AI gun because water is lethal to semen.

(v) Improper cutting of semen straw: Always cut the straw straight and not at an angle at the crimped sealed end. Push the straw into adaptor of the plastic split sheath to prevent semen back flushing into gun during insemination.

(vi) Failure to protect semen from direct sunlight: Always protect straw from ultraviolet light with a clean tissue paper to prevent sperm cell damage.

(vii) Thawing too many straws at one time or taking too long to inseminate: Thaw only one straw at a time. Inseminate the animal within 15 minutes once a straw is thawed.

(viii) Failure to protect AI gun from temperature extremes: Cold or heat shock to semen results in damage to morphology and motility of sperm.

(ix) Use of soap or detergent as a lubricant: Soaps and detergents are lethal to semen. Always use an approved non-spermicidal AI lubricant.

(x) Failure to pull the plunger back before loading insemination gun: Always pull back the plunger approximately 6 inches before loading a straw into a semen gun. Not doing so will cost a straw of semen.

(xi) Failure to identify the target area for deposition of semen: The target for semen deposition is quite small. Accurate gun tip placement is probably the most important skill involved in the whole insemination technique. Inseminators generally identify this target area by feeling for the end of cervix and the tip of the gun as gun emerges

through the internal-os.

(xii) Improper site of semen deposition: Liquid semen is usually deposited in the mid-cervix whereas frozen-thawed semen is placed in the body of the uterus.

(xiii) Fast or rough deposition of semen: Gently express the semen and not forcefully throw it out. Semen deposition should take 5-7 seconds.

(xiv) Improper position of AI gun during semen deposition: While deposition of semen at the suitable place; take care not to draw the gun too far back.

(xv) Accidental blocking of uterine horn during semen deposition: During the process of semen deposition take care that fingers of the palpating hand are not inadvertently blocking a uterine horn or misdirecting the flow of semen in some manner.

(xvi) Quick and rough withdrawal of AI gun after semen deposition: Pause before withdrawing the gun allowing the semen to get away and then slowly withdraw the gun form the cervix. Rapid gun withdrawal may allow the semen to flow back into the vagina. Therefore, remove the gun slowly from the vagina.

(xvii) Vigorous movement of animal during semen deposition: If the animal has moved during semen deposition, stop the semen deposition and correctly reposition the gun tip before continuing with the semen deposition.

(xviii) Failure to use a locking-ring on the AI gun: Always lock the plastic sheath into place on the inseminating gun with a locking-ring. Otherwise, the sheath will slip, leading to improper semen placement during insemination.

(xix) Sheaths left out in hot weather: Always store plastic sheaths in a cool place out of direct sunlight to avoid irreversible shrinking and curling of plastic sheaths, which renders them unusable.

(xx) Taking shortcuts during insemination: It is highly recommended that all technicians attend an annual refresher course before the breeding season begins. Check that all equipment is functioning properly and all supplies are stocked to avoid makeshift improvisations that may undermine a successful AI program.

Summary

Therefore, proper use and maintenance of the insemination equipment, proper semen handling, improving the technical skills of the inseminator and keeping accurate herd records are essential for ensuring a successful artificial insemination program.

CYTOKINES: A NATURAL ALTERNATIVE TO ANTIBIOTICS FOR POULTRY

MONIKA THAKUR, KULDIP GUPTA AND AMARJIT SINGH

Department of Veterinary Pathology, GADVASU, Ludhiana

Poultry are usually reared under intensive conditions which are conducive to infection by opportunistic pathogens. Newly hatched chickens are highly susceptible to infection during the first 2 weeks of life. Several factors contribute to this problem, including immaturity of their immune system, declining maternal antibodies level, and stress factor associated with intensive rearing of poultry. A major problem faced by all livestock industries, is loss of productivity due to disease, which is of major concern. Therefore, considerable measures are required in order to maintain the health status of these animals. The two main mechanisms by which the disease is controlled, involves the use of vaccines and antibiotics.

Antibiotics have been used to treat and control diseases in livestock and poultry for more than 50 years. In-feed antibiotics are generally used at low levels and result in improvements in growth rate and feed-conversion efficiency. Antibiotics generally provide short-term, broad-spectrum protection and are provided continuously to poultry as feed additives. The use of antibiotics has become very popular in the poultry industries because, in addition to being an antimicrobial, they also have growth promoting activity. However, the extensive use of antibiotics as feed additives has raised concerns about the potential spread of antibiotic-resistant bacteria, in the food chain and unwanted residues in food products.

As recently reported from a WHO meeting held in Berlin on the medical impact of the use of antimicrobials in food animals, the extensive use of antibiotics, particularly those that are used in human medicine, has resulted in human health concerns. The WHO has recently urged meat producers to stop using the same antibiotics that are used in humans. Furthermore, the WHO has emphasize the search for environmentally-friendly alternatives methods to control disease in livestock animals.

A novel approach in the search for alternative therapeutics has been to examine cytokines as potential replacements for in-feed antibiotics in poultry. Cytokines are proteins that are naturally produced by the body's immune system immediately following infection or vaccination, resulting in protection from disease. They determine both the type and extent of an immune response that is generated following infection with a pathogen. These proteins exert either suppressive or enhancive effects on cellular proliferation, differentiation, activation, and motility. Cytokines control and promote immune responses in all animal

species and therefore represent excellent candidates as therapeutics.

In order to grow an animal, it has to be free from illness and stress. Growth is influenced by interactions between the immune system and other systems within the body such as the neurological and endocrine systems in which, cytokines play a crucial role. One of the most characterized chicken cytokine genes is chicken (Ch) IFN-ã. Treatment with ChIFN-ã results in enhanced growth rates in healthy chickens as well as in chickens infected with E. acervulina.

The utilization of cytokines as an alternative to antibiotics in livestock animals, particular poultry, has become more feasible with the recent cloning of cytokine genes and the progression of new technologies such as live vectors. Since the chicken's immune system is similar to that of mammals, they offer an attractive model system with which to study the effectiveness of cytokine therapy in the control of disease in intensive livestock.

Under such conditions, the use of cytokines as nonspecific potentiators of the immune system may be a more practical solution to protection from infectious diseases. Cytokines potentially provides the animal production industries with the most natural, non-antibiotic methods for increasing disease resistance in chickens and offer an exciting alternative to antibiotics. Therefore, the use of cytokines as an effective, naturally occurring growth promoter is now an emerging area of research and use of cytokines in poultry will become an essential component of disease management in the future.

DIAGNOSTIC TOOLS FOR IDENTIFYING COMMON CANINE HEMATOPROTOZOAL BY FIELD VETERINARY PRACTITIONER

SHIVANI SANGHA[1] AND KARANDEEP[2]

[1]Pathologist, Regional Disease Diagnostic Laboratory (North Zone), Jalandhar, [2]Incharge, Civil Veterinary Hospital, Nauli, Jalandhar

Canine Ehrlichiosis, anaplasmosis and babesiosis are the most common tick borne haemoprotozoan diseases prevailing in Punjab region. Canine monocytic ehirlichiosis is caused by *Ehrlichia canis*; Aanaplasmosis or Canine granulocytic ehrlichiosis by *Anaplasma phagocytophilum* (earlier called *Ehirlichia phagocytophila)* and Babesiosis by large (*Babesia canis)* or small forms (*B.gibsoni, B.micorti)* of babesia species.

Due to increasing globalization, massive deforestation and rapid import-export, the tick count and thus tick induced diseases have increased to great extent in pet animals. The infection usually starts from mild clinical symptoms like anorexia, lethargy or generalized weakness but turn into life threatening condition in very short span of time. Moreover, loss of pet animal is a great emotional trauma for the owner. So a quick diagnosis is needed for proper curative treatment. In field conditions, there is paucity of sophisticated laboratory equipments for molecular or immunological diagnosis. Thus, self collection and investigation of blood/serum/ aspirate using light microscopy and less expensive laboratory equipments can be done by field veterinarian. Correlating these investigations with clinical symptoms and biochemical alterations becomes the first hand diagnostic tool for the field practitioner.

Clinical Findings:

Depression, anorexia and weight loss are the primary concerns of the most of the pet owners at the time of presentation of the pet to the veterinarian.

Other clinical signs during ehrlichial infection include increased bleeding tendencies (epistaxis, melena, hematuria, and haemorrhages on the skin), lethargy, depression, anorexia, fever, exercise intolerance, swelling in hind limb region, lymphadenomegaly, spleenomegaly and hepatomegaly. Sometime ocular disorders like corneal opacity, retinal haemorrhages and blindness are also reported.

The clinical signs during *Anaplasma phagocytophilum* are variable; include lethargy, gastrointestinal disorders like vomiting, diarrhoea, tense abdomen, cough, nasal discharge, shifting lameness, surface bleeding and rarely cough, uveitis etc.

Dogs affected with babesiosis are generally presented with high fever (106 degree Fahrenheit), weight loss, inappetance, anemia, jaundice, muscle tremors, hemoglobinurea etc.

Collection and preparation of Sample:

The blood can be collected in commercially available blood collecting EDTA vial or in simple sterile glass vial containing EDTA @ 1-2 mg/ml of blood. The air dried blood or aspirate smears can be stained with various Romanowsky stains like Giemsa, Leishman or

Wright stain. Platelets and reticulocytes (immature RBC) examination can be done using various stains as per established guidelines. For investigating *Ehrlichia* spp in buffy coat, the blood sample needs to be centrifuged at 2260xG for 30 minutes.

Blood sample investigations:

A Giemsa stained blood smear of haemoprotozoan infected canine presents altered haemogram values than normal (Table 1). Abnormal findings are variable; mild to moderate normocytic (RBC similar in size to that of healthy animal), normochromic or hypochromic (RBC similar or less intense in colour to that of healthy animal), haemolytic, non-regenerative anemia is observed. Non regenerative anemia indicates non responsiveness of bone marrow to anemic state with absence of reticulocytes.

Other erythrocyte indices include decrease in PCV (Packed cell volume) and MCV (Mean corpuscular volume) and increase in MCHC (Mean corpuscular haemoglobin concentration) are observed. PCV is most accurate and simple method for estimating the degree of anemia; lesser the PCV, higher is the degree of anemia.

The White blood cell count reveals pancytopinea (decrease in value of all the cell types) in chronic cases. Thrombocytopenia is hallmark of these infections. Presence of immature megaplatelets is indicative of regenerative thrombocytopoiesis.

Table1: Hematological and biochemical reference range in dog

Normal reference range	Value
Hemoglobin (g/dl)	10-16
PCV (%)	30-50
RBC (X10^6/microliter)	5-8
MCV (fl)	55-75
MCH (pg)	19-24
MCHC (g/dl)	30-36
Plateletcount (x10^5/microliter)	2-8.5
WBC Count	6000-16000
Neutrophils (/microliter)	3000-11000
Lymhocytes (/microliter)	1000-4500
Monocytes (/microliter)	1000-1200
Eosinophils (/microliter)	100-700
Basophils (/microliter)	Rare
Total plasma protein (g/dl)	5-7
Albumin (g/dl)	2.5-4
Creatanine (mg/dl)	0.5-1.6
Urea nitrogen (mg/dl)	8-25
Total bilirubin (mg/dl)	0-0.6
Alanine aminotransferase (IU/L)	25-92
Alkaline phosphatase (IU/L)	10-94

Diagnostic value of microscopic evaluation depends on species of causative pathogen. The *Ehrlichia* species of organisms parasitize agranulocytes i.e monocytes and lymphocytes and the morulae can be observed in the cytoplasm of these cells. However, very low detection rate is documented from blood smear examination and it can be enhanced

by making the smear from concentrated buffy coat rather than peripheral blood smear.

Blood smears of *Anaplasma phagocytophilum* infected animal presents round, basophilic cytoplasmic inclusions in the neutrophils.

In case of babesiosis, canine red blood cells reveal merozites of large or small babesia forms. Large forms like *Babesia canis* are 3-7 micrometer long and show paired merozoites (pair tear-drop forms) while the small forms like *Babesia gibsoni* are 1-3 micrometer long and show single merozoites (signet-ring form).1 2

Biochemical findings:

Serum biochemistry shows high Bilirubin content (a by-product of red blood cell lysis), increased activity of liver enzymes like Alkaline phosphatase, Alanine amino-transferase etc. There is hyperglobulinemia, hypoalbunimea. Plasma protein estimation indicates decrease in albumin due to leak of albumin through damaged vessels and tissues. Hyperglobulinemia is seen with reverse albumin to globulin ratio (Normally more than 1) in long standing cases due to increase in gaama-globulins. Decreased serum albumin results in decreased colloidal pressure which in turn produces edema and ascites. Urine analysis in babesiosis present bilirubinurea, proteinurea and haemoglobinurea.

This article has intended to provide certain basic clues to identify causative agents with the help of facilities available to field veterinarians. Though, confirmatory diagnosis requires molecular and immunological assays.

BRUCELLOSIS IN DOGS

HAZARIKA D, PAVITER KAUR, SANDHU Y AND SHARMA N S

Department of Veterinary Microbiology, GADVASU, Ludhiana-141004

Canine brucellosis is an important zoonotic disease caused mainly by *Brucella canis* and occasionally by *B. abortus*, *B. melitensis* and *B. suis*. *Brucella* spp. are facultative intracellular pathogens, Gram-negative coccobacillus or short rod, oxidase, catalase, and urease positive. *Brucella canis* was first described in USA in 1966 where mass abortion in beagles breed of dogs was reported. In India, *B. canis* infection was reported for the first time in 1991. Clinical manifestations of brucellosis in dogs include epididymitis, testicular atrophy and sterility in male dogs, while the major symptom in females is abortion. Although dogs that have been spayed or neutered do not have reproductive signs, they occasionally develop other conditions such as ocular disease and discospondylitis. Transmission to humans especially pet owners may be through contact with the semen, urine, and/or aborted fetuses of infected animals.

Transmission

B. canis can be demonstrated in the aborted fetus, placenta, fetal fluids, milk, urine and semen of infected animals. The organism can persist in vaginal discharges for several weeks after an abortion and is shed in normal vaginal secretions, particularly during estrus. High concentrations of *B. canis* may be found in semen for weeks or months after infection and intermittent shedding of smaller quantities can occur for years. *B. canis* may also be excreted in saliva, nasal and ocular secretions and feces.

In dogs, *B. canis* primarily enters the body by ingestion, through genital, oronasal and conjunctival mucosa or by contact with the aborted fetus and fetal membranes. Transmission through broken skin and through aerosols may also be possible. Most cases are thought to be acquired by venereal transmission. Chronically infected dogs can shed this organism despite being seronegative and blood culture negative. Puppies can be infected *in utero*, and may remain persistently infected even though they may appear normal. Blood transfusions and contaminated syringes are the other potential sources of infection.

Disease in animals:

B. canis is only known to be important in dogs. *B. canis* can cause abortions and stillbirths in pregnant dogs. Most abortions occur late, particularly during the seventh to the ninth week of gestation. Abortions are usually followed by a mucoid, serosanguinous or

grey-green vaginal discharge that persists for several weeks. Early embryonic deaths and resorption have been reported a few weeks after mating, and may be mistaken for failure to conceive. Sometimes live but weak pups are born which often die soon after birth. Other congenitally infected pups can be born normal and later develop brucellosis. Clinical signs occur during subsequent pregnancies in some dogs, but not in others. In males, epididymitis and scrotal edema are common in the acute stage. Other symptoms include unilateral or bilateral testicular atrophy in chronic infections, infertility in some males, orchitis and scrotal dermatitis self-trauma by licking. Other symptoms that are occasionally reported include lethargy or fatigue, exercise intolerance, decreased appetite, weight loss and behavioural abnormalities (loss of alertness, poor performance of tasks). However, most affected dogs do not appear seriously ill. Fever is rare and many infected dogs remain asymptomatic.

Dogs with brucellosis may recover spontaneously, beginning a year after infection, but recovery is more common after two to three years, and some dogs remain chronically infected for years. Deaths are rare except in the foetus or newborn.

Disease in Humans:

Little information is available regarding the incubation period for brucellosis caused by *B. canis* in humans. The symptoms caused by other *Brucella* spp. usually appear within 2 weeks of exposure, but some cases have developed as late as 3 months. The virulence of *B. canis* for humans has been considered to be low, as few cases have been documented and most have been mild. Hence infections may go under reported and specific diagnostic tests are rarely performed for diagnosis of the disease. The expected clinical signs are based mainly on the syndromes caused by other species of *Brucella*. Some people infected with *Brucella* spp. remain asymptomatic. In symptomatic cases, brucellosis begins as an acute febrile illness with nonspecific flu-like signs such as fever, chills, headache, malaise, back pain, myalgia and generalized aches. Drenching sweats can occur, particularly at night. Some patients may also have lymphadenopathy, splenomegaly or hepatomegaly. Some patients with brucellosis recover spontaneously, while others develop persistent symptoms including fever, weakness and other nonspecific signs. Arthritis, spondylitis, chronic fatigue and epididymo-orchitis can be seen. Neurologic signs (including personality changes, meningitis, uveitis and optic neuritis), anemia, internal abscesses, nephritis, vasculitis, endocarditis and dermatitis have been reported with some species of *Brucella*. The mortality rate for brucellosis is low and can vary from less than 2% to 5%.

Diagnosis

Diagnosis in dogs can be made on the basis of reproductive conditions; however, some infected dogs are asymptomatic or have only nonspecific signs. Canine brucellosis is sometimes difficult to diagnose, hence, multiple techniques (e.g. culture, PCR and serology) are often used in combination. The rapid slide agglutination test (RSAT) and the tube agglutination test (TAT) are often used to detect antibodies to *B. canis* in dogs. Other serological like AGID, ELISA, an indirect fluorescent antibody test, complement fixation, a lateral flow immune-chromatographic assay and counter-immunoelectrophoresis can also be carried out. Definitive diagnosis can be achieved by isolation of *B. canis* from an animal. For isolation of the organism, samples from the genital tract (e.g., semen, vaginal discharges, placenta) are often more useful than blood, especially in animals with reproductive signs. *B. canis* may also be detected in milk, urine and aborted fetuses (gastric contents, liver, spleen), as well as in tissues such as the lymph nodes, spleen, prostate, epididymis, testis, uterus, liver and bone marrow, and clinically affected vertebrae or eyes. Molecular methods like conventional and Real time PCR can also be used for diagnosis.

Treatment, Prevention and Control:

No treatment is certain to eliminate *B. canis*. Even when this organism seems to have disappeared, it may persist in tissues such as lymph nodes, spleen, uterus and prostate. Relapse of the disease is possible, especially when an animal is stressed. Since canine brucellosis is usually introduced into a kennel by an infected dog or semen so dogs from infected kennels should not be sold or used for breeding. Newly purchase animals should be quarantined and tested before introduction. It has also been recommended that dogs be tested before allowing them to breed. In infected kennels, brucellosis can be controlled by sanitation and infection, housing the animals in individual cages and by isolation or removal of infected dogs. Neutering can be used as an additional control measure in treated animals, if they are intact. There is no vaccine for *B. canis.*

IMPORTANT ANATOMICAL DIFFERENCES IN SKELETON OF FLYING AND NON FLYING BIRDS

NEELAM BANSAL, ANURADHA GUPTA AND VARINDER UPPAL

Department of Veterinary Anatomy, GADVASU, Ludhiana

For diagnosis and treatment of any musculoskeletal disorders in birds, a thorough knowledge of skeleton is prerequisite for a clinician. In this paper, some of the important differences in the axial and appendicular skeleton of flying and non flying birds are discussed to provide a data base for applications to design a clinically oriented orthopaedic model.

Anatomical part	**Flying birds**	**Flightless birds**
Family	Carinatae	Ratitae
Wing bones	Well developed	Poorly developed
Scapula	Sword like	Rib like
Pneumatic foramina	Present	Absent
Coracoid bone	Robust bone	Small elongated bone
Clavicle	Slender, rod like bones of opposite sides fused to form Hypocledium	Flat to rounded bone with or without ventro-lateral groove
Humerus	Scapula, humerus and radius-ulna are of equal size	Humerus is smaller than scapula and larger than radius-ulna
Flight muscles	Well developed	Poorly developed
Radius-ulna	Well developed	Poorly developed
Carpals	Radiale and ulnare carpals are distinctly visible and articulate with distal extremity of ulna bone	Radiale and ulnare carpals are not distinct and articulate with distal extremity of radius bone
Carpometacarpal	The distal row of carpals is completely fused with the proximal extremity of metacarpal to form Carpometacarpal	Both the proximal and distal row of carpals is completely fused with the metacarpal to form Carpometacarpal
Digits	I and II digits have two phalanges and III has one phalanx	I and III has one phalanx, while the II digit has three phalanges
Hind limbs	short	Very large
Acetabulum	Formed by ilium and ischium	Formed by ileum , ischium and pubis
Obturator foramen	Slit like	Oval to crescent shaped
Femur	Fovea capitis present	absent
Patella	Present	Absent

Tibia	Medial condyle is larger	Lateral condyle is larger
Fibula	Terminates at half way of tibia	Terminates at distal third of tibia
Tarsometatarsus	Medial and lateral condyles on proximal extremity are separated by a spine	There is no spine between two condyles
Digits	I,II,III and IV	II,III and IV
Skull	Smaller in size	Larger in size
Quadrate bone	The quadrate articulates with the cranium by double head.	The quadrate articulates with the cranium by a single head.
Sternum	The ventral surface of sternum had a prominent keel and the dorsal surface was pierced by numerous foramina	Keel absent
Vertebral formula	C 14, T 7, L-S 14, Cy 4-9	C 17, T 9, L-S 11, Cy 14
Neck	Smaller Neck	Longer Neck
Notarium	Second to fifth thoracic vertebrae fused together to form notarium	First seven thoracic vertebrae are not fused
Synsacrum	Formed by last thoracic, lumbar, sacral and first coccygeal vertebrae	Formed by last two thoracic, lumbar, sacral and first few coccygeal vertebrae
Pygostyle	Formed by fusion of last few coccygeal vertebrae	Absent
Ribs	7 pairs of ribs with uncinate process.	9 pairs of ribs without uncinate process

FOOD BORNE PARASITIC ZOONOSES

MANDEEP KAUR* & MANDEEP SINGH BAL**

***Department of Veterinary Public Health & Epidemiology, KCVAS, Amritsar**
****Animal Disease Research Centre, GADVASU, Ludhiana**

Food borne parasitic zoonoses (FPZ) are human infections transmitted through ingested food and caused by parasites whose natural reservoir is a vertebrate animal species. These diseases not only effect the health of humans and animals but also cause huge economic loss to food industry especially meat industry, because of condemnation of infected meet. Various factors such as food habits, socio economic status, lifestyle, lack of hygiene, poverty, occupation etc. affect the occurrence of these diseases in an area. In some parasitic diseases such as cysticercosis and sarcocystosis, cysts can be seen with naked eyes in meat, while in other cases cysts/parasitic stages are not visible. Further, FPZ can be classified under three categories;

A. Meat borne parasitic zoonoses

B. Fish borne parasitic zoonoses

C. Vegetable and water borne parasitic zoonoses

A. Meat borne parasitic zoonoses: Common meat borne zoonotic parasites include *Sarcocystis* sp., *Toxoplasma gondii, Taenia saginata*, *T. solium* and *Trichinella* sp. These parasites can be transmitted to humans by consumption of raw contaminated pork and beef, however, parasitic species associated with pigs are more important than that of bovines. *Sarcocystis* spp. and *T. gondii*, are coccidian protozoans which have a global distribution.

Sarcocystosis: The life-cycle is heterixenous with herbivores (domestic and wild) primarily acting as intermediate hosts and carnivores (domestic and wild), including humans, act as definitive hosts. Oocysts are passed in the faeces of definitive hosts. Intermediate hosts acquire infection by ingesting infective oocysts. Numerous species of *Sarcocystis* infect cattle, sheep, pigs, horses, camels, buffalo and wild game animals. Heavy infections in these intermediate hosts may cause abortion, anorexia, fever, anaemia and reduced live weight gain. Two species are recognised as zoonotic, namely: *Sarcocystis hominis* and *Sarcocystis suihominis*, although zoitocysts of unknown origin have also been found in humans. *S. suihominis* (pigs as intermediate host) is more prevalent in India than *S. hominis*(cattle as intermediate host). Humans acquire infection by consumption of uncooked beef/pork containing zoitocysts. *S. hominis* is only mildly pathogenic in humans, causing stomach pains, nausea and diarrhea. *S. suihominis* is more pathogenic than *S. hominis*, causing stomach pains, nausea, diarrhoea and dyspnoea within 24 hours of infection. No effective treatment is available for either intermediate or definitive hosts. Control is possible by avoiding eating undercooked meat.

Toxoplasmosis: Toxoplasmosis is an important protozoan parasitic disease of all warm blooded mammals including humans. Oocysts are passed in the faeces of definitive host (cat). Cattle, buffaloes, sheep, goat, pigs and humans act as intermediate hosts in which consumption of oocysts leads to development of tachyzoite (fast multiplying cyst) in blood and ultimately bradyzoite i.e tissue cyst in various organs like heart, liver etc. Human

also get infection by consumption of infected meat containing tissue cyst. Toxoplasmosis is a threat to immunocompromised individuals and pregnant females. In normally healthy individuals, fever, lymphadenopathy, muscle aches, and headache can be observed. Encephalitis is an important and severe manifestation of toxoplasmosis in immunosuppressed persons including AIDS patients. In pregnant woman, it causes abortion and congenital abnormalities in new born child. Congenitally infected children may suffer from impaired vision and mental retardation. Severely infected children show classic tetrad of signs i.e. retinochoroiditis, hydrocephalus, convulsions, and intracerebral calcifications.

Taeniasis: Cysticercosis/ Taeniasis is an important cestode parasitic disease of zoonotic importance. This is a case of obligatory cyclozoonoses i.e. here man involvement is compulsory for the completion of life cycle of parasite. Man act as definitive host In case of *T. saginata* where as in case of *T. solium* man act as definitive as well as intermediate host. Man passes the eggs in the faeces, which are consumed by the cattle/ pig and causes cyst formation in the muscles of these animals. Again when this cyst containing beef and pork is eaten by human, life cycle is completed on passage of eggs in the faeces. Symptoms of taeniasis is mild in humans. But the major zoonotic importance is cysticercosis, which is caused by larva (*cysticercosis cellulosae*) of *T. solium* resulting in nervous problems like seizures, epilepsy in humans. It occurs in man because of consumption of *T. solium* eggs in contaminated food and water and due to auto infection. Auto infection occurs because of poor hygienic practices of a person.

Trichinellosis: Trichinellosis is an important nematodal parasitic disease which occurs because of ingestion of pork containing coiled larvae of *Trichinella spiralis*. People acquire infection after eating infected pork. Common clinical findings in humans include diarrhea, abdominal pain, swelling of eyelids or face, nausea and vomiting, muscle pain and tenderness.

B. Fish / crustacean borne parasitic zoonoses: Fish is an important protein source and is consumed by majority of human population. But fish harbours many parasites which are of zoonotic importance. Along with fish, crabs and lobsters are also eaten which can also transmit zoonotic parasites to people. Contamination of the snail infested waters by egg laiden faeces from humans and use of human faeces, “night soil” as fertilizers helps in transmission of these fish borne parasitic diseases. Common fish/crustacean borne parasitic diseases of zoontic importance include; gnathostomiasis, clonorchiasis, opisthorchiasis, paragonimiasis, diphyllobothriasis, hetrophyiasis and anisikiasis etc. Eating of raw fish, salted, under cooked, lightly fermented fish, crabs and sea food containing encysted larvae of the parasites result in transmission of disease to human population.

Gnathostomiasis: *Gnatostoma spinigerum* is widely distributed in Asia and has been considered to be the only species with human pathogenicity. Various fishes like cat fish, snake head fish etc harbour the parasites. Malaise, fever, urticaria, and nausea occurs after ingestion of larvae containing fish. Visceral larva migrans can occur in any part of the body. Migration of larva along the spinal cord into the brain cause paralysis, seizures & coma along with bloody CSF. It can also produce creeping eruptions known as cutaneous larva migrans by migration in skin & S/C tissue.

Diphyllobothriasis: Diphyllobothriasis is an important fish borne disease caused by by the fish tapeworm *Diphyllobothrium latum*. and *D. pacificum.* Infective larvae (plerocercoid) of *D. latum* resides in the muscles of trout, salmon, pike, and sea bass. Eating of these raw fishes cause the disease. This parasitic infection leads to deficiency of Vit B-12 in the host & hence causes pernicious anaemia because of the competition of adult worm with the host for Vit B-12.

Paragonimiasis: Paragonimiasis is caused by eating crabs and cray fish infected with *Paragonimus* lung flukes. *P. westermani* is the most common species in Asia and is the major source of human infection. Infective larvae metacercariae encysted in freshwater crabs and upon ingestion of larvae containing crabs, larvae penetrate the peritoneal cavity & migrate across the diaphragm into the pleural cavity. Abdominal symptoms are seen during the migratory phase and the parasites finally migrate into the lung parenchyma, where they mature and form solid worm cysts. Fever, chest pain, and chronic cough with hemoptysis (rusty-colored sputum) are the main clinical manifestations of this parasite.

Clonorchiasis and opisthorchiosis: Clonorchiasis (caused by *Clonorchis sinensis*) and opisthorchiasis (caused by *Opisthorchis* sp.) is caused by consumption of raw or undercooked cyprinid fish containing the encysted metacercariae. The parasite develop & live in the bile duct for many year. Clinical manifestations are rare, but infection increases the risk of cholangiocarcinoma. Liver cirrhosis, Blocking & thickening of bile duct, Periportal fibrosis, dilated & tortuous intra hepatic duct are the other complications of this disease. Opisthorchiasis is the similar parasitic disease as is Chlonorchiasis. The main animal hosts are cats, dogs, pigs, rats and camels.

Hetrophyiasis: *Heterophyes heterophyes* is an intestinal fluke found in mammals and birds which ingest encysted metacercariae in raw or undercooked fish. The life-cycle is similar to that of *Clonorchis* and *Opisthorchis* spp. and the operculated eggs passed in faeces are morphologically very similar. Clinical manifestations are rare and, if present, are usually due to eggs trapped in various tissues.

C. Vegetable and water borne parasitic zoonoses: Many diseases are transmitted through consumption of vegetables or contaminated water. Faciolopsis, giardiosis, cryptosporidiosis, cysticercosis, gastrodiscoidiasis, ameobiasis etc. are the important zoonotic parasitic diseases transmitted through vegetables and water. The most common mode of transmission of the these diseases is by ingestion of food and water contaminated with faeces from infected animals or humans and the consumption of raw leafy green vegetables irrigated with sewage water.

Fasciolopsis*: Fasciolopsis buski*, is the fluke, commonly found in pigs. The metacercariae of this parasites attaches to the shell of water chestnuts (sanghera) which grow in seasonal ponds. These ponds are frequently visisted by pigs and hence contamination of water with pig faecal matter occurs. Disease occurs in human when they peel the chestnut with their teeths.

Giardiosis: *Giardia intestinalis* (synonyms: *Giardia duodenalis*, *Giardia lamblia*) is a flagellate exhibiting a very simple and direct life-cycle. After ingestion of Giardia cysts through water and food the cysts pass through the duodenum and then the organisms leave

the cyst and undergo binary fission to form new trophozoites that continue to proliferate and establish infection in the host. Morphologically, the trophozoite has a face-like or pear-shaped appearance and, when viewed with the narrow end down, the paired nuclei look like eyes, the anterior flagella loop above the nuclei appears like eyebrows, and the median body resembles a down-turned mouth. Initial signs of giardiosis include anorexia, nausea, discomfort in the upper intestine and fatigue. This is followed by foul-smelling watery diarrhoea, flatulence and abdominal distension. Chronic infection is marked by recurrent brief episodes, or to a lesser extent, persistent episodes of foul-smelling loose stools, flatulence and abdominal distension.

Table 1: Common food borne zoonotic parasites.

Type	**Parasite**	
	Protozoan	**Helminth**
Meat Borne	*Toxoplasma gondii*	*Trichinella spiralis*
	Sarcocystis suihomonis, Sarcocystis hominis	*Taenia solium, T.saginata*
Fish Borne	-	*Diphyllobothrium latum*
	-	*Clonorchis* sp.
	-	*Opisthorchis* sp.
	-	*Anisakis* sp.
	-	*Heterophyes* sp.
	-	*Spirometra* sp.
	-	*Hetrophyes* sp.
	-	*Paragonimus* sp.
Vegetable and water borne	*Entamoeba histolytica*	*Fasciolopsis buski*
	Giardia sp.	*Taenia solium*
	Cryptosporidium sp.	Gastrodiscoides

Cryptosporidiosis: Out of the eight recognised species of *Cryptosporidium*, only one, C. *parvum,* is of zoonotic importance. The parasite has been associated with outbreaks of diarrhoea in the young of cattle, sheep, goats, deer, horses, dogs, cats and turkeys. The first case of C. *parvum* in a human was reported in 1976. An increasing incidence has since been reported, mainly in immunocompromised patients with AIDS, in whom the infection is life threatening. *Cryptosporidium parvum* has been demonstrated to be responsible for sporadic outbreaks of water-borne illness in especially in immunocompetent individuals. Water-borne epidemics are facilitated by the ability of the oocyst to withstand standard water treatments (chlorination and sand filtration) and to remain viable for long periods in the environment.

Cysticercosis: Cysticercosis is caused by larva (*cysticercosis cellulosae*) of *T. solium* . Various manifestations of disease are neurocysticercosis, ocular cysticercosis and muscular cysticercosis.

Neurocysticercosis resulted into nervous problems like seizures, epilepsy in humans. Disease occurs in man because of consumption of *T. solium* eggs in contaminated food and water and also due to auto infection. *T. solium* eggs can be ingested when agricultural land is irrigated with sewage water and vegetables and fruits are not washed properly before eating.

Gastrodiscoidiasis: *Gastrodiscoides hominis* is primarily an intestinal fluke of pig, but also infect other vertebrates including human. Sometimes also known as colonic fluke, it infects the colon of pigs and rhesus monkey. But in case of humans the worms are attached on the wall of the caecum. Humans are considered an accidental host because the parasite can survive without humans. Humans acquire infection by ingesting the metacercaria by the contaminated vegetable. Disease manifestations in humans include diarrhoea, fever, abdominal pain, colic and an increased mucous production.

Amoebiasis: Amoebiasis, also known as amebiasis or entamoebiasis is an infection caused by protozoans of the *Entamoeba* group especially by *E. histolytica*. Amoebiasis is usually transmitted by the fecal-oral route, but it can also be transmitted indirectly through contact with dirty hands or objects as well as by anal-oral contact. Amoebiasis can present with no, mild, or severe symptoms. Symptoms may include abdominal pain, mild diarrhoea, bloody diarrhea or severe colitis with perforation which may lead to peritonitis.

Prevention and control of FPZ:

- Consumption of raw meat, offals and fish should be avoided.
- Vegetables should be washed properly before eating especially carrots, raddish, cabbage etc. which are generally eaten as salad.
- Proper cooking and freezing of meat should be done to render the parasites ineffective.
- Proper hygienic measures should be followed.
- Meat inspection should be done strictly and infected meat should be condemned accordingly.
- Usage of sewage water for irrigation purpose should only be done after proper treatment and disinfection of sewage water.

ORGANIC MEAT AND MEAT PRODUCTS

PAVAN KUMAR, MANISH KUMAR CHATLI, NITIN MEHTA, O P MALAV

Department of Livestock Products Technology, GADVASU, Ludhiana

Meat is an excellent source of high quality animal protein, fat, vitamins and minerals. It has been an integral part of our diet since time immemorial. During pre-historic era, human being got meat by hunting wild animals. Later the practice of rearing animals for meat and other purposes came into existence. Rearing of livestock proves an important milestone in our cultural and social evolution. The livestock rearing and agricultural are complementary to each other and imagination of a strong agriculture without high quality livestock is practically impossible. The agricultural sector provides fodder to livestock sector whereas livestock sector provide organic fertilizers as well as energy for farming in return. The importance of drought breeds of cattle are very essential in our country as these breeds provide a source of drought energy and widely used in seeding, irrigation, harvesting etc. The presence of small and marginal farmers makes it an economical as the mechanizing of agriculture by the use of machines are more suitable for large land holdings.

Organic farming:

The rapid increase in global population has put more pressure on our natural resources for food and residential habitats. In current industrial era, the farming is become more intensified and mechanized. The chief aim of modern agriculture is to get maximum output and for this the use of various chemicals in the form of fertilizers, pesticides, insectides, hormones etc are rampant. This has hampered the delicate ecological balance and ecological cycles of the farming system. These bad effects are seen in the form of shrinkage of the agricultural area due to conversion of the fertile lands into barren fields, destruction of useful microflora as well as entry of harmful insecticides/ pesticides in our food chain. Moreover, due to education and awareness, the consumers are increasingly demanding food that are minimally processed, safe, containing natural ingredients and produced without causing/ minimally damaging the environment from animals without putting any stress and giving ample considerations to the welfare of the animals. Thus the need of the hour is to shift the production methods for a sustainable production in place of conventional production system which focuses on the maintaining the soil fertility, minimally polluting the environment, producing good quality safe foods without any toxic or chemical residue, utilizing the renewable energy, maximizing the profit and production etc.

Codex Alimentarius commission Guidelines (1999) defined the organic farming as a holistic production management system, which promotes and enhances agro-ecosystem health including biodiversity, biological cycles and soil biological activity. These guidelines have set principles to be followed during the complete cycle of production i.e. from production, processing, storage and transport for the better and efficient use of our natural resources for better future. It relies on the maximum use of on-farm inputs in place of off-farm inputs by proper management practices by utilizing cultural, biological, social and mechanical methods. This method of farming is in contrast to conventional farming which is based on the using of synthetic materials and inputs. The organic farming emphasizes the need to produce food in a sustainable way by integrating human and environment to produce economically suitable agricultural production system for better future. This resulted in the

wider acceptability of this type of natural production system in developing as well as developed world. Thus, the wider approval and acceptance of this innovation is due to peoples concern about food safety, sustainability and environmental impact on intensive system of conventional farming.

For livestock, the organic means livestock reared under the principles of organic farming in their entire life cycles. It includes all process during the livestock rearing such as housing, health management by increasing their immunity and self defense against various diseases, breeding and transportation as well feeding of fodder obtained from organic farming. Recently European Commission has given some guidelines for organic livestock rearing. These guidelines put emphasis on animals welfare, rearing of animal without using any growth promoters/ hormones, feeding the animal upon fodder of which minimum 80% obtained from organic agriculture without using artificial fertilizers or pesticides on the crops or grasses. The European Commission guidelines strictly forbid the use of animal offal or any other additives. The various livestock products harvested from such animals are known as organic products such as milk, meat, egg etc.

Historical Background

The concept of organic farming has the developed form of biodynamic farming. This concept of biodynamic farming is first proposed by Rudolf Steiner in Germany in 1924 during a series of eight lectures delivered to agriculture course on the request of farmers who complained about degradation of soil fertility, quality of produce and health of livestock due to excessive use of fertilizers and pesticides. This concept is based on holistic understanding of agriculture process. It is basically a form of sustainable agriculture encompasses soil fertility, plant growth and livestock care as ecologically interrelated tasks and a single unit and emphasize on marinating the ecological harmony. The inclusion of natural elements to a greater degree leads to calling this system as spiritual science by Steiner. The main focus of biodynamic farming has been on use of manures and compost rather than synthetic fertilizers, locally production and distribution system, development of new breeds suitable to local conditions, adhering to the prescribed farming schedule/ calendar of that particular area. Although the inclusion of mystical elements in biodynamic farming has leads to its criticism, but its experience pave the way to the development of organic farming which began in 1960 with the development of organic movement.

Avery (2006) mentioned the growing mistrust of human beings in the modern science and technology which is mainly on the overutilization or excessive exploitation of our environmental and natural resources, which has caused havoc in the society. This has forced the human beings for preferring and searching the greener and environmentally friendly options. This has lead to the much needed impetus for the development and growth of organic sector.

Principles of Organic Farming

Organic farming is mostly based on the on-farm input based livestock management practices in place of of-farm input management practices. There may be no difference between the genetic makeup of the breed and only the managemental practices are differ in case of organic meat as compared to conventional meat. These practices are as follows-

i. Organic farming put more emphasis on the grazing of livestock instead of stall feeding. Animal should be provided sufficient grazing for sufficient time to the livestock. Pasture-based production may also have environmental benefits, such as improved soil quality and reduced soil erosion.

ii. The feed should be obtained from the crops raised by following organic agriculture. The feed storage facilities should be kept clean, tidy and rodent free, ensure good control of humidity and temperature, even during adverse weather conditions. There should not be any molds growth and dampness in the feed. The feed should not emanate off-odour and it should have the normal colour.

iii. The use of veterinary drugs/ growth promoters/ enzymes etc is strictly forbidden for use in dairying farming to livestock except in very emergency cases. It is based on the concept of prevention is better than cure. The emphasis is on the development of natural immunity in livestock by following proper managemental practices.

iv. The meat animals should be healthy.

v. The livestock should be given potable water ad-lib. The water should be provided in such a way that it facilitate easy access to the animal such as water trough etc.

vi. The focus of organic farming is to produce locally adaptable local breeds having pure germplasm. These breeds are well suitable for the local environment and thus have less managemental problems.

vii. The livestock should be provided sufficient amount of green fodder. The supply of the fodder should be from the organic farming without use of any pesticides/herbicides/ insecticides. The animals should be given as much grass as possible, fresh or as silage, preferably with a high content of aromatic herbs.

viii. As far as possible, it is better to provide information to consumers, e.g. a website or a farm visit scheme, where the agronomic and economic factors are explained (e.g. the low quality and price of beef from milking breeds) rather than hidden.

ix. The documentation and verification of record is very important for running an organic farm successfully. Thus all the record regarding production as well as processing should be kept with the firm.

International Federation of Organic Agriculture Movements (IFOAM) was formed in Versallie, France on 5th Nov, 1972 by the initiative of *Ronald Chevriot of Nature et Progres*. Later IFOAM evolved as association of about 800 affiliates covering 120 countries. It advocates and facilitates the sustainable, viable and credible alternate to the conventional farming. The International Federation of Organic Agriculture Movements (IFOAM) laid down 4 principles based on ethical principles to be followed for organic agriculture. These are as follows-

i. Principle of health: The organic farming should not damage the health of living beings as well as their environments.

ii. Principle of ecology: In organic farming, there should be proper working of all ecological systems in their natural ways, thus ensures sustainability for future generations.

iii. **Principle of fairness**: According to IFOAM, fairness is characterized by equity, respect, justice and stewardship of the shared world, both among people and in their relations to other living beings. The organic farming should be based upon the relationship of mutual benefits and thus ensure a balance between the environment and opportunities of life.

iv. **Principle of care**: The organic farming forbids the injudicious use of our natural resources and it promotes the judicious use of our natural resources so that they will be available for use for future generations. There is emphasis on the development and adaptation of newer technologies for better and efficient utilization of our natural resources.

ORGANIC MEAT

Organic meat is obtained from the animals or birds raised in an organic system, which are based on the physiological and behavioral needs of animals. Animals are not cased, tethered or confined in buildings without adequate natural ventilation and light. They are given enough space for free movement and kept in appropriate size herds and flocks. Proper care should be taken for bedding materials, access to pasture and fresh water. The health and vitality of the animal is maintained by sound nutrition and good management practices, prophylactic antibiotics should not be necessary. Veterinary drugs are allowed only where there are no effective complementary treatments. Withdrawal periods after giving a veterinary drug are strict in order to prevent residues in meat

According to USDA (2012) certified organic meat must originated from a fully verifiable production system that collects information on the history of every animal in the program, including its breed history, veterinary care, and feed. The U.S. Department of Agriculture allows any fresh meat to be described as “natural” if it includes no artificial flavoring, coloring, preservative or any other artificial ingredients.

Further, to be certified as organic, it should follow certain criteria:

a) Reared on certified organic pasture

b) Should not be administered antibiotics in their life

c) Use of growth promoters has not been used

d) Fed only on concentrate and fodder obtained from organic farming

e) The animal should have unrestricted outdoor access for grazing and movement.

In case of starting up the organic farming when organic livestock are not available, then conventional animals are allowed to brought under organic farming with certain conditions at the entry age such as-

a) Two day old chicken for meat production.

b) 18-weeks hens for egg production.

c) Piglets up to 6 weeks after weaning.

d) Calves up to 4 weeks old that have received colostrums and have been fed a mainly milk

diet.

e) Breeding stock may be brought in from conventional farms but maximum replacement rate will be 10 per cent.

Advantage of organic Meat:

i. Organic meat is tastier than conventional meat and thus widely preferred by consumers.

ii. It is free from additives.

iii. It is free from various antibiotic and hormonal residues and thus safe for consumption.

iv. During rearing of meat animals during organic meat production, there is proper use of natural resources on the principle of sustainability. This ensures availability of these resources for future generations.

v. Protect water quality by judicious use of it without polluting by various chemicals such as fertilizers, pesticides, herbicides etc.

vi. Protect future generations' health.

vii. Keep rural communities health.

viii. Support a 'true' economy

ix. Preserving our livestock by giving more emphasis on indigenous/ local breeds adapted for local environment.

x. Preserve topsoil by controlling soil erosion.

xi. Preserve biodiversity

Breeds and breeding: For organic meat production, following care should be taken while considering for breeding and selection of breed as-

a) For organic meat production, locally available breeds should be preferred as these breeds are better adaptable for locally availing conditions. Breed should be chosen which are adapted to local conditions.

b) Natural breeding should be preferred over artificial insemination.

c) Embryo transfer technologies are not allowed.

d) Hormonal treatments for oestrous synchronization and other purposes are not allowed.

e) Use of GMO (Genetically modified Organisms) or recombinant technologies are not allowed.

Feeding: Feeding forma an important component for running successful organic farm.

a) The organically reared livestock should be fed on 100% organically grown feed.

b) More than 50% of the feed shall come from the farm unit itself and shall be produced within the region.

c) However in some cases 15-20% of total feed could be obtained from conventional farms.

d) The use of synthetic growth promoter substance, synthetic appetizers, preservatives, artificial colouring agents, urea, animal byproducts to ruminants, solvent extracted oil cakes, pure amino acids, genetically engineered organisms or products thereof, are not allowed.

Animal health

An important objective of organic livestock husbandry is the avoidance of reliance upon routine and/or prophylactic use of conventional veterinary medicines.

i. Natural medicines and methods, including homeopathy, ayurvedic medicine and acupuncture, shall be emphasized.

ii. The use of conventional veterinary medicines are allowed when no other non-allopathic alternative is available and where these are used, the withholding period shall be twice the legally required period.

iii. Vaccines shall be used only when diseases are known or expected to be a problem in the region of farm and where these diseases cannot be controlled by other management techniques. However genetically engineered vaccines are prohibited.

Apart from the above-mentioned standards, there are several other standards concerning mutilation, record keeping, transport and slaughter. Welfare of farm animals is very important during production of organic meat. The animals should be free from any fear, stress, thirst, hunger and should have proper space for movement. Processing of organic meat is very less as compared to conventional meat as there are only 55 non-organic agricultural products. Only sodium potassium and calcium citrate and lactic acids have been listed as permissible chemicals. Nitrite which prevents the development of botulism, a deadly poison, has not been permitted in organic products.

Quality aspects of organic meat

However, there are some concerns during production of organic meat. The quality of organic meat and its yield is mostly lower due to a reduced energy supply and growth performance as a consequence of more locomotive activity and uncontrolled environmental condition which increase the energy requirement with consequent increase of feed conversion, but grater locomotive activity reduces abdominal fat and favoured muscle mass development and increase breast muscle percentage in chicken. Some recent findings have reported that steer in conventional finishing had heavier carcass, larger rib eye areas and less marbling than steers in organic finishing. However, implication of reduced nutritional supply on carcass quality can be compensated by choosing breeds more adopted in home grown feeds like fodder. The production lean carcass to meet consumer's demand of low fat pork has resulted into decrease into intramuscular fat but it may reduce the eating quality. Although amino acid supplementation to conventional pig diet resulted into increased pig performance, it produced fatty carcass.

The lack of prophylactic drug treatment and outdoor rearing may increase the likelihood of *Trichinae*, *Salmonella* etc in organic meat. It has been reported some workers that organic meat, milk and eggs are more dangerous than conventionally grown produce because organic farmers use animal manure as the major source of fertilizer for their food crops. Some other researchers also noted that organically produce chicken, pork and beef showed more post-mortem lesions than conventionally reared one. The postmortem lesions relating to peritonitis, parafilariosis, dicrocaeliosis and liver granuloma in animal from organic farm were studied.

When studied on physico-chemical quality, it has been found that organic meat is high in moisture, but low in WHC, pH, fat and energy. Fatty acid profile of organically produced animals had a higher fraction of saturated fatty acids (SFA) and lower monounsaturated fatty acids (MUFA). However leaner the meat of the animals, has higher the proportion of phospholipids that are richer in polyunsaturated fatty acids and particularly in C_{20} and C_{22} fatty acids. Organically produced animal products have higher TBARS number, but acceptability is not affected. High content of metal ions in organic meat lowers the lipid stability due to catalase peroxidation and to greater degree of unsaturation of intramuscular lipids. It also suggests that a greater degree of physical fitness increased the muscle oxidative capacity and that exercise increases the number of mitochondria in áW fibers, hence turning them into áR fibers.

Recent data compiled by US Center for Disease Control reveals that people who eat organic and natural food are eight times more prone to attack by new strain of *E. coli* bacteria (O157:H7) than rest of the population. Organically grown poultry is most contaminated product and according to USDA study, 99% of broiler chicken carcasses are contaminated with faecal *E. coli*. Another study reveals dangerous *Salmonella* and *Campylobacter* contamination up to 80% in all chicken poisoning and seriously injuring millions of consumers annually. Organic and natural food consumers also face increase risk of illness from toxins produced by fungi, and some of these toxins are carcinogenic to men. Refusing to use of artificial pesticides organic farmers allow their field to suffer more insect and rodents, which create opening through which fungi can enter the fruits and seeds.

On the other hand, most cows, chicken and other livestock raised under intensive system are given low level of antibiotics routinely in their feeds or water, make the animals grow slightly faster and help stave off infestation. But when antibiotics are used over long time in this way, some of the bacteria become resistant to them. Once these antibiotic resistant strains of bacteria evolve, they can cause food poisoning cases that are harder or even impossible to treat with those same antibiotics. In fact consuming of milk from animals raised with antibiotics may even put consumers at a higher risk of counter acting of these drug resistant bugs directly from milk, particularly if it is not boiled properly. Further, this harmful bug carries the resistant gene and passes it on to more harmful bug that people pick up elsewhere.

Organic Certification Agencies:

The certification and validation of organic products is very important for success in organic venture. The organic certification is a process, which certifies the organic products. Different countries have formulated different organic food standards. The basic purpose of

organic certification is to assure quality of the organic products and prevent frauds. This gave the necessary confidence to the consumers for buying the certified commodity and thus helps in marketing of organic products. Individual certifying bodies are having their unique identification mark/ logo, which help establishing the brand value of the product and give advantage to the producers for marketing of organic products. At international level, efforts are initiated to harmonize the different organic certification by following common standards to facilitate internal trade. IFOAM is continuously working in this direction to establish one single global reference (COROS) and in 2011 introduced standards to harmonize the standards which focus more on the quality of standards rather than on marketing.

In India, followings are the organic certification agencies-

- Natural Organic Certification Association, Pune, Maharashtra
- Bureau Veritas Certification India Pvt. Ltd., Mumbai, Maharashtra
- Ecocert SA, Aurangabad, Maharastra
- Teichert, Mumbai, Maharashtra
- IMO Control Private Limited, Banglore, Karnataka
- Skal International (India) Banglore, Karnataka
- Aditi Organics Certification Pvt. Ltd. Banglore, Karnataka
- APOF Organic Certification Agency, (AOCA), Banglore, Karnataka
- Indian Organic Certification Agency (INDOCERT), Ernakulam, Kerala
- Lacon Quality Certification Pvt. Ltd, Thiruvalla, Kerala
- Rajasthan Organic Certification Agency (ROCA), Jaipur, Rajasthan
- OneCert Asia Agri Certification Private Limited, Jaipur, Rajasthan
- SGS India Pvt. Ltd. Gurgaon, Haryana
- Uttaranchal State Organic Certification Agency (USOCA), Dehradun, Uttaranchal, India
- FoodCert India Pvt. Ltd. Hyderabad , Telangana
- Vedic Organic Certification Agency, Hyderabad, Telangana
- U.P. State Organic Certification Agency, Lucknow, U.P.

Fig 1: Organic Certification logos

Conclusions

Organic meat production is the need of the hour as it will improve animal welfare, conservation of natural resources, and sustain rewarding rural lifestyles. Traditional and alternative medicine holds the promise for alternative prevention and treatment of animal diseases. The future of organic meat production is to continue searching for alternatives that are environmentally friendly, human health conscientious and animal considerate. Understanding organic livestock farming and selection of suitable breeds from economic, ecological, and animal welfare perspectives will increase the likelihood of success.

Literature Consulted:

Avery A (2006). The Truth about Organic Foods. Henderson Communications LLC, Chesterfield, MO.

Codex Alimentarius Commission (2001). Guidelines for the Production, Processing, Labelling and Marketing of Organically Produced Foods, Rome: Joint Food and Agriculture Organization/World Health Organization (FAO/WHO) Food Standards Programme. Available online: http://www.fao. org/organicag/doc/glorganicfinal.pdf (assessed: October 9, 2004).

Sundrum A (2001). Organic livestock farming. A critical review. Livestock Production Science. 67: 207–215.

United States Department of Agriculture (USDA). 2000. *National Organic Rule 7 CFR Part 205: Final Rule with request for comments*, Washington, DC: USDA, Agricultural Marketing Service. http://www.ams.usda.gov/nop/NOP/standards/FullText.pdf.

Winter, C K and Davis S F (2006). Scientific status summary – Organic foods. Journal of Food Science. 71(9):R117-R124.

Woese K, Lange D, Boess C and Bogl *K* W (1997). A comparison of organically and conventionally grown foods – results of a review of the relevant literature. Journal of Science of Food and Agriculture. 74:281-293.

MYCOPLASMA INFECTIONS IN FARM ANIMALS

HARPEET KAUR AND SHUKRITI SHARMA

Department of Veterinary Medicine, GADVASU, Ludhiana

Once thought to be viruses, the true nature of Mycoplasma species as free-living bacteria was recognized around 1900 and then, for many decades, they were considered to be L-forms of common bacteria. Mycoplasmas are the smallest, self-replicating group of wall-less bacteria belonging to class *Mollicutes.* They are characterized by small genome size (500-1100 kbp) and are extremely fastidious *in vitro* with a tendency to form centered colonies on solid medium. Most of the mycoplasma infections are chronic in nature, and cause some of the most serious and economically most costly diseases of cattle. The only bacterial disease on the former List A of Communicable Animal Diseases of the Office International des Epizootics (OIE), and two of the five bacteria on the United States Department of Agriculture (USDA) restricted animal pathogens list are mycoplasmas. *M. mycoides* subspecies *mycoides* small colony type, which causes contagious bovine pleuropneumonia, is on both lists, while *M. agalactiae*, which causes contagious agalactia in small ruminants, is on the USDA list. Mycoplasmas cause serious economic losses in farm animals worldwide characterized by systemic infections such as pneumonia, mastitis and arthritis. Keeping in view the significance of these pathogens, genome of many species and strains of mycoplasmas have been sequenced and available worldwide (http://services.cbib.u-bordeaux2.fr/molligen/).

Mycoplasma agalactiae

Mycoplasma agalactiae, a major causal agent of classical contagious agalactia, is a serious, economically important but neglected agent of small ruminants. The agent has been reported from almost all the countries of the world and is responsible for heavy economic losses mainly due to high morbidity. ELISA test directed against lipoprotein p48 of *M. agalactiae* (IDEXX) conducted in ovine and caprine sera have revealed an overall serological prevalence of 2.79% in Punjab. Besides, a clinical outbreak has also been recorded in goats in Punjab. The main clinical signs observed in the outbreak in this study were mastitis and agalactia in the does, and polyarthritis in kids, but numerous does also had polyarthritis. Mycoplasma colonies were isolated from the milk samples and further confirmed by PCR. The affected animals responded well to treatment with enrofloxacin.

The pathogen spreads rapidly by contact between infected and healthy animals. The main sources of infection include ocular, nasal secretions, faeces, milk, urine, and excretions from open joint lesions or the male genitourinary tract. The infection can be transmitted via teats contaminated by milking equipment or the hands of milkers. Young animals are infected while suckling contaminated colostrum or milk. The presence of asymptomatic carriers in a herd carrying the infectious agent is of major concern.

M. agalactiae can affect both sheep and goats of either sex. The incubation period varies from one week to two months depending upon virulence of organisms and immune status of the animal. *M. agalactiae* can produce acute, subacute or chronic form of disease. In some animals atypical or asymptomatic forms have also been reported. Anorexia, lethargy and lagging the herd are the first clinical signs followed by the clinical symptoms depending

upon the involvement of organs such as mammary glands, lungs, genitalia, joints, and conjunctiva. Fever is common in acute cases and may be accompanied by nervous signs, but both signs are rare in the more frequently observed subacute and chronic infections. Rarely abortions in pregnant animals have also been reported.

At the beginning, the udder shows catarrhal or parenchymatous mastitis. It is hot, swollen and tender and later becomes flaccid, filled with connective tissue and eventually becomes atrophic. Milk changes into a yellowish colour with salty taste. It may have a watery consistency and separates into an upper grayish-blue and a lower yellowish-green layer with clots. Milk gradually becomes purulent and, at the final stage, its production ceases. Arthritis usually involves the carpus or tarsus with swollen and painful joints with accumulation of synovial fluid. In chronic cases, ankylosis may develop and animal becomes lame or lie down.

There is congestion of the conjunctiva initially followed by keratoconjunctivitis, keratitis and the loss of sight due to vascularisation of the cornea. Some animals heal spontaneously after a short time, even though they have undergone ulceration of the cornea. There may be septicemia, arthritis, or pneumonia with high mortality in kids.

In sheep and goats, the signs usually become manifested shortly after parturition and lactating animals develop mastitis. The most common form is a mastitis accompanied by yellowish-green milk secretion. Ocular involvement may be found in only about 50% of cases. Lameness, which is common and may persist for a long time, is more frequent in males than females.

Tentative diagnosis is based on typical clinical features of mastitis, keratoconjunctivitis and arthritis. It is very difficult to make a clinical diagnosis if only a single form of disease is present. Clinical diagnosis can be confirmed by isolation and identification of the infectious agent. The best samples being milk, ocular, vaginal or nasal swabs, articular exudates, blood and urine. For post-mortem examination, samples are collected from the mammary gland and regional lymph nodes, pulmonary lesions and articular exudates. Antibodies in serum or milk can be detected by ELISA. PCR techniques based on 16S rRNA or *uvrC* gene can be used for the identification of *M. agalactiae.*

Antibiotics, namely, tetracycline, macrolide, florfenicol, tiamulin and fluoroquinolones are used worldwide for treatment of contagious agalactia.

Mycoplasma bovis

Since its first isolation from a clinical case of mastitis in a cow, *M. bovis* has been the subject of considerable interest. *M. bovis* is a contagious pathogen of cattle associated with pneumonia, mastitis, conjunctivitis, otitis, arthritis, neurological disorders, abortions, seminal vesculitis, and possibly septicemia and meningitis.

Primary route of transmission is through aerosol infection of respiratory tract. Udder can get infection through teat canal and milking process due to contaminated milking pen, milkers and fomites. Both male and female genital tracts are affected through ascending infections from the contaminated environment.

Clinical diseases associated with *M. bovis* are bronchopneumonia, mastitis, otitis media, conjunctivitis, arthritis, genital disorders or combinations of these conditions. Respiratory disease characterized by fever (>40°C), depression, weight loss, coughing, nasal discharge, tachypnea, and often dyspnea, is more common in calves. *M. bovis* causes alteration in milk consistency, a rapid decline in milk yield down to a few millilitres within 3-5 days, quick spread from one quarter to the other, and lack of response to any antibiotic treatment. Unilateral or bilateral ear drooping is characteristic clinical sign of otitis media, but is not specific for *M. bovis* infection. Arthritis may be a sequel to either the respiratory or mastitic form of the disease. There may be lameness, swelling of joints, slight fever, failure of antibiotic treatment, and if severe, reduced consumption of feed.

Clinical and pathological signs are not characteristic so laboratory diagnosis is necessary including bacteriological culture, serological (ELISA, immunohistochemistry) and molecular techniques (PCR). Serological detection of *M. bovis* antibody is often a more reliable diagnostic method as antibody levels detected by ELISA remain high for many months. *M. bovis* strains are resistant to antibiotics traditionally used for treatment of mycoplasma infections in particular oxytetracyclines, tilmicosin and spectinomycin. The fluoroquinolones are still effective but their use in animals is controversial. Inactivated or killed vaccines are available for use in some developed countries but their efficacy is unknown.

Mycoplasma hyopneumoniae

M. hyopneumoniae is the primary agent of enzootic pneumonia, a chronic respiratory disease in pigs, and is one of the main pathogens involved in the porcine respiratory disease complex. Transmission between herds occurs mainly by the introduction of infected animals or is airborne. Horizontal transmission can occur via direct or indirect contact between infected and healthy animals.

It has a long incubation period of 2 to 8 weeks. In most cases, infections are subclinical and common clinical sign is non-productive cough. Coughing may be present in nursery, grower and finisher pigs and usually a considerable percentage of the pigs are affected. Coughing may disappear after 2-3 weeks, but it can also persist throughout the whole fattening period. Sometimes there is severe respiratory distress including fever, labored breathing, prostration, and reduced appetite. This leads to an increase in the feed conversion ratio, lower average daily weight gain and more weight variation between the pigs.

Diagnosis of enzootic pneumonia is generally established at group level rather than at individual level. The presence of coughing in fattening pigs combined with chronic broncho pneumonia lesions, as well as poor performance and feed efficiency during the fattening period may lead to a presumptive diagnosis that can be confirmed by bacteriological culture, immunohistochemistry, ELISA or PCR.

Antimicrobials such as tetracyclines, macrolides, lincosamides, florfenicol, aminoglycosides and fluoroquinolones can be used as a group treatment via feed or drinking water.

Suggested Readings:

Caswell, J.L., Archambault, M., 2007. *Mycoplasma bovis* pneumonia in cattle. *Anim. Health Res. Rev.* **8**, 161-186.

Caswell, J.L., Bateman, K.G., Cai, H.Y., Castillo-Alcala, F., 2010. *Mycoplasma bovis* in respiratory disease of feedlot cattle. *Vet. Clin. North Am. Food Anim. Pract.* **26**, 365-379.

Maunsell, F.P., Woolums, A.R., Francoz, D., Rosenbusch, R.F., Step, D.L., Wilson, D.J., Janzen, E.D., 2011. *Mycoplasma bovis* infections in cattle. *J. Vet. Intern. Med.* **25**, 772-783.

Minion, F.C., 2002. Molecular pathogenesis of mycoplasma animal respiratory pathogens. *Front. Biosci.* **7**, d1410-1422.

Nicholas, R., Ayling, R., McAuliffe, L., 2007. Mycoplasma mastitis. *Vet. Rec.* **160**, 382; author reply 383.

Nicholas, R.A., 2011. Bovine mycoplasmosis: silent and deadly. *Vet. Rec.* **168**, 459-462.

Nicholas, R.A., Ayling, R.D., 2003. *Mycoplasma bovis*: disease, diagnosis, and control. *Res. Vet. Sci.* **74**, 105-112.

Pfutzner, H., Sachse, K., 1996. *Mycoplasma bovis* as an agent of mastitis, pneumonia, arthritis and genital disorders in cattle. *Rev. Sci. Tech.* **15**, 1477-1494.

Razin, S., Yogev, D., Naot, Y., 1998. Molecular biology and pathogenicity of mycoplasmas. *Microbiol. Mol. Biol. Rev.* **62**, 1094-1156.

Singh, Manjot. 2015. Seroepidemiology of contagious agalactia and bluetongue in sheep and goats. MVSc thesis submitted to Guru Angad Dev Veterinary and Animal Sciences University, Ludhiana

Office bearers of the Alumni Association, College of Veterinary Science, Guru Angad Dev Veterinary and Animal Sciences University (GADVASU), Ludhiana - 141 004, India

Founder President	**Dr. Balwant Singh**
President	**Dr. Simrat Sagar Singh**
Secretary	**Dr. H.K. Verma**
Joint Secretary	**Dr. N.S. Sharma**
Treasurer	**Dr. S.K. Kansal**
Co-Treasurer	**Dr. S.K. Sharma**
Editor	**Dr. Amarjit Singh**
Associate Editor	**Dr. Jaswinder Singh**

Members of the Executive Committee

Dr. B.S. Taneja	**Dr. K.B. Singh**
Dr. G.S. Khatra	**Dr. M.S. Kwatra**
Dr. V.K. Gandotra	**Dr. Jeewan Gupta**
Dr. V.K. Sobti	**Dr. N.S. Saini**
Dr. N.K. Talwar	**Dr. P.S. Mavi**
Dr. S.S. Arora	**Dr. P.N. Dwivedi**
Dr. Parvinder Kaur	**Dr. Neelam Bansal**

Overseas Convenor
Dr. Sukhpal Singh

Printed and Published for and on behalf of the Alumni Association of the College of Veterinary Science, Guru Angad Dev Veterinary and Animal Sciences University (GADVASU), Ludhiana for private circulation and printed at SOMALIA PRINTERS, Ludhiana, Tel: 093169-14892, Email: somaliaprinters@gmail.com, sharmark.25471@gmail.com.