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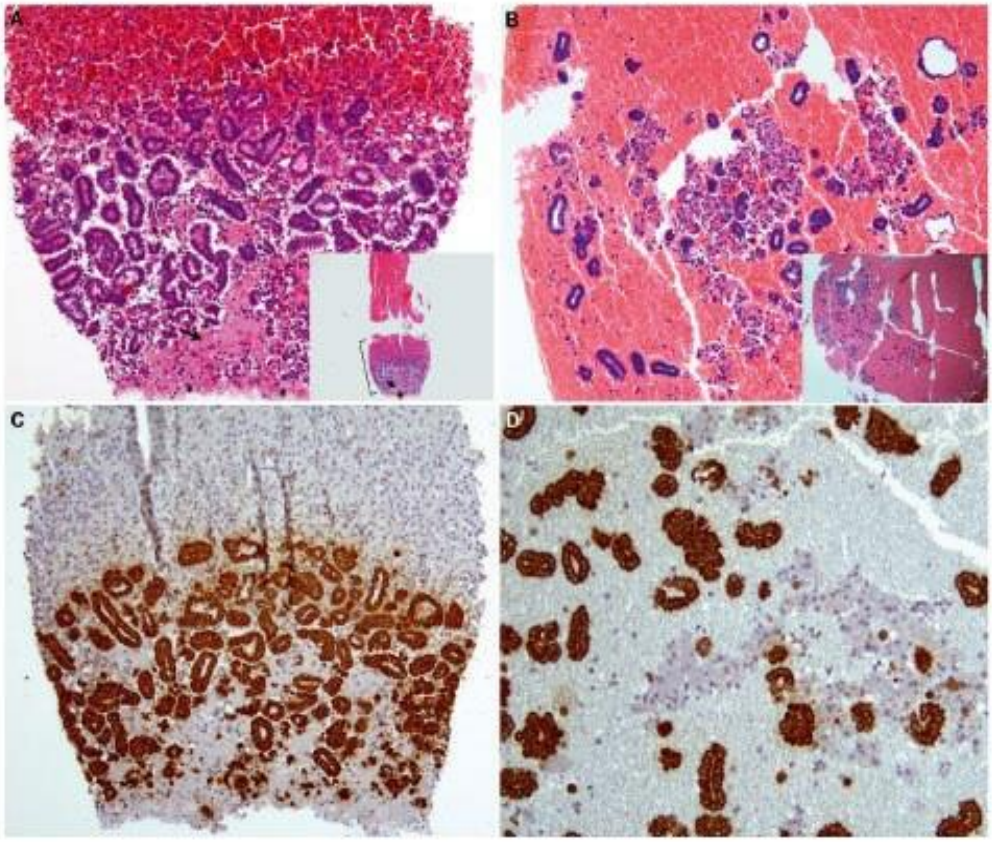

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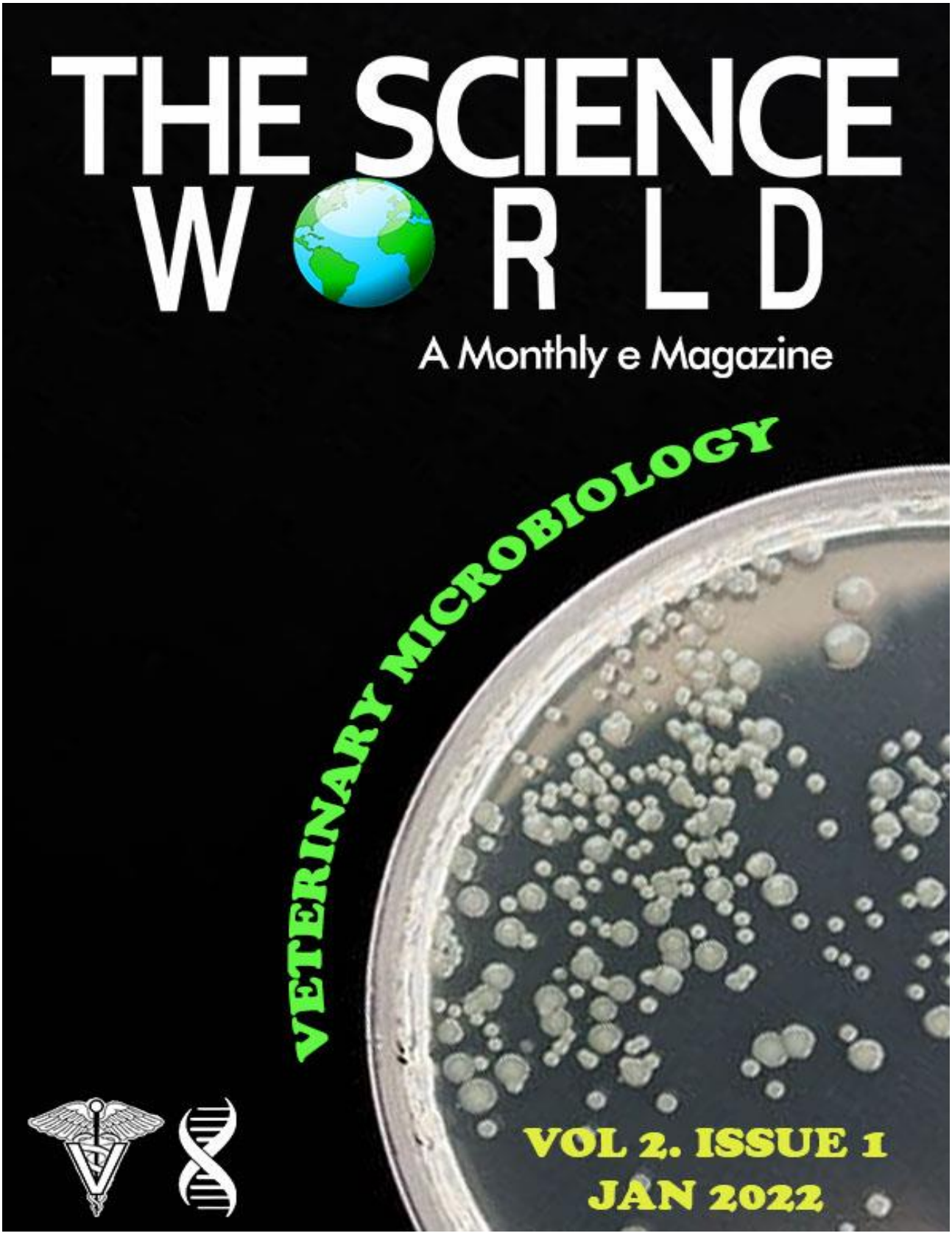

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Urinalysis in Animals: A Review

Jove Jacob

B.V.Sc & A.H. scholar, Apollo College of Veterinary Medicine, Agra road, Jaipur, Rajasthan-302031.

Correspondence Author: jacobjove47@gmail.com

Abstract

Urinalysis is one of the underrated, yet remarkable tools in practice. The initial stages of development of several diseases such as diabetes mellitus, urinary tract infection and glomerulonephritis can be easily traced by using urinalysis as an aid. Observing the physical, chemical and microscopical aspects accompanied by microbial culture and sensitivity test reveals majority of the lower tract infection and also determines the overall health status of a patient [1]. Urinalysis being a readily available and an inexpensive toolkit is not widely used in practice. This review intends to highlight several beneficial aspects of urinalysis which is an asset and an irreplaceable tool to the veterinary practice.

Key words: Urinalysis, diabetes mellitus, urinary tract infection, lower tract infection

Introduction

Urinalysis is one of the key tools within the hands of the Veterinarians which play a major role in diagnosis of the disease. From the ancient times till the Victorian era, urine acted as one of the primary diagnostic tools. Laboratory medicine started with urine analysis almost 6000 years ago and then called uroscopy was given a new name urinalysis after 17th century [2]. Uroscopy is derived from Greek word “uroscopia” meaning scientific examination of urine. Physicians also considered urine as “divine fluid”. Hippocrates is credited with being the original Uroscopist.

From an Ancient period, Hindu cultures were aware that some urine tasted sweet and black ants were attracted towards the urine of some patients which compelled them to suspect that individual might be suffering from pathological condition which is now termed as Diabetes mellitus. Although uroscopy emerged out to be a primary toolkit but overtime, became a more deputize form in medical field but in veterinary practice, is still a relief to a majority of veterinarians practicing worldwide.

Correct Urine sampling- Why and How?

Urine samples reveal the Health status of urinary system, majorly kidneys and other systems too. Hence, proper sampling and storing (if necessary) is a prerequisite for any accurate prognosis of an ailment. Sterility while collecting the sample should be maintained at all conditions and a fresh collection container is preferred. Mainly, there are three methods adopted for collection of urine samples. Out of all the three methods available, cystocentesis is the most preferred and accurate one. A sterile needle is inserted into the urinary bladder via the abdominal wall and with the help of syringe, is withdrawn directly. Collecting a contamination free sample is the major advantage. This method is useful for determination of bacterial infection in the urinary bladder and kidneys. This method is only useful if the bladder of the patient is full and cooperates with the vet [3]. Another method used in practice is catheterization; this is a clean process but not a sterile process. Generally, patient is preferred for lateral recumbency (both male, female dogs and cats alike) and a narrow sterile catheter is introduced into the urethral passage till it reaches the bladder and urine starts to drip from the end of the catheter. This technique is usually practiced when voluntary sample is not available and also has the potential to introduce new bacterial infection via the urethral passage to the urinary bladder. Another most widely practiced method is mid-stream free flow, common method used in bovines and easily done non-invasively. But the sample may be contaminated with debris from the urethra or environment.

Ideally fresh sample collected within 30 minutes of examination is considered. But if it's not possible, urine should be refrigerated as soon as possible and should be stored for not more than 6-12hrs. Refrigerated sample should be thoroughly mixed prior to examination.

Physical Examination of Urine

Color and Transparency

Normal color of urine ranges from pale yellow to amber color and it depends on the amount of urochrome present. However dark yellow color in dogs and cats is often associated with dehydration due to vomition or diarrhea and very pale-yellow color may be a clinical sign of polydipsia or polyuria which may be an indication to the underlying kidney disease or the inability to concentrate the urine. Brown colored urine is an indicative of haemoglinuria or nephritis. Faint pink color of urine is an indicative of congenital porphyria or urolithiasis. The transparency of urine is hindered by the presence of epithelial cells, crystals of calcium carbonate and amorphous urates.

But in case of horses, it is normal to find cloudy urine due to a slight increase in the amount of mucous membrane and calcium carbonates in the urine. Interestingly in bovines, obstructive urolithiasis urine is still transparent and clear.

Odour and Foam

Odour of urine is usually ammonical in nature, primarily due to decomposition of volatile fatty acids (acetic acid, butyric and propionic acid). Sweet odour leads to primary prognosis of diabetes mellitus and acetone like smell is found in case of ketonuria. Foamy urine is found in case of Proteinuria. Common reason for Proteinuria is bleeding and urinary tract inflammation. Proteinuria can occur for a variety of reasons other than kidney dysfunction.

Specific Gravity

Specific gravity is the relative amount of solids in urine and also throws light over the ability of kidney to concentrate or dilute the urine. Specific gravity is inversely proportional to the quantity of urine but exception is that of patients suffering from diabetes mellitus, has high specific gravity along with large volume of urine voided. Generally, urine specific gravity of less than 1.001 is marked as hyposthenuria in dogs and cats. Urine specific gravity may falsely be increased by 0.003 to 0.005 for every1g/dL of protein in urine and for every 1g/dL of glucose may be increased by 0.004 to 0.005[4]. Specific Gravity of urine can be detected with the help of urinometer or by a refractometer. Refractometers are generally used for human urine sample but refractomers for veterinarians are also available. Usually, refractometers provide with four measurement scales which includes Canine Urine Specific Gravity, Feline Urine Specific Gravity, Large Animal Urine Specific Gravity and Serum Protein concentrations for all animals.

Chemical Examination

pH of Urine

Urine pH gives a rough estimate of the ability of kidneys to concentrate hydrogen ions and thus, is an aid to veterinarian to determine the rough acid- base status of the body. Herbivores generally produce alkaline urine and carnivores produce acidic urine.The normal pH of urine in dogs and cats ranges from 5.5-7.0 and 5.0-7.0 respectively [4]. Diet has the potential to contribute to acid base balance via the supply of acid and base from diet. Hepatic oxidation of sulphur containing amino acids such as methionine and cysteine generates hydrogen ion. This is balanced by carbonates from green plants/vegetables which supply more amounts of Magnesium and Potassium, hence equilibrium is maintained. Kidneys are the main sources of excretion of dietary sources for hydrogen ion. Hence, it is directly reflected into the urine. Alkaline urine is observed in dog patients suffering

from urinary tract infections. [5] Urine pH plays an important role in the formation of uroliths. Struvite and calcium apatite are commonly found in alkaline pH while cystine stones are found in the acidic pH. [6, 7]

Proteins in urine

Excess amount of proteins present in urine is called as Proteinuria. Glomeruli prevents large protein particles such as albumin from getting voided in urine but in case of physical oxidative stress particularly to renal system may lead to albuminuria and other types of stress leads to increased glomerular permeability which ultimately leads to Proteinuria. The proteins can also originate from portions of reproductive tract which are directly connected to the urinary tract (prostate gland, uterus and vagina). However in these cases, cystocentesis is recommended. Protein in urine can be detected by use of dipstick which primarily assess albumin in urine. Dipstick detects protein by production of color with an indicator dye. Bromophenol is most sensitive to albumin but detects globulin and Bence- Jones poorly. Sulfosalicylic acid test is more sensitive test for albumin, globulin and Bence-Jones even at low concentrations. The most accurate determination of Proteinuria is done by protein: creatinine ratio. Tubular concentration of urine increases the urinary protein and urinary creatinine ratio equally so that the ratio remains constant whether the urine is concentrated or diluted. This ratio is normally less than one [8]. However, in case of dipstick analysis, must be interpreted in the light of urine specific gravity; that is, at low urine specific gravity values, the presence and degree of Proteinuria might be concealed, whereas at higher values, these might be overestimated. [9]

Glucose in urine

Presence of glucose in urine is called Glucosuria. Glucose is freely filtered and then reabsorbed in the proximal tubules, hence preserving glucose for being utilized as energy. If blood glucose level is too high (hyperglycemia), it exceeds the renal threshold to be reabsorbed and the glucose is excreted in urine. The renal threshold in dogs is 10mmol/L and is slightly higher in cats (14-17mmol/L). Glucosuria in combination with hyperglycemia reflects a tubular resorption defect in which the renal tubules fail to resorb glucose from the glomerular filtrate [10, 11]. Non pathologic glucosuria is found in various emotional states. Pathologic glucosuria is found in diabetes mellitus, hyperthyroidism, acute renal failure, hyper activity of adrenal cortex and urinary obstruction in dogs and cats.

Ketones in urine

Ketones are the product of fat metabolism and their normal reference range is zero to negative. Presence of ketone bodies in urine is termed as ketonuria. Ketones are produced from fatty acid metabolism and include acetoacetic acid, acetone and betahydroxybutyrate. Acetones are usually expired by lungs. Dipstick method can be used for detection of ketone bodies. Dipstick detects majorly acetoacetate and to lesser extent acetone, but unable to detect betahydoxybutyrates. Ketonuria is commonly pathologic; especially in case of ruminants may be an indication of diabetic ketoacidosis. Animals in late pregnancy and early post parturition can develop ketonuria. Diets rich in fats, excessive starvation may also lead to ketonuria.

Bilirubin in urine

When haemoglobin is degraded, the heme part is converted into bilirubin, which is conjugated in the liver and excreted in bile. Some conjugated bilirubin is filtered by the glomerulus and excreted in urine. Normal reference range is zero to negative. There is low range of threshold for bilirubin hence, even a minor change in plasma bilirubin may lead to bilirubinuria. Bilirubinuria is occasionally found in dogs partly due to low renal threshold and partly because canine renal tubular cells are able to catabolise heamoglobin to unconjugated bilirubin and then secrete it into urine. [11] Unlike dogs, bilirubinuria in cats are associated with several underlying diseases. It is associated with feline infectious peritonitis, primary hepatic disorders, diabetes mellitus and feline leukemia related disorders. Bilirubin is unstable and decreased by exposure to sunlight and high levels of vitamin C.

Microscopic examination

Cellular components

Often it becomes difficult to trace the origin of a particular cellular component as they may originate from several areas such as urogenital tract, urothelium or vascular system. Erythrocytes are usually found in increased number in the urine samples collected via cystocentesis or catheterization, but excessive numbers of erythrocytes indicate haemorrhage. This may be an indication of urolithiasis, trauma, cancer or infection. Excessive numbers of leucocytes indicate pyelonephritis and cystitis. Pyuria indicates a purulent process at some point in the urinary tract especially urethritis or cystitis [12]

Crystals in urine

Crystals are commonly found in urine. Their formation is dependent on oversaturation of the mineral substrate, urine pH and length of time between urine collection and examination. Crystalluria should not be always over interpreted. Crystals in the urine of herbivores animals have no special significance unless they occur in very large numbers and are accompanied by other clinical signs such as irritation of the urinary tract. [13] Calcium oxalate and calcium carbonate crystalluria is commonly found in healthy horses and cattle. Bilirubin crystals may be normal in small amounts in dogs. Some crystals are also formed on administration of certain type of drugs such as sulphadiazine.[14] Different crystals have different shape. Struvite crystals have coffin lid appearance; calcium oxalate monohydrate crystals have picket fence appearance, envelope ditetragonal pyramids/bipyramidal shape, while calcium oxalate dehydrate crystals have a maltese cross or square envelope shape. [15] Urate crystals are thorn apple or fine needle shaped and cystine crystals are of hexagonal shape. Struvite and calcium phosphate crystals may be observed in neutral to alkaline urine of dogs and cats. Acidic urine may contain amorphous urates, cystine urates, calcium oxalate and hippuric acid.

Pregnancy diagnosis

The earliest detection of pregnancy relied on chemical test done by urinalysis. Pregnancy diagnosis can be easily done with the help of urine and in case of mares, cuboni test is commonly used which mainly detects the conjugated estrogens in the urine. While in bovines and camels, barium chloride test is also used. Accuracy of the test was described to be 70-95% from 15 to 210 days of pregnancy. In camels, the test was considered to be 85% accurate between 50-90 days of pregnancy. [16]

Cancer detection by urinalysis

This provides an exciting opportunity to utilize a true screening test with the help of simple urinalysis method. Transitional cell carcinoma is the most common tumour of the urogenital system in dogs. The test helps in the detection of mutation in BRAF gene which has been identified as a mutation in 85% of canine urogenital cancers and is available through sentinel biomedical. Clinically this test can provide diagnosis months prior to a patient showing clinical signs or a sizable mass effect.

Conclusion

The fame of ancient name uroscopy had once kept pace with the modernization almost till the 19th century. But in the new era of modernization, uroscopy has been left behind with its old time consuming method. Though new advancements have been made in this method but still lag the pace. However parameters obtained by proper urinalysis are still extensively used to guide even the minor underlying ailments that are often subdued. So, rather than condemning the method author would emphasize on the merits of this method and ease of the practitioners to rely on the results obtained. Author recommends the practitioners should perform by themselves for better and reliable results thus, improving the prognosis and further treatment. The mind therefore is the most important element of informative urinalysis. Urinalysis is a safe and simple method with the only requirement of urine sample from the patient causing no discomfort or pain to the patient.

Acknowledgment

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Role of Iodine in Farm Animals

U. Mishra, K. Sethy*, S. Tripathy, S. Jadhao and P. Senapati

Department of Animal Nutrition, CVSc & AH, OUAT, Bhubaneswar, 751 003, India

***Corresponding author:** babuivri@gmail.com

Abstract

Iodine being a micro-mineral plays a pivotal role in animal biology. About 80% of the total body iodine resides in the thyroid gland. It helps in the metabolism of thyroid gland and production of thyroxine (T_4) and triiodothyronine (T_3). Both hormones have various functions in the energy metabolism and thereby accelerate body reactions. Deficiency of iodine causes structural and functional alterations to the thyroid gland leads to reduced production of these hormones in animals. It is a vital factor in foetal brain development and involved in immune defense, muscular function and neurotransmission.

Introduction

Iodine found naturally in sea water, in certain rocks and sediments. It is one of the heaviest elements essential for physiological functioning of animals. It increases the basal metabolic rate (BMR), accelerate growth and increase consumption of oxygen. It is required for the production of thyroid hormones thyroxine (T_4) and triiodothyronine (T_3). Deficiency of iodine leads to diminished production of T_3 and T_4, causing the disease known as simple goitre. T_4 can be converted to the active T_3 by the enzyme deiodinases. These are further undergo decarboxylation and de-iodination to produce iodo-thyronamine and thyronamine.

T_4 and T_3 contain 65% and 59% of iodine respectively. Iodide enters into the cells directly via sodium-iodide symporter (NIS). A higher daily allowance is recommended for animals in lactation, It is also vital for optimal functioning of reproductive system, gut mucosa, choroid plexus and thymus. It has got immuno-modulatory effects as well.

Sources of Iodine

Sea fishes, shrimps, seaweeds and other seafood are rich sources of Iodine. Leafy vegetables are rich sources of iodine. Cereal grains are comparatively poor iodine than vegetables. Iodine deficiency is mainly due to consumption of feeds and drinking water containing iodine in trace amounts. Iodine is abundantly available in sea water, as a result livestock reared in coastal regions are relatively less prone to iodine deficiency than those reared on mountains.

Iodine content of different foods

Marine fish: 1455 µg/kg	Dairy: 83 µg/kg	Fresh
fruit: 30.6 µg/kg	Meat:68.4 µg/kg	Leafy
vegetables: 88 µg/kg	Cereals: 56.0 µg/kg	

Absorption of Iodine

Dietary iodine is available mostly in inorganic form such as iodide which gets absorbed in the stomach and small intestine. In feed supplements iodine is available in the form of iodate which get further reduced to iodide just before absorption. It is absorbed via sodium-Iodide symporter (NIS). NIS is generally found at the apical surfaces of enterocytes and in the thyroid follicular cells. When iodate concentration in the feed increases, the expression of NIS gene in the body is down-regulated.

Recommended iodine supplementation in cattle and pigs feed, according to NRC (National Research Council)

Species/ Categories	Requirement (in mg/kg DM)
Dairy cows	0.5
Beef cattle	0.4
Fattening pigs	0.16
Breeding sows	0.16

The iodine requirements in farm animals' range between 0.15 to 0.6 mg/kg of dry matter (DM) of feed.

Physiological functions of iodine in the body

- Synthesis of thyroid hormones
- Thermoregulation: Thyroid hormones causes dilation of blood vessels, this in turn affect low heat escape from the body. Hyperthyroidism animals feel too hot and hypothyroidism animals feel too cold.
- Neurotransmission: Iodine influences the functioning of neurotransmitters and cognitive behavior.
- Normal architectural development of glandular tissues like mammary gland, ovary and prostate gland.
- Reproduction: Supplementation of iodinated diet improve fertility, libido and conception rate.
- Involved in the foetal growth and brain development: It is essential for development of brain, glial cell differentiation and myelination. It has got role in cellular metabolism and use of energy within brain cells.
- Regulate body oxidation rate and protein synthesis

- Assist in digestion
- Hair and wool growth
- Immunological defense

Signs of iodine deficiency

Hypothyroidism may occur due to less iodine supplementation in animals. Iodine deficiency causes increased thyroid gland size and less functional activity of thyroid. However, unlike calves and kids, swelling of neck is not a prominent sign in pig and poultry. The symptoms of iodine deficiency vary among farm animals, depending on their age, sex, species and label of supplementation in feed (Underwood, 1977).

Iodine deficiency in the foetus

In pre- and perinatal animals iodine deficiency shows most pronounced clinical signs as there is rapid growth and nutritional requirements is higher. At the initial stage of pregnancy, dam provides sufficient thyroid hormones to the foetus, but in the advanced stage foetus may produce some iodine of its own (Nathanielsz, 1976). Iodine deficiency increases intrauterine foetal mortality (Kursa et al., 1998). Still births and placental retention are most significant in advance stages of pregnancy. Calves born are often blind and hairless. Iodine-deficient piglets and calves are partially or totally hairless (Kursa et al., 1998).

Iodine deficiency in pregnant animals

Hypothyroid dam despite lacking T4 don’t show typical clinical signs of deficiency as compared to normal females. Reproductive health and performance assessing factors such as estrus signs, frequency, libido and reproductive behavior are affected. However, in goitrous areas cows when supplemented with iodine was found to have normal reproductive behaviors. Abortion rate and prolonged pregnancy also observed in iodine deficiency animals.

Iodine deficiency in growing animals

Iodine deficiency may lead to following symptoms in growing animals:

- Inactive and delayed flight behaviour
- Change in voice
- Stunted growth and dwarfism
- Shortened trunks and legs
- Dry, brittle and lusterless hair and wool
- Lowered rectal temperature
- Impaired digestion
- Decreased protein and energy metabolism,
- Reduced erythropoiesis
- Reduced alkaline phosphatase activity

- Impaired immune response

Iodine toxicity

Like deficiency, Iodine toxicity also affects the performance and health of animals. Toxic symptoms include persistent cough, hyperthermia, excess salivation, occulo-nasal discharge, depression, dermatitis and reduced appetite. In dairy cattle rapid breathing, nervousness, weight loss and a higher metabolic rate is observed. Other clinical signs include exophthalmos, respiratory distress and high mortality of the offspring. In pig's excess iodine in feed induces colloid goiter causing significant increase of the weight of thyroid gland and also inhibits iodine uptake.

Conclusion

Iodine is a key mineral for body metabolism and functioning. Iodine deficiency mainly results from consumption of iodine deficient feeds. Iodine requirement is higher in lactating and pregnant animals than in growing animals. Excessive intake of iodine may be toxic to the animals as well as to the consumers.

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Goat Rearing a Way of Self-Employment and Economic Enhancement of Rural People

Dr. R.S. Khillare[1*], Dr. Muskan Kaushal[2]

[1]Scientist, Department of Veterinary Public Health, Mumbai Veterinary College, Parel, Mumbai-400012.
[2]Senior Research Fellow, Department of Veterinary Public Health, Mumbai Veterinary College, Parel, Mumbai-400012.
[*]**Corresponding author:** rajpalkhillare10@gmail.com

Abstract

India is an agricultural, rural country with two thirds of the population and 70% of the workforce living in rural areas. Indian agricultural is mostly restricted to the monsoon season. This has led to unemployment in rural people. Most of India's poorest people live in villages. An estimated 20.5 million people depend on livestock for their livelihood in India. The goat is described as a poor man's cow. Goats are raised for meat and milk purpose. Goats play an important role in rural economy and the livestock industry that is adaptable to adverse weather conditions making them suitable for landless labour and small land farmers. Goats are important part in the arid, semiarid and mountainous regions in India. Goat farming provides nutritional security, self-employment, economic enhancement to millions of smallholder farmers, landless labour and unemployment rural youth.

Key words: Goats, Self-employment, Economic enhancement.

Introduction

India is an agricultural country and the livestock sector is a part of it and livestock is often regarded as an important asset of rural life. Animals plays a vital role in Indian economy. An estimated 20.5 million people depend on livestock for their livelihood (Mundre, 2020). Goats are mainly reared for meat and milk purpose. The goat is a versatile animal and plays a key role in the economy and food of landless, small and medium scale farmers. It is a very important segment of the dry land farming system. Goat farming is a self- employment, which has been done by a large part of the population in rural areas. Goats can thrive on trees and shrubs found in extremely difficult areas in low fertile land areas where no other plant or crop can be grown. Goats are also raised in rainfed areas where crop production is uncertain, and raising large animals viz. cow, buffalo is prevented by severe fodder. In rural area, goats are also kept as a source of additional income and as insurance against crop failure shocks. Poor rural people who cannot feed a cow or buffalo get a goat as the best way to earn additional money, milk and meat. Goats are among the leading meat producers in India, their meat is one

of the best meat and has a great domestic demand. In addition to meat, goats provide other products such as leather and compost manure. Unlike cattle or buffalo, few goats can be easily farmed and sold easily in times shortage of money. In India goat population over 124 million, make up more than 25% of the total livestock and contribute 1,06,335 million a year to the national economy. According to 20th livestock statistics the number of goats was 148.88 million which represents a growth of 10.1% in the last census (Government of India, 2019). Goats are a major contributor to the Indian economy by providing economic enhancement to the rural poor people with basic household food, specifically in arid and desert areas. Goat rearing is beneficial for income and employment generation for the millions of resource poor rural unemployment people. Out of the 138 million Indian rural households, 33.01 million are rearing goats (Singh *et al.*, 2018). India supplied 28 goats breeds and it is distributed various agroecosystems across the country.

The goat is known as the 'poor man's cow' in India because of its significant contribution to the economy of the poor. They not only provide nutritious and digestible milk but also a common source of income for poor, landless, small land farmers. Being small animals, goats can be easily handled by women and children. rearing, feeding, milking, housing and caring for goats does not require much advanced equipment and hard work. Money investments and food costs are also very low. Goat has early sexual maturity, higher prolificacy rate and easily marketing with profit. Goats can be successfully farmed in areas where fodder is limited and milking cows do not grow well. A return of up to 50% money is possible in goat farming. Small land farmers and landless labour that are not suitable for rearing of other species such as cattle, buffalo but goat is the best option for them four goats can be kept cheap as one traditional cow. In rural areas, goat farming plays an important role in providing self-employment to people. Goat rearing turned out to be a very good source of income for the landless as well as the landowners. The wide variety of genetic diversity of Indian goat breeds enables them to survive under stressful natural conditions, including high disease, malnutrition and high temperatures. Goat farmers can get the most profit by selling pure breeds of goats and special occasions such as Eid. Rural unemployment people take training about scientific farming of goats, also develop their management skills for proper housing, feeding including fodder development for goats and their conservation, proper breeding skills, disease control, prevention, value addition of goat milk and meat products. Goat insurance is the best protection

against mortality risk, especially for small producers of farmers. Encourage goat farmers to switch extensive goat farming to semi extensive system.

Advantages of goat rearing/farming

1. There is no religious law on goat farming or chevon and all sections of society eat goat meat easily. Goat meat is much demanded.
2. The initial investment required for goat farming is low.
3. Goat meat contains lower cholesterol and lean meat than other species of red meat.
4. Due to their small size and domicile in behaviour, housing needs and goat management problems are lesser.
5. Goats are mature breeders and reach sexual maturity when they are 10-12 years old. The gestation period in goats is short and when they are 16-17 years old, they start to give milk. Twinning is very common in goat breeds thus ensuring more economic recovery in the short term.
6. Depending on the availability of land, labour and income, goats can be raised from one goat unit to a large commercial farm suitable for an unemployment people, small farmer and landless labour.
7. Goats are mixed graze species. Goats can be raised by landless agricultural workers, women and children because they can grow well on a variety of leaves, many thorny trees, weeds, and unsuitable agricultural crop residues, shrubs, small trees, kitchen waste etc. On a small scale of goat farming the family labour can be used effectively who cannot go into the others land work.
8. Goat farming can be a beneficial business for a farmer and can be well suited for mixed farming. goat can thrive in all ago-climatic condition of the country. Because of the fast-eating habitat. generating employment opportunities for rural unemployment people
9. The goat can eat all kinds of plants that are often rejected by other animals and can be more resistant to bitterness.
10. Because of its tiny fat content in goat's milk, it is easily digested and medically recommended for children and adults.
11. Goat manure is rich in nitrogen, phosphorus and potassium and is an excellent compost for agricultural production of crop.

12. Goat meat is low in fat and is suitable for people who prefer low-fat diets especially in summer and sometimes goat meat is popular over a sheep for chewing.
13. From ancient times the goat's milk has traditionally been known for its medicinal properties and has recently gained importance for human health due to its proximity to human milk so that it can be easily digested and is a health-promoting factor (Verma *et al.*, 2021). Goat's milk is easier to digest than cow's milk because of its smaller fat globules and is naturally made homogenized. Goat's milk is said to play a key role in improving appetite and digestion efficiency. Goat's milk is non allergic and has anti-fungal and antibacterial properties and can be used to treat urogenital infections of fungal origin.
14. Goats are 2.5 times cheaper than sheep grazing in open space under desert conditions.
15. The goat rearing creates job opportunities for self-employment for rural people. There is ample of scope to establish value addition meat and milk products besides the value addition of new product from skin of goat.
16. Goats can digest raw/crude fibre and can even produce good quality of meat at low quality of roughage. Goat eats less feed than cattle and buffalo.
17. Goats are called foster mothers of man, as their milk is considered better in human diet than other breeds of livestock. All ages of people from small children to adult can easily digest goat's milk.
18. Goat's milk having chartists of buffering qualities and this increases its value in patients with peptic ulcers, liver dysfunction, jaundice, biliary disorders and digestive problems. Goat's milk has a higher content of phosphate and B-complex vitamins. Goat's milk is suitable for preparing various dairy products.
19. Goat manure is 2.5 times richer in nitrogen and phosphoric acid than cattle manure.
20. Goats are form an excellent animal for physiological and biomedical research purpose.
21. The commercial goat business is a major source of employment and income. So even less educated unemployed people can easily create jobs and income by farming goats by commercially.

Conclusion

Goat rearing play an important role in rural economy. It provides self-employment to rural people with economic enhancement. Goat farming has different economic and managerial

benefits than other breeds of animals due to your initial investment need, low demand for inputs, high fertility, early sexual maturity and easy marketing.

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Antioxidants in Meat and Meat Products: A Brief Review

Pompi. R.Boro*

PhD Scholar, Department of Livestock Products Technology, College of Veterinary Science, Assam Agricultural University, Khanapara, Ghy-22, Assam, India.

***Corresponding author:** pompi8420@gmail.com

Abstract

Lipid oxidation is one of the most important problems that decrease the shelf life of meat and meat products. Antioxidants are used to reinstate free radicals thereby retarding lipid oxidation, delay development of unpleasant-flavors, and improve color stability.Application of synthetic antioxidants to mitigate oxidative damage may consider unsafe for consumers. Furthermore, the recent growing in the understanding of the consumers about these hazards resulted in the replacement of synthetic antioxidants with natural bioactive compounds. Plant materials are rich sources of bioactive phenolic compounds; hence they can be an effective alternative to synthetic antioxidants. This review presents an overview regarding the new advances in the application of natural antioxidant compounds such as herbs, spices, fruits, plant essential oils and extracts in meat and meat products to improve their quality and shelf-life.

Introduction

Antioxidants are added to different meat products to prevent lipid oxidation, retard development of off-flavors, and improve color stability. In the food industry, they can be divided into natural and synthetic antioxidants. BHA (butylated hydroxyanisole), BHT, PG (propyl gallate), and TBHQ (tert-butylhydroquinone) are examples of synthetic antioxidants; while ingredients obtained from natural sources which exhibit antioxidative potential in a food model system are considered as natural antioxidants. These antioxidants play a very important role in the food industry. However, synthetic antioxidants have been identified as toxicological and carcinogenic agents in some studies. Thus, the food industry now chooses natural products over synthetic ones. Consequently, the food market is demanding natural antioxidants, free of synthetic additives and still orientated to diminish the oxidation processes in high-fat meat and meat products.

Meat and meat products are an excellent source of essential nutrients with high-quality proteins, fat and mineral. There are a wide variety of meat products including cured meats, patties, nuggets, meatballs and etc. Lipid oxidation is a major cause of deterioration in meat

and meat products due to their high fat content and low water activity leading to loss of nutritional value, unpleasant flavor and texture, and water holding capacity. Lipid oxidation has long been recognized as a major problem in the storage of fatty foods. Oxidative changes can result in repugnant flavors, destruction of valuable nutrients and even generate toxic compounds leading to economic loss to the producer and consumer. Unsaturated fatty acids are the potential sources of oxidative offflavors in fatty products and significantly contribute to the shelf life of many products such as ghee (clarified butter), butter, fat spread, milk powders, etc.

Major Oxidative Changes in Food Products

The storage of fat-containing food materials is limited by the period of slow oxidation, where the sensory value is still acceptable. The stage of very slow oxidation in the beginning of storage is called the induction period. The induction period, and thus the shelf life, may be prolonged by addition of antioxidants, which are not able to entirely eliminate the oxidation reactions even when they are active in prolonging the storage time. Several types of rancidity exist in fats, oils and fatty foods, not always connected with oxidation reactions. The most important types are listed in Fats, oils and related compounds, which turn rancid on oxidation, are mostly oxidized by oxygen in the air that penetrates foods and is dissolved in both aqueous and lipid phases. If the reaction is catalyzed by enzymes, the oxidant is still air oxygen. Other oxidants are of minor importance. In the presence of photo-sensibilizers (such as chlorophylls) and in light, ordinary triplet oxygen is converted into singlet oxygen, which is 1500 times more reactive. Fats and oils are highly vulnerable to oxidation, which can be initiated by enzymatic and nonenzymatic mechanisms. Singlet oxygen can be generated by the photosensitization of molecular oxygen by lights which in turn initiate the lipid oxidation by reacting with unsaturated fatty acids of food products. Oxidation of β-carotene and vitamin A results in release of more polar oxidation products. The oxidative destruction of the fat soluble vitamins (A, D, E and K) has important nutritional implication. Some amino acids can also undergo oxidation along with the oxidizing lipids (Min, 2007). Food lipids are susceptible to the oxidation process, which takes place in different steps like initiation, propagation and termination. Different chemical mechanisms are responsible for the oxidation of fats and oils during processing, storage and cooking.

Classification of Antioxidants

Antioxidants are naturally present in a wide variety of raw materials, but can also be added to foods for additional protection against oxidation. The antioxidants which are added

to food products can be natural or synthetic compounds depending on their availability, and preparations.

Natural antioxidants

The beneficial effects of foods are being partially attributed to naturally occurring antioxidant substances. The search for natural sources of compounds with functional activity to be added to foods (functional) for specific population groups (diabetics, hypertensive, etc.) is important and necessary. It is generally accepted, that natural antioxidant molecules are safer than synthetic antioxidants, available in complex forms, which include tocopherols, lycopenes, flavonoids, nordihydroguaretic acid(NDGA), sesamol, gossypol, vitamins, provitamins and other phytochemicals, enzymes (catalase, glutathione peroxidase, super oxide dismutase), minerals (Zinc, Selenium), and lecithin Alpha(α)-tocopherol (vitamin E) is well known as one of the most efficient naturally occurring lipid-soluble antioxidant. In recent years, due to increasing public awareness regarding health and wellbeing and apprehension of using synthetic antioxidants in food system, there has been a growing interest to identify and utilize antioxidative properties in many natural sources such as soy protein alfalfa leaf protein found rapeseed protein hydrolysates to be a potential source of antioxidants in addition to high quality protein for human consumption.

Limitations of natural antioxidants

Natural antioxidants are available from raw materials of variable composition whereas, synthetic antioxidants are produced as pure substances of constant composition. Application of synthetic antioxidants, unlike natural antioxidants, is relatively easy requiring no substantial modifications of the recipe and processing conditions. The amount of natural antioxidant added to food products should be adapted according to analytical results obtained. It is also affected by the processing conditions like pasteurization (change in vitamin E), sterilization, boiling and evaporation which destroys some heat-labile vitamins and reduces the biological value of proteins'

Synthetic antioxidants

Synthetic antioxidant compounds are widely used in food products to inhibit progress of lipid oxidation. Addition of these to food products is however, prohibited in some countries.

Limitations of synthetic antioxidants

There are a number of controversies in the use of synthetic antioxidants. Since food additives are subjected to the most stringent toxicological testing procedures, only a few

synthetic antioxidants have been used in foods for any length of time. Since the toxicity of some synthetic antioxidants is not easily assessed, as a result a chemical may be considered safe by a country, tolerated in another country and forbidden in third one.

Commercial Application of Antioxidative Materials in Meat Products

For several decades, numerous natural antioxidants have been widely studied in the food science field, including in meat products. However, the use of natural antioxidants in the meat industry is scarce.

We found that most of these processed meat products were prepared using traditional additives, such as vitamin C and E, sodium erythorbate, or sodium hydrosulfite, as antioxidants, instead of natural antioxidants (phytochemicals, other vitamins, or extracts). Although several processed meats are labeled as “organic” and “natural”, they do not use natural antioxidants. Therefore, we cannot present data on the development of meat products using natural antioxidants.

This indicates a lack of research attention to natural antioxidants in the development of meat products. Therefore, we offer the following suggestions or comments for the study of antioxidants and their use in the meat industry.

First, the lack of utilization of natural antioxidants could be due to the fact that using synthetic antioxidants is more cost-effective, safer, and simpler than using natural antioxidants

- The meat industry has difficulty in developing products using natural antioxidants because of the possibility of changing the sensory characteristics of products.
- The shelf-life of meat products can easily be extended by controlling temperature conditions, employing packaging methods, and using preservatives.
- Consumers may not be interested in the benefits of increasing the shelf life of meat products or issues related to lipid oxidation.
- Some consumers prefer meat products with a short shelf-life because they think that products with a short shelf-life lack additives or are natural.

Second, scientists already know the antioxidant activity of most natural substances containing phytochemicals, but consumers and the meat industry are less aware of this.

- Traditional spices in meat products are known to have strong antioxidative activity. These spices include rosemary, nutmeg, cloves, fennel, onion, garlic, ginger, thyme, pepper, cumin, caraway, coriander, laurel leaf, allspice, anise, basil, cardamom, oregano, and turmeric.
- The main mechanisms underlying the antioxidative activity of phytochemicals in meat products have already been discovered .

- Because of the increasing health awareness of consumers, meat products using natural antioxidants have a positive effect on purchasing behavior.Therefore, it is necessary to encourage the meat industry to use or label natural food antioxidants from this point of view.
- Most phytochemicals and many natural sources exhibit antioxidative activity, and there is a need to further confirm this for their application in the meat industry.
- There is a need to publish a paper (i.e., presenting the antioxidative effect of extracts or phytochemicals) with an accurate examination of the structure or profile of extracts from plant-based foods or phytochemicals.
- There is a need to study the exact structural profile of active compounds of new materials in addition to approaches for improving antioxidant activity.

Third, although the use of natural antioxidants is limited in developing meat products, natural antioxidants or bioactive materials should be considered multifunctional, providing antioxidative activity, reducing harmful substances, improving color stability, improving flavor, or controlling pathogens at low cost.

- Bioactive compounds such as antioxidants that are multifunctional could be more usable.
- Certain antioxidants can effectively prevent the production of carcinogens (heterocyclic amines, polycyclic aromatic hydrocarbons, biogenic amines, or benzopyrene) during cooking.
- Certain antioxidants can effectively replace sodium nitrite as a coloring agent.
- Certain antioxidants can be used as novel spices in meat products.
- Antioxidants should be safe to ingest.
- Antioxidants should be readily available and inexpensive.

Taken together, we suggest that more efforts are needed to develop safer, easy-to-obtain, easy-to-use, and cost-effective materials, and to promote these materials to consumers and the meat industry.

Conclusions

Numerous plant resources are rich in vitamins, tocopherols, phenolic compounds, and flavonoids. All these compounds possess antioxidative activity and can hence inhibit the lipid oxidation of meat products during cooking or storage. The antioxidative activity of these phytochemicals in meat products has long been recognized, widely studied, and confirmed, and the mechanisms underlying their action have already been tested. For these reasons, studies on the antioxidative effects of phytochemical or plant resources (extracts, oils, seeds, or powders) on meat products are predictable. However, despite the prospect that natural antioxidants could

replace synthetic antioxidants in meat products, natural antioxidants are rarely used in the meat industry. Meat scientists must develop novel research paradigms that allow the use of bioactive compounds in the development of meat products.

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Fasciolosis in livestock

Deepak Sumbria[1], Vikrant Sudan[2]

[1]Assistant Professor, Department of Veterinary Parasitology, COVSc Rampura Phul, GADVASU, Punjab.
[2]Associate Professor, Department of Veterinary Parasitology, COVSc Rampura Phul, GADVASU, Punjab.
[*]**Corresponding author:** deepak_sumbria@yahoo.com

Abstract

Across the globe livestock industry is heavily affected by fasciolosis and it has adverse effect country's growth. It is present in almost every continent of the earth. Production of animal gets reduced by the infection of present fluke and there are chances of transmission of infection to human also. Current article provides us brief information about some crucial aspect of *Fasciola* sps such as morphology, life cycle, pathogenesis, control and treatment aspect.

Introduction

In 2019 India had about 535.8 million numbers of total livestock, which consist of 302.3, 74.3 and 148.9 million of bovine (cattle and buffalo), sheep and goat respectively (https://www.nddb.coop/information/stats/pop). These animals are used for both milk and meat purpose and due to great diversity in their habitat suffer from wide variety of parasitic disease, out of which Fasciolosis plays a crucial role. It is one of the serious helminthic diseases which occur in hilly as well as plain region. This disease can reduce the productive potential of animal and can cause huge lose to country economy and farmer income. Infection this parasite can also infect human. In this popular article we have discussed general aspect of parasite including its morphology, life cycle, pathogenesis, control and treatment aspect.

General structure of Fasciola species

Fasciola hepatica mainly occur in bile duct of small and large ruminants, dogs, horse, man, cat etc. It is leaf like in shape and is greyish brown in colour. Anterior portion is broad than posterior region. Cone shape projection is present in anterior region followed by well develop shoulder. Anterior sucker is present on cone and ventral sucker is present at level of shoulder. Body is covered by spiny tegument, intestinal caeca is highly branched, testes and ovary is also branched, vitelline gland is present in lateral region (Soulsby 1982, Bhatia et al 2016). Another important species is *Fasciola gigantica* whose general difference and structure

is given in latter section. *F. hepatica* is mainly found in Himalayan region and *F. gigantica* is found in Meghalaya, Andaman and Nicobar, Jammu and Kashmir, Sikkim, Haryana, Uttar Pradesh, Punjab, Bihar, Maharashtra, Gujarat, Madhya Pradesh etc (Bhatia et al 2016).

Appearance of fluke

***Fasciola hepatica* (Abdisa 2017)**

***Fasciola gigantica* (Abdisa 2017)**

Difference between 2 important species of Fasciola

S. no	*Fasciola hepatica*	*F. gigantica*
1	Found in hilly area (temperate)	Found in plain area (tropical)
2	Size small	Size is large
3	Anterior cone is large	Anterior cone is smaller
4	Shoulder are broad and prominent	Shoulder are not prominent
5	Body is grayish brown	Body is more transparent
6	Ovaries, testes and intestinal caeca are more branched	Ovaries, testes and intestinal caeca are less branched
7	Egg is small (130-150 by 63-90 um)	Egg is large (156-197 by 90-104 um)
8	Snail is amphibious (*Lymnaea truncatula*)	Snail is aquatic (*Lymnaea auricularia, L. acuminate* [Indian subcontinent])
9	Development in snail is shorter duration as compared to *F. gigantica*	Development in snail is longer duration as compared to *F. hepatica*
10	Control is easy because IH is amphibious	Control is difficult because IH is aquatic

Life cycle

Adult fluke are present in the DI i.e. definitive host (sheep, goat etc). Fertile egg comes out of fluke body and via bile reaches to the duodenum of DI. At appropriate humidity and temperature, egg hatch in the environment and produce 1st larval stage i.e. miracidium. With the help of boring action of anterior spine and secretion of apical gland, miracidium penetrate into the body on IH i.e. intermediate host (snail). It removes its ciliated outer covering and form sporocyst (2nd larval stage), after some time sporocyst form 5-8 redia (3rd larval stage), these redia have ring like thick part at pharynx region and 2 blunt process at hind end. Redia then form cercaria (4th larval stage), it has a rounded body with no eye spot and a tail of twice in length. Cercaria then leaves the body of snail and swim in water body with help of tail. It then crawl on local water vegetation and with the help of secretion secreted by cystogenous gland a covering is formed on body, tail is casted off and it turn into metacercariae (5th larval stage). This metacercariae is ready for infection to DH. When DH ingests this vegetation, metacercariae reach to gastro-intestinal tract (GIT). Excystation (removal of outer covering) take place in duodenum. Host factors such as trypsin, pancreatin, and cholesterol help in the removal of covering. Juvenile fluke are released in GIT, within 24hrs via penetration of intestinal wall reaches to abdominal cavity and at last penetrate liver capsule. After penetration they first migrate in parenchyma and reach to bile duct and form adults (Soulsby 1982, Bhatia et al 2016).

Pathogenesis

(1) ***Acute fascioliasis***- This condition is caused due to simultaneous migration of large number of immature fluke in liver. It is mainly observed in late summer due to presence of higher cercarial load on vegetation. Migration of juvenile fluke cause marked haemorrhage and massive destruction of parenchyma. They also feed on hepatic cells. In some case liver capsule also get rupture due to higher parasitic load and haemorrhages are also formed in peritoneal cavity. Sudden death of animal may occur; post mortem examination shows enlarged liver with pale haemorrhagic tract on liver surface. Sometime fibrinous clot can also been seen on hepatic surface and peritoneal cavity. Numerous immature flukes can also be observed, Acute fascioliasis lead to the formation of necrotic lesion and it potentiate proliferation of Gram-positive, endospore-forming anaerobic bacteria i.e. *Clostridium oedematiens novyi* and lead to "black disease".

(2) ***Chronic fascioliasis***- It leads to 2 types of condition i.e. hepatic fibrosis and hyperplastic cholangitis

(a) Hepatic fibrosis- As discussed above that migration of juvenile fluke lead to haemorrhage, necrosis and destruction of liver parenchyma moreover migration of fluke cause the formation of thrombus in hepatic vein, as a result proper flow of blood get hampered and this result in formation of coagulative necrosis of parenchyma. After some weeks healing and regeneration of lesion begin, collagen is laid down and resulted in the formation of fibrosis. Many time contraction of scar tissue also occurs and it alters normal hepatic architecture. In order to restore normal architecture, band of fibrous tissue are formed and it interconnect migratory tract with normal tissue and thus lead to formation of lobules (Soulsby 1982, Bhatia et al 2016).

(b) Hyperplastic cholangitis- Adult fluke mainly cause this condition. Hyperplasia of bile duct epithelium occurs along the side of fluke attachment. Suckers and spine of adult fluke denude the bile duct wall and it lead to local inflammation. Hyperplastic mucosa became more permeable to various protein mainly albumin, this along with blood sucking habits of adult fluke (blood loss @ 0.5ml/day/fluke) lead to the formation of hypoalbuminaemia and hypoproteinaemia in animal. Many time calcification of fibrotic lesion, walls of bile duct occur and lead to formation of pipe-stem liver. In rare cases hazel-nut-sized cysts are also formed due to parasite in other organs such as lungs (Soulsby 1982, Bhatia et al 2016).

Clinical sign

1. Acute fascioliosis:

Animal dies suddenly. Blood stained froth appear at the nostrils like in Anthrax.

2. Chronic fascioliosis:

Animal is off colour, followed by increasing anaemia. Lack of vigour, when the infected animals are driven for long and remains behind amongst the flock. Appetite diminishes, mucous membrane pale, oedema. Skin is dry & doughy to touch. Hypoproteinemia is seen that leads to bottle jaw condition. Marked constipation is seen in cattle. Diarrhoea in concurrent infections with ostertagiosis(Soulsby 1982, Bhatia et al 2016).

Diagnosis

Clinical sign, faecal examination for golden yellow egg with indistinct operculum, serological test such as ELISA, latex agglutination test. ELISA: Cathepsin L, **Bio K201** Sandwich ELISA kit has been developed for detecting *F. hepatica* (Belgium).

Treatment

Triclabendazole (10-12mg/Kg body wt effective against both form: *DOC for acute fasciolosis*, Oxyclozanide (15mg/Kg body wt effective against mature): safe in milk (3 day withdrawl period), Rafoxanide (7.5mg/Kg body wt effective against mature), Bithionol (35-40mg/kg body wt against chronic form), Nitroxynil (10-15mg/kg body wt S/C effective against both form), Diamphenethide (100mg/Kg body wt good for acute fascioliosis), Albendazole (7-15mg/kg body wt effective against mature form) (Soulsby 1982, Bhatia et al 2016).

Control measure

Destruction of IH by use of insecticide such as copper sulphate, sodium pentachlorophenate etc, rearing of snail eating ducts, use of spores of predacious fungi, segregation and treatment of infected animal (Soulsby 1982, Bhatia et al 2016). Control of snail by three ways:

1. Physical: Net in water channel in farms/ flow of water, destruction of breeding ground.
2. Chemical: Copper sulphate (1:100000) or 10-35kg/hectare, N-tritylomorpholine (0. 45kg in 680litres/hectare), Cuprous chloride (5ppm), Niclosamide .
3. Biological: Duck and goose rearing, Fish (Black Carp), Nymphs of dragon fly, Predatory Prawn (*Macrobrachium vollenhoveni*), Water bugs (*Sphaerodema urinator)* and Plant extracts.

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Sarcoptes scabiei Infestation & its Therapeutic Management in Black Bengal Goats

Jowel Debnath[1], Mritunjay Kumar and Joyabrata Roy

Department of Livestock Farm Complex, College of Veterinary Sciences & Animal Husbandry, R.K.Nagar-Tripura West-799008

***Corresponding author:** jowelagb@gmail.com

Introduction

Goat rearing plays a vital role in socio-economic condition of rural people in developing country like India, among small ruminant husbandry. Ectoparasitic infestation often causes severe economic constraints on goat production across the world. Amongst the ectoparasites, *Sarcoptes scabiei* causes major economic threat in terms of poor quality meat, low production of milk and make a major trade embargo in leather industry. The disease is characterized by intense pruritus and appearance of red papules as well as general erythema of the skin. Though the diseases seem to be less dangerous however, in neglected cases animal emaciation, weakness and anorexia causes significant morbidity and mortality in domestic and farm animals (Walton and Currie, 2007). Recent findings suggest that tissue damage attributed by oxidative stress and reactive oxygen species (ROS) play a key role in pathogenesis in many ecto-parasitic and skin diseases (Dimri *et al*.,2010).

Materials and Methods

Out of total 25 goats (Does: 10, Bucks: 2 & kids: 12) reared at Instructional Livestock Farm Complex (Goat Unit), College of Veterinary Sciences & Animal Husbandry, R. K. Nagar, Agartala , Tripura, twelve goats with history of inappetence , weight loss and skin lesions were selected for present study. A total 12 affected goats were divided in to 2 groups. Group I, consisting of 6 goats in which dipping was performed with Deltamethrin 12.5% solution @ 4ml/litre of water at weekly for three times. However, Group II consisting of 6 goats was treated with Deltamethrin dipping along with vitamin ADHE injection @0.05ml/kg

body weight at weekly interval for 3 times. All the goats were between the age group of 2 months to 3years. Deep skin scrapping taken from three different site of body was examined microscopically at weekly interval for mites using standard method (Soulsby, 1982). Haematological parameters viz., Haemoglobin% (Hb %), packed cell volume (PCV %), total

erythrocyte count (x106/µl), total leukocyte count (x103/µl) and differential leukocyte counts (%) were estimated as per standard protocol (Jain,1986).

Results and Discussion

Microscopic examination of skin scrapings taken from the infected goats revealed the presence of *Sarcoptes scabiei* mites (Fig 1). Haematological values were almost within normal range. Physical examination of affected goats showed rough hair coat with scale, alopecia, itching, erythema and hyper keratitis (Fig 2). Clinical signs of rough hair coat, scales, alopecia and erythema in present study are associated with burrowing of Sarcoptes

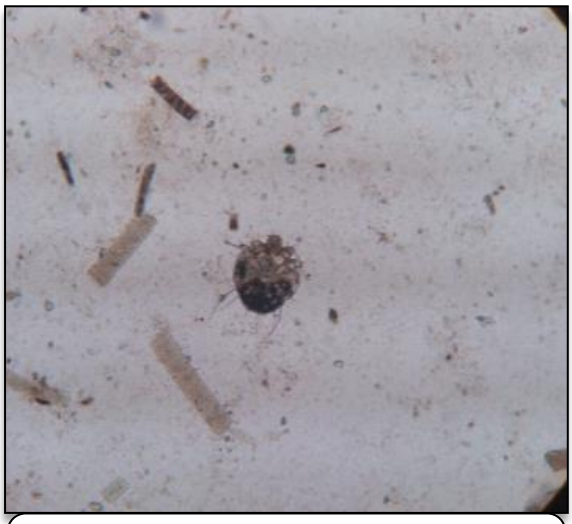

Fig1. *Sarcoptes scabiei* mite in the skin scraping of Black Bengal goat

Fig 2. Rough hair coat, scale, alopecia and hyper keratitis in a Black Bengal goat

mites in the stratum corneum of the skin and hyperkeratitis. As the infestation progresses, the number of mites increases in the skin and it releases sufficient antigenic material from saliva, scybala (fecal pellets) and other secretions (Elder et al.,2006). Scabies mite-inactivated serine protease paralogs, an important antigen has been identified both internally in the mite and externally in the faces (Willis et al.,2006). Researchers found that in vivo and in vitro *Sarcoptes scabiei* antigens are able to increase proinflammatory cytokines level in blood and skin cells (Mullins et al., 2009). A part from dermatological symptoms, scabies infection is also associated with physiological changes. Group I and Group II treated goats showed parasitological recovery on day 15 of treatment. However, group II treated animals revealed earlier clinical recovery on day 21 compared to group I treated animals on day 30. In present study, group II treated goats clinically recovered earlier than group I treated goats due to antioxidant properties of vitamin supplements. Goats with mite infection were observed enhanced lipid peroxidation and reduced glutathione activity (De and Dey., 2010) which exerts

harmful effect of skin due to alterations in the integrity of cellular membrane structure (Portugal et al.,2007).

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Antibiotic residues in meat and meat products

Bilifang Daimary1*, Pranjal Moni Nath[2], Nanda Kumar Roy[3], Pompi Rani Boro[4]

[1] Ph. D. Scholar, Department of Livestock Products Technology, College of Veterinary Science, Assam Agricultural University, Khanapara, Ghy-22, Assam, India
[2] Ph. D. Scholar, Department of Veterinary Public Health, College of Veterinary Science, Assam Agricultural University, Khanapara, Ghy-22, Assam, India
[3] Ph. D. Scholar, Department of Livestock Production and Management, College of Veterinary Science, Assam Agricultural University, Khanapara, Ghy-22, Assam, India
[4] Ph. D. Scholar, Department of Livestock Products Technology, College of Veterinary Science, Assam Agricultural University, Khanapara, Ghy-22, Assam, India
***Corresponding author:** bilifangdaimary143@gmail.com

Abstract

Antibiotics are used for treatment, as growth promoter and for prophylactic measures in livestock farming. However, the inadvertent use of antibiotics has led to the development of antimicrobial resistance which has become a global concern for human as well as animal population. The antibiotic residues have been found to have many negative effects on human health. Recently many methods have been developed for detecting and quantifying the antibiotic residues in meat and meat products.

Introduction

Antibiotics are the substances produced naturally by microorganisms or synthetically in a laboratory, which are used to treat infections primarily of bacterial origin. They either kill the organisms or inhibit their growth and multiplication. With the ever-increasing human population, there has been a gradual increase in demand of proteins to fulfil the requirements of human body, which has led to increase in demand of meat and meat products. To meet the increasing demand of animal proteins, the livestock farmers rely on use of antibiotics for the treatment of diseased animals and birds to reduce their mortality. Some farmers also use antibiotics as growth promoter and prophylactic agents to increase the productivity, growth of animals and to prevent an outbreak of diseases in their farms. Although antibiotics are essential for the welfare of animals, its misuse has led to the development of antimicrobial resistance, a phenomenon where the microorganisms acquire ways to resist the effects of drugs and does not respond to the antibiotic therapy. Majority of the antibiotics used in treatment of farm animals are also used in the treatment of human

population. Thus, the antibiotic residues in meat and meat products have become a global concern for human health.

In a country like India with the world's second highest population, the burden of bacterial infections is also highest among the nations with an estimated death rate of 410,000 per year for children aged 5 years or below with pneumonia accounting for about 25% of all child deaths. The emergence of antimicrobial resistance among the newer generation of drugs has set the alarm bells ringing.

Antibiotic residues in animals

The access of antibiotic residues in meat and meat products comes from its use in

1) Controlling or preventing disease
2) Indirect contamination of antibiotics through feed
3) Contamination of feedstuff with drug excreted in the fecal material of treated animals
4) Contamination of water bodies with antibiotics which travels through various cycles of soil, plant, water and ultimately reaches animal's body
5) Vertical transmission from mother to offspring etc.

Impact on human health

The indiscriminate use of antibiotics in livestock farming has led to the spread of antibiotic residue worldwide irrespective of geographical, economical, or legal differences between countries. The antibiotic residue affects the human health in the following ways mentioned below:

1) Anaphylactic reaction in sensitive individuals
2) Certain macrolides may lead to damage of liver
3) Can lead to the development of resistant bacteria, making it more difficult to treat the infections in human
4) Also, it can lead to the development of resistant bacteria in animal population which may get introduced into the human food chain due to improper handling and post processing contamination of food with these organisms.
5) Can disrupt the fermentation process in foodstuff which ultimately leads to financial loss
6) May destroy the beneficial microflora present in our gut, thus making the person susceptible to various diseases caused by pathogenic bacteria.

Detection of antibiotic residues

The methods for detection of antibiotic residues in meat can be classified into two categories: screening test and confirmatory test. Screening tests includes tests like enzyme-linked immunosorbent assay (ELISA), thin layer chromatography (TLC), commercial ampoule test, the Nouws antibiotic test (NAT), the Premi Test etc. where as confirmatory test includes tests like high performance liquid chromatography (HPLC), high-performance thin-layer chromatography (HPTLC), gas chromatography (GC) etc.

Maximum residue limit (MRL)

MRL is defined as the highest concentration of a contaminating metabolite resulting from the use of veterinary drug which may be legally permitted or recognized as acceptable in or on a food. In recent years various efforts have been made by World Trade Organization and Codex Alimentarius to harmonize the standard for Maximum Residue Limit (MRL) of different antimicrobial agents, but still MRL vary from one country to another due to adoption of different standards which varies from country to country.

Table 1: MRL for some commonly used drug in veterinary medicine

Sl. No	Species	Tissue	Parent drug	MRL	Year of adoption
1.	Cattle	Muscle	Amoxicillin	50 µg/kg	2012
2.	Pig	Fat/Skin	Amoxicillin	50 µg/kg	2012
3.	Sheep	Muscle	Amoxicillin	50 µg/kg	2012
4.	Cattle	Muscle	Ceftiofur	1000 µg/kg	1999
5.	Pig	Muscle	Ceftiofur	1000 µg/kg	1999
6.	For all species of food animals	-	Chloramphenicol	No safe residue	-
7.	Cattle	Muscle	Colistin	150 µg/kg	2008
8.	Pig	Muscle	Colistin	150 µg/kg	2008
9.	Sheep/Goat	Muscle	Colistin	150 µg/kg	2008
10.	Chicken	Muscle	Colistin	150 µg/kg	2008
11.	Chicken	Muscle	Erythromycin	100 µg/kg	2008
12.	Cattle	Muscle	Gentamicin	100 µg/kg	2001

13.	Pig	Muscle	Gentamicin	100 µg/kg	2001
14.	Cattle	Muscle	Neomycin	500 µg/kg	1999
15.	Chicken	Muscle	Neomycin	500 µg/kg	1999
16.	Goat/Sheep	Muscle	Neomycin	500 µg/kg	1999
17.	Cattle	Muscle	Chlortetracycline/oxytetracycline/ tetracycline	200 µg/kg	2003
18.	Pig	Muscle	Chlortetracycline/oxytetracycline/ tetracycline	200 µg/kg	2003
19.	Poultry	Muscle	Chlortetracycline/oxytetracycline/ tetracycline	200 µg/kg	2003
20.	Sheep	Muscle	Chlortetracycline/oxytetracycline/ tetracycline	200 µg/kg	2003

Decontamination of antibiotic residues

1) **Cooking**- The reason behind reduction of antibiotic residue in cooked meat has been attributed to the transfer of antibiotic residues in the boiling medium and loss of juices from meat during heating process. Although different cooking methods can be applied to reduce the antibiotic residues to a safer level, however it can't guarantee the complete removal of the residues from meat.
2) **Freezing-** Recently it has been found that freezing the meat for a definite interval helps to reduce the antibiotic residues in meat. It takes months to reduce the antibiotic residue in meat with freezing method and from practical point of view, it does not hold any value, however more research in this field is needed to realize the potential application of this method in near future.

Measures to reduce or control antibiotic residues in meat

1) Educating and raising awareness among the livestock farmers, consumers and persons dealing in livestock regarding the development of antimicrobial resistance
2) Adoption of biosecurity measures in farm complex.
3) Reduction in use of antibiotics except for treatment of diseased animals.
4) Following of withdrawal period of a given drug
5) Proper use of the prescribed drugs according to the label directions

6) Enactment of legislation to prevent the unauthorized use of drug in livestock
7) Use of probiotics to maintain the overall health
8) Use of substances like acidifiers in water, feed and water sanitizer in livestock farming to reduce the development pathogenic bacteria in feed, water.
9) Use of natural antimicrobial agents
10) Vaccination of animals against various diseases

Conclusion

Many methods have been developed to screen and quantify the levels of antibiotic residues in meat and meat products. Moreover, there has been a recent development in decontamination of antibiotic residues in meat with few successes. However, the best strategy to prevent the antibiotic residues in meat is to reduce the use of antibiotics in food animals.

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Popular Article

Bio-Marker Concept for Mineral Requirement for Correction of Deficiencies and Toxicity of Minerals

Manju Lata*, B.C. Mondal**

*** Ph.D Scholar, **Professor,** Department of Animal Nutrition, College of Veterinary and Animal Sciences, GBPUAT, Pantnagar, 263145, Uttarakhand, India

Corresponding author: manjundri1@gmail.com

Introduction

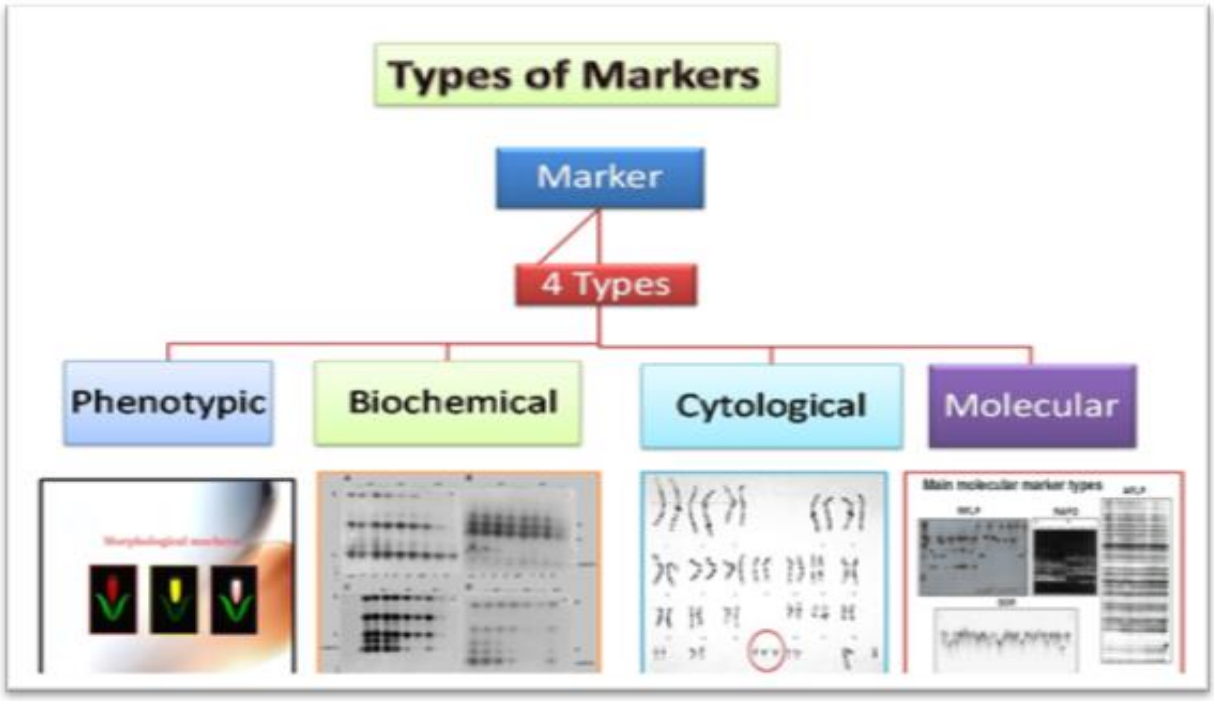
According to the **World Health Organization** (WHO) a biomarker is, "Any substance, structure, or process that can be measured in the body or its products and influence or predict the incidence of outcome or disease,".

The term "**biomarker**" is used in this monograph, as it is in the US National Academy of Sciences report (US NRC, 1989b), in a broad sense to include almost any measurement reflecting an interaction between a biological system and a potential hazard, which may be chemical, physical or biological. The measured response may be functional and physiological, biochemical at the cellular level, or a molecular interaction.

Biomarkers can be found in biological fluids, including urine, serum, feces, lymph, and synovial fluid. Blood is easily withdrawn from the body, and it mediates many of the immune and immunologic pathways of the body. Urine is easily accessible.

Biomarkers of digestion and absorption can provide information about the extent of nutrients breakdown and absorption into the circulation. These biomarkers can ultimately gage how effectively the gastrointestinal tract is carrying out its basic digestive and absorptive functions. While the assessment of digestion and absorption is performed routinely in research settings, many of the technologies and equipment used for this purpose are not available as a point of care tool that can provide a real-time assessment on digestion and

absorption on farm. Testing for faecal biomarkers however, could prove useful in assessing the effectiveness of the digestion and absorption processes.



Biomarkers of Effects

These are biomarkers that are related to a target function or biological response. Thus, not only do they reflect intake but also nutrient metabolism and, possibly, effects on physiological or disease processes. It is important to note that a biomarker may not reflect the effect of a single nutrient but the interactions of various nutrients. For example, some of the biomarkers of the metabolism of one carbon compounds such as homocysteine, which reflect not only nutritional intake but also various metabolic processes related with pathological or physiological conditions

Homocysteine, Folic Acid and Vitamin B_{12}

Amino acid, Methionine is produced from diet protein intake. A part of methionine is changed in to Homocysteine. Amino acid help to converts lots of homocysteine in to methionine. In a case of B_{12} deficiency, homocysteine levels will enhancement because of defect in reaction (Blom and Smulders, 2011). Both sufficient B_{12} and folic acid (folate) levels indispensable to keeping Homocysteine at status associated with less rates of problems

as well as inadequate vitamin B_6 levels brings about increased Homocysteine in animals (Blom and Smulders, 2011).

Metabolism of Folic Acid (Folate):

Folic acid and vitamin B_9 are another name of folate which is belong to B vitamins family group. Daily intake level of folate is nearly 400 micrograms from foods or dietary supplements. Metabolism process of folate is the basic metabolism in which carbon units are tended to Homocysteine, more over amino acids and purine-pyrimidine nucleotides are generated (Bostom *et al.*, 1999).

Folic Acid

Water-soluble folate which is known as folic acid and pteroyl monoglutamate (PteGlu) is belonging to vitamin B groups (vitamin B_9). Chemical appearance of it includes of 3 portion: a pteridine hoop, glutamic acid and para-aminobenzoic acid. Considering that oxidation situation of the pteridine hoop, folic acid are classified, the rest of glutamic acid and one-carbon units at the N_5 and N_{10} status. Homocysteine and folic acid are elevated risk in lots of various diseases, consisting innate birth faults like heart problems, cleft palate and lip the residues of glutamic acid, neuro-degenerative, cancer, late gestation, osteoporosis and neurodegenerative which suggests a potential role for folate in reducing probability of related diseases (Bostom *et al.*, 1999).

Vitamin B_{12} Metabolism

Vitamins like B_{12}, B_6 and riboflavin are contributed in the metabolism of an S-including amino acid, Homocysteine. Methionine and folic acid cycle links Homocysteine metabolism. Vitamin B_{12} is indispensable for methylation processes which is necessary for cell metabolism and deoxyribonucleic acid (DNA) reactions, so any shortage may lead to interruption of cell metabolism and DNA so may causes important clinical problems (Stabler, 2013). Succinyl-CoA is generated by Methylmalonic acid and vitamin B_{12} plays as a cofactor role for this process.

Vitamin B_{12} transformation to two active coenzymes, methylcobalamin in the cytoplasm and adenosylcobalamin in mitochondria which is essential for methylmalonic acid and Homocysteine homeostasis. Homocysteine again synthesised into methionine or changed

into amino acid cysteine. In a case of vitamin B_{12} level shortage Homocysteine and methylmalonic acid are elevated. There is a potent relationship between Homocysteine levels and methylmalonic acid, and the sensitivity of Homocysteine levels are the marker (more than 95%) for recognizing vitamin B_{12} shortage. Disease animal response to treatment beside measurement of folic acid, vitamin B_{12} and creatinine levels will indicate the reason of the elevated Homocysteine amounts (Refsum *et al.*, 2004).

Factors Contribute to High Homocysteine Levels:

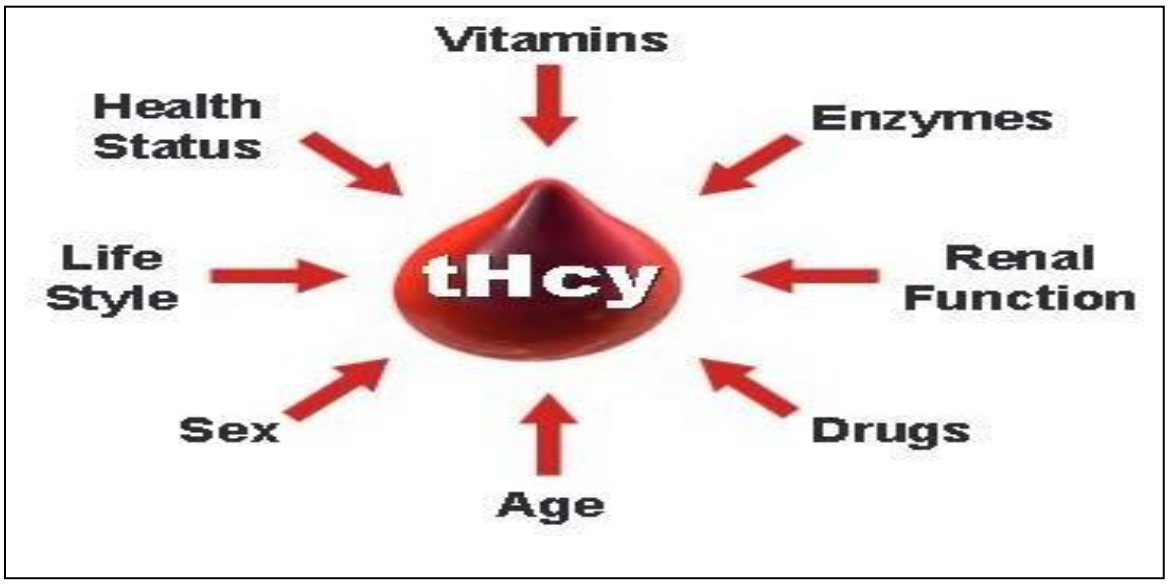
Vitamin and Mineral Shortage

In Homocysteine metabolism: Folate deficiency, vitamins (B_2, B_6 and B_{12}), betaine, and magnesium which are important (Ueland and Refsum, 1989).

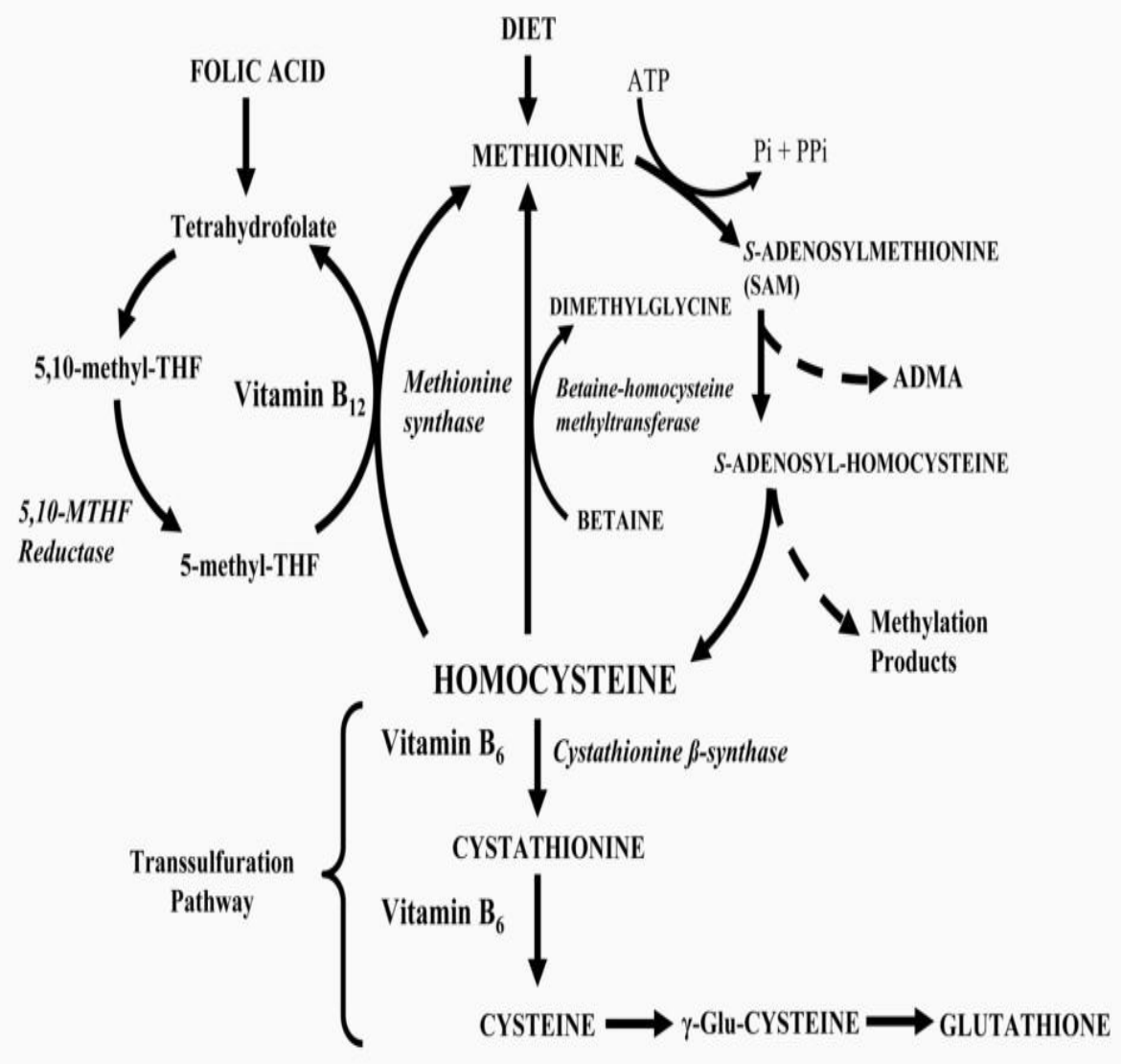
Enzyme shortage: Genes encoding abnormality for MS and MTHFR as they take part in the Homocysteine metabolism directions Genetic variant that bring about disorder in metabolism of folate by folic acid (Ueland and Refsum, 1989).

Diseases: Low levels of thyroid hormone, renal abnormalities (kidney failure can elevate Homocysteine amounts due to lowered kidney eliminate and ruin metabolism), psoriasis and some medications can increase homocysteine levels.

Factors That Cause Elevation Total Homocysteine



The Metabolic Cycle of Homocysteine



Measurement of Homocysteine

Homocystine (homocysteine-homocysteine disulfide) almost 70% of the Hcy in serum and plasma is combined with rest of cysteine in plasma proteins like albumin and just small levels presence as free Hcy and homocysteine-cysteine disulphide. Dithiothreitol or beta-mer-captoethanol is available method to detect this process by addition of a lowering agent, to fresh obtained plasma, to detach Hcy from thiols and plasma proteins, before direct evaluation of tHcy with normal values of 5–15 μmol/L (or μM).

Biomarkers of Health/Disease and Physiological Status

These are biomarkers which indicate an end-point, relate to a state of health and/or disease risk. These markers reflect the different intermediate disease phenotypes or the severity of the disease and are widely used in clinical practice. For example, plasma levels of fasting glucose are associated with insulin sensitivity and diabetes or plasma cholesterol and triglycerides are linked to cardiovascular disease.

Biomarkers of Nutritional Status

The limitation of dietary assessment to estimate nutritional status determines the need for analytical determinants that can objectively and accurately quantify nutritional status. Biomarkers provide a more proximal measure of nutrient status than dietary intake. Generally a nutritional biomarker is a characteristic that can be objectively measured in different biological samples and can be used as an indicator of nutritional status with respect to the intake or metabolism of dietary constituents. Biomarkers are clinically useful, in particular to detect deficiencies in support of animal treatment. Analysis of folate, iron and vitamin B_{12} but also copper and zinc, is useful to identify potential nutritional causes of anaemia. The development of biomarkers faithfully representing the nutritional status for those micronutrients. Clinical biomarkers are focused on diagnosis of a disease state.

Categories of Biomarkers of Mineral Nutrient Intake and Status

Tissue Concentrations:

A) Blood Plasma or Serum:

For using plasma/serum samples in both clinical practice and epidemiologic research, of the trace minerals, only selenium assays in plasma/serum are a primary choice of biomarker. There are more sensitive biomarkers of iron status, and for other trace minerals, plasma/ serum assays are of limited value. This may be attributable to homeostatic mechanisms that maintain plasma/serum levels when intake is marginal or inadequate (zinc), which results in lack of adequate sensitivity. Lack of specificity (copper, zinc and iron) may also compromise the value of plasma/serum levels as biomarkers.

Cellular Components of Blood.

Cellular blood components are used quite rarely and then primarily for research purposes. Whole blood selenium is sensitive to intake of this micro mineral and provides a longer-term biomarker, but plasma selenium is simpler to assay. Erythrocyte-membrane zinc has been found to be sensitive to dietary zinc restriction in some but not all studies. This zinc is presumably part or whole of the smaller of two pools of erythrocyte zinc, which exchanges rapidly both *in vitro* and *in vivo*. Total leukocyte, lymphocyte and especially neutrophil zinc have all been reported to have value as biomarkers of zinc status.

Hair and Others:

For several of the trace minerals, hair analyses have provided a tantalizing potential biomarker. Group differences in hair zinc concentrations that are related to probable differences in intake of bioavailable zinc are a case in point. Inadequately substantiated commercial claims have unfortunately resulted in considerable disrepute for this sample material, which, although still requiring more extensive research, may provide certain useful insights into the long-term status of selected minerals.

Mineral Homeostasis and Metabolism:

To appreciate the potential value of excretion data and other parameters of mineral homeostasis as biomarkers of intake and status, it is helpful to review, at an organ or system level, the differences in mechanisms by which trace mineral homeostasis is maintained. As an aside, the kidneys also have a primary role in the maintenance of major mineral homeostasis with the notable exception of calcium, for which the role of the kidneys is secondary to that of the intestine. For those minerals for which the kidneys are not involved in maintaining homeostasis, measurement of urine excretion rates does not provide useful information on dietary intake. Nor do these measurements provide biomarkers of mineral status except possibly in certain pathological circumstances like in hepatolenticular degeneration in which biliary excretion of copper is disrupted. Although important for investigating homeostasis in normal and abnormal circumstances, measurements of urine excretion rates do not provide acceptable biomarkers of intake or status for those minerals for which the kidneys have a relatively minor role in homeostasis. In contrast, urine excretion rates of trace minerals for which the kidneys have a prominent role in homeostasis such as iodide provide useful biomarkers of dietary intake of these minerals. In those instances in which excretion of endogenous mineral is regulated by the gastrointestinal system including

the liver and pancreas and for which the intestine is the major excretory route, measurements of endogenous mineral in feces theoretically provide a biomarker of dietary intake and status. The only mineral for which this has been the focus of significant research interest is zinc.

Organs and systems that have a major physiological role in maintaining whole body trace mineral homeostasis:

Gastrointestinal tract			
Mineral	**Absorption**	**Endogenous excretion**	**Kidneys**
Iron	**Single major site**	**-**	**-**
Copper	**Substantial**	**Major (liver)**	**-**
Manganese	**Major**	**Major (liver)**	**-**
Zinc	**Major**	**Major**	**Minor**
Iodide	**-**	**-**	**Major**
Selenium	**-**	**-**	**Major**
Chromium	**-**	**-**	**Major**
Molybdenum	**-**	**-**	**Major**

Tracer Techniques

Tracer techniques provide a powerful research tool but in general are too complex to be used as biomarkers for large populations under field conditions. Turnover rates e.g., iodine and pool sizes e.g., zinc measured with tracer techniques can also provide invaluable biomarkers of mineral status.

Homeostatic Mechanisms at The Sub Cellular and Molecular Levels

The most outstanding example is that of transferrin receptors, which can now be measured quite simply using a small plasma sample and which are strongly inversely correlated with the supply of iron that is reaching the cell membranes.

Body Stores:

Iron is the most notable example of a mineral that is stored by the body when intake of bioavailable iron is generous and released as required when intake is less adequate. Because of the potential of this mineral for oxidant damage, iron is sequestered tightly bound, primarily to ferritin in the liver. Circulating serum levels, though modest, have a strong

positive correlation with tissue stores of ferritin and therefore provide a readily available biomarker. The body also appears to have the ability, though much more modest, to store zinc.

Functional Indices:

Functional indices are of special putative practical value because they indicate when intake and status are sufficiently compromised to cause measurable disturbance of normal physiology and biochemistry. To be of value, these perturbations have to be more or less specific for deficiencies of a single micronutrient.

Examples include a low hemoglobin, hematocrit and red cell morphology consistent with iron-deficiency anemia, low circulating concentrations of thyroid hormones that result from iodide deficiency and low blood levels of selenium-dependent glutathione peroxidase (GPX3) in selenium deficiency.

Individual Minerals:

IRON:

A range of biomarkers is available that in combination allows for reliable assessment of iron status and, therefore, of the adequacy of iron intake, especially in non-infected, non-stressed individuals.

Plasma ferritin is a key biomarker in screening for hereditary hemochromatosis: heterozygous individuals typically have a modest increase in plasma ferritin. Ferritin is an acute phase protein, and plasma ferritin is increased in the presence of infections, inflammatory disorders and other disease states. Serum ferritin is also increased with ethanol consumption and hyperglycemia and is directly correlated with body mass index.

Plasma transferrin or total iron-binding capacity is elevated with storage-iron depletion before there is evidence of any effects of iron deficiency or erythropoiesis, but this is a less sensitive and reliable biomarker of iron stores than plasma ferritin. Transferrin is reduced during infection, inflammation and other stresses.

Iron Deficiency Anemia:
Hemoglobin and Hematocrit:

Hemoglobin and hematocrit are extremely important because of the simplicity of measurements and especially because low values (anemia), if due to iron deficiency, are clearly indicative of a deficiency of this micronutrient that is of sufficient severity to cause impairment of normal physiology. These biomarkers are, however, neither specific for iron deficiency nor very sensitive for the detection of mild but functionally significant iron deficiency. In adults, levels < 12–13 g hemoglobin/dl whole blood are indicative of anemia.

Red Blood Cell Indices:

Red blood cells in iron-deficiency anemia are microcytic with a low mean corpuscular volume (MCV) and low mean corpuscular hemoglobin. None of these changes are specific for iron deficiency. Iron deficiency is associated with increased variation in red cell width. The precision of the laboratory diagnosis of iron-deficiency anemia can be improved by combining hemoglobin with other indices of iron status, specifically ferritin or MCV together with erythrocyte protoporphyrin and transferrin saturation. Two or more abnormal indices are indicative of iron deficiency.

Thyroid Function Tests:

The mean serum thyroid-stimulating hormone is increased in iodine deficiency, although absolute values may remain within the normal range. Serum thyroglobulin concentration correlates with urine iodine. Both of these assays can be undertaken with blood spot filter-paper technology. Thyroxine (T_4) is also decreased during iodine deficiency, but considerable overlap with normal data limits its usefulness. A compensatory increase in triiodothronine (T_3) may occur. Thyroid function tests provide useful functional biomarkers of longer-term iodine intake and iodide status. In individuals in non-iodine-deficient populations, abnormal thyroid function tests are likely to be attributable to factors other than iodine deficiency.

Thyroid size. When assessed clinically or by ultrasonography, thyroid size provides a well-accepted biomarker of the early clinical response to iodine-deficient diets in lab animals.

Iodine Accumulation:

Iodine accumulation and turnover provides a useful research tool. The fraction of a dose of radioactive iodine concentrated by the thyroid gland is inversely related to iodine

status. Turnover studies based on the intravenous administration of ^{131}I have been used to calculate the average daily iodine requirement.

Zinc:

Plasma Zinc:

Plasma zinc is currently the most widely used and accepted biomarker of zinc status despite poor sensitivity and imperfect specificity. The homeostatic control of plasma zinc concentrations can occur while moderate changes are occurring in the zinc content of one or more of the pools of zinc that exchange rapidly with zinc in plasma. These may be in the form of a small readily exchangeable store that is quite possibly associated with metallothionein in hepatocytes and other organs. 70 mg zinc/dl plasma have been found to be a useful predictor of growth response to zinc supplementation, and lower cutoffs have predicted beneficial effects of zinc supplements in the prevention and management of diarrhea. Plasma zinc is profoundly depressed in severe acute zinc deficiency states, for example, in untreated acrodermatitis enteropathica.

Cellular Components of Blood:

Zinc incorporated in carbonic anhydrase accounts for most of the erythrocyte zinc. This zinc has been generally regarded as not readily depleted, although low levels have been reported with some depletion studies and further evaluation is required. Red cell membrane zinc, in contrast, may be sensitive to zinc depletion.

Hair Zinc: Associations between low hair zinc levels and impaired growth velocity have been reported including low hair zinc concentrations in young children who have had a growth response to zinc supplements.

Selenium:

The quality of biomarkers of dietary intake of selenium and selenium status is quite favorable relative to that of most trace minerals. These biomarkers are in increasing demand principally because of the antioxidant role of this micromineral and the strong epidemiological evidence of the links, which are primarily protective, between dietary intake and carcinogenesis. Plasma selenium responds rapidly to selenium supplementation and is

regarded as a biomarker of short-term selenium status, although in reasonably stable circumstances it also provides a biomarker of long-term intake.

Whole Blood, Hair and Nail Selenium:

Whole blood selenium is of potential value as a biomarker of relatively long-term selenium intake and status. Acid digestion is required before analysis and data are limited.

Plasma Glutathione Peroxidase:

Plasma GPX_3 activity provides a good functional index of dietary selenium intake and status when these are in the deficient range. Positive features include the provision of a functional marker for this micro mineral, the availability of automated assay procedures and the lack of concern about sample contamination. A disadvantage is that values plateau when intake reaches and exceeds an optimal level.

Copper:

Plasma Copper and Ceruloplasmin:

Plasma copper and ceruloplasmin levels (measured either as the protein or as oxidase enzyme activity) are the most frequently used biomarkers of copper status. They are depressed in copper deficiency states. Levels plateau when copper intake reaches an adequate level, and these biomarkers do not reflect the magnitude of copper intake beyond this point. Hepatic synthesis of ceruloplasmin depends on an adequate supply of copper. A high percentage of the copper circulating in plasma is bound to ceruloplasmin. Hence in turn the level of circulating copper is dependent on that of ceruloplasmin. Ceruloplasmin is an acute phase reactant and is elevated during infections, inflammatory processes and other stress circumstances. Notable among other factors that increase ceruloplasmin synthesis are estrogens, which result in an elevation of ceruloplasmin (and therefore of plasma copper) levels during pregnancy. In these circumstances, depression of these biomarkers by copper deficiency may not be apparent. Ceruloplasmin synthesis together with that of other hepatic proteins may be depressed by protein deficiency and result in low levels of circulating

ceruloplasmin and copper that is not caused by copper deficiency. Levels of these biomarkers are also age dependent.

Manganese:

Plasma manganese concentrations reflect dietary manganese intake.

Molybdenum:

Biomarkers for molybdenum deficiency are decreased urinary levels of sulfate and uric acid with elevated sulfite, hypoxanthine and xanthine.

Chromium:

Chromium deficiency may be widespread, especially in individuals with some degree of glucose intolerance, points to a need for reliable biomarkers of dietary chromium and chromium status.

Gastrointestinal Biomarkers of Digestion and Absorption

Biomarker	Test site	Biological sample	Method
Total carotenoids	Duodenum and jejunum	Blood	Spectrophotometry; high performance liquid chromatography
Products of protein fermentation	Ileum and colon	Faeces	Gas chromatography; high performance liquid chromatography; nuclear magnetic resonance; capillary electrophoresis
Faecal fat	Whole intestine	Faeces	Microscopy; Sudan stain; colorimetry; spectrophotometry; nuclear magnetic resonance
Fat soluble vitamins	Duodenum and jejunum	Blood	Spectrophotometry; high performance liquid chromatography

Conclusion

The emerging animal health importance of zinc and selenium and the continuing animal health challenges of iron and iodine draw attention to the unmet need for improved

biomarkers of trace element status. Currently available biomarkers of these elements are used for the assessment of micronutrient such as zinc, copper, iodine, iron and others micronutrient status in animals. Numerous and rapidly evolving methodologies are producing an ever-increasing number and types of biomarkers, each with their own distinct advantages and disadvantages.

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Supply Chain Management in Agriculture

[1] Prathiksha.I, And [2]Gopika Somanath

[1]PG Scholar, Department of Agricultural Extension, College of Agriculture, Vellayani, Thiruvananthapuram.
[2]Assistant Professor, Department of Agricultural Extension, College of Agriculture, Vellayani, Thiruvananthapuram.

Corresponding author: prathikshalankesh98@gmail.com, gopika.s@kau.in

Abstract

Supply Chain Management refers to the effective management of the activities in transforming the raw materials to the finished products from their source till it reaches the consumers. It mainly aims to maximize the profit by gaining a competitive advantage in the market. An effective management of supply chain enables the companies to cut excess costs and deliver products to the consumer at a faster pace. Every product marketed results from the efforts of various players and stakeholders that make up its supply chain. In spite of its obvious presence in the production-marketing scenario, the importance of managing the supply chains in improving the quality and value of the commodities for the customers gained popularity lately. Supply chain management helps in improving the effectiveness in the management of resources together with establishing prominent relations with the stake holders.

Key Words: Supply Chain Management (SCM)

Supply chain management is the process of transforming the raw materials into final product which reaches the end user of the chain. It involves directly or indirectly, in fulfilling the customer request. It is the process of controlling the utilization of available raw materials till it reaches the customers as the product desired. This involves the process of producing and storing the goods as finished products which can be used in future.

Supply chain management is an important task for a business to get success. The starting from (idea creation) raw materials to end product is a complicated process. The efficient management of this process leads to the increase in revenue of the business. The process of SCM involves every aspect of business operations, including logistics, purchasing and information technology, new product development, marketing, operations, distribution, finance and customer service. It integrates all the components (raw materials, finances, suppliers, manufacturing facilities, wholesalers, retailers and consumers) into a seamless system.

The main function of supply chain management is to reduce the expenses and maximize profit.

A supply chain has **three major parts (components)**: upstream, internal, and downstream.

• **The upstream supply chain:** The upstream part of the supply chain includes connecting the first-hand information and their connection to their suppliers (also known as second-tier and third-tier suppliers). Here mainly procurement is done. (e.g., mining ores, growing crops).

• **The internal supply chain:** The internal part of the supply chain includes all of the information and inputs transforming from their own suppliers to the other organization for outputs. This exchanging time can be increased until it reaches the organization. Here it mainly involves manufacturing, inventory control and production management.

• **The downstream supply chain:** The downstream part of the supply chain is mainly involved in delivering the products to the final customers. Here it mainly involves distribution, warehousing, transportation and after-sales services.

Why Is Supply Chain Management Important?

A supply chain is important for a business because it reduces the expenses thereby increasing the profit. This managing efficiency can be reflected in all aspect of the chain, starting from idea creation to the marketing of the final product. Agribusiness supply chain management involves in managing the efficient production and supply of products from the farm level to the consumers to meet all consumers' requirements mainly in terms of quantity, quality and price. The most less commonly known part of supply chain is that it can also play a critical role in the society.

How Does Supply Chain Management Work?

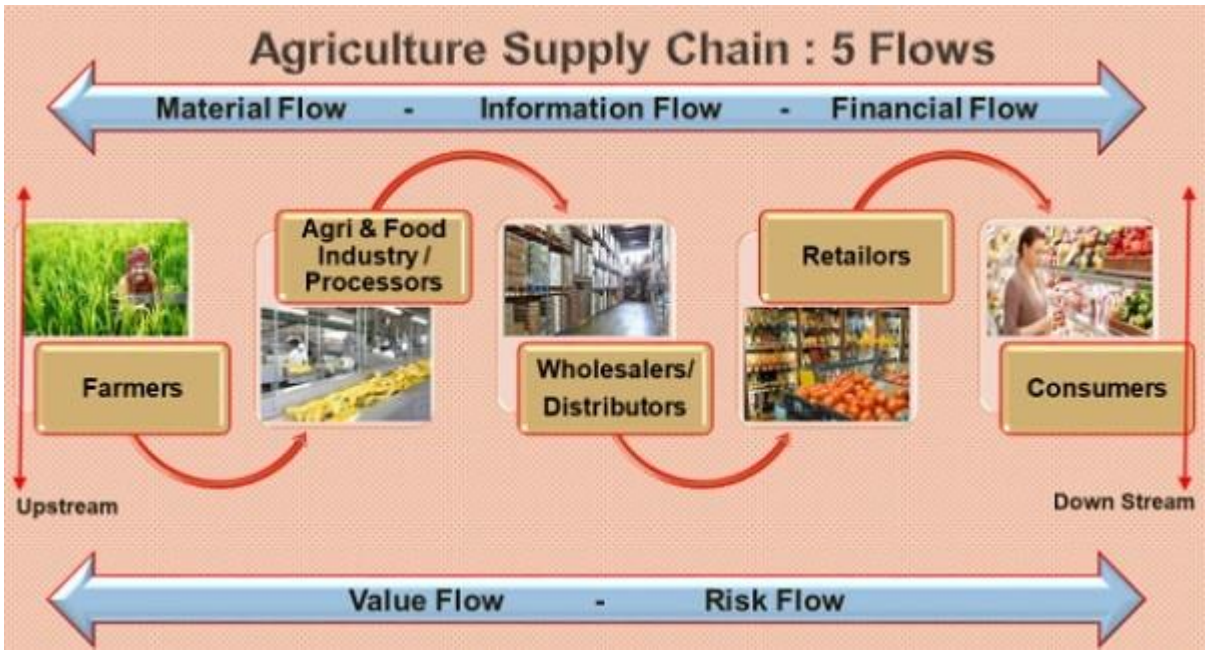
Supply chain management works by coordinating raw materials, suppliers, manufacturers, retailers, distributors and customers as they come along the production, sales and buying cycles. Effective SCM involves management of supply chain assets and product information and fund flows to maximize total supply chain profitability. If we are aware of those factors we can manage it efficiently. SCM involves in reducing expenses at every step and delivers a better-quality goods to consumers as quickly as possible.

Elements of Supply Chain Management

Supply chain management has five key elements—planning, sourcing raw materials, manufacturing, delivery, and returns. The planning phase involves in creating an overall strategy for the supply chain, while the other four elements specialize in executing that plan. Companies must develop expertise in all five elements to have an efficient supply chain and avoid expensive bottlenecks.

The Supply Chain Flows

There are typically five major flows in any supply chain: product flow, financial flow, information flow, value flow & risk flow. In managing the supply chain, it is necessary to coordinate all the flows among the various parties involved in the chain.



a. Material flows: These are raw materials, supplies, etc, which flow along the chain. These includes reverse flows—returned products, recycled products, and disposal of materials or products. Thus, a supply chain involves a product life cycle approach, from "dirt to dust."

b. Information flows: This includes information related to demand, shipments, orders, returns, schedules, and changes in the data. It includes customer feedback, ideas from suppliers to manufacturers, order flows, credit flows, information to customers, and so forth.

c. Financial flows: The financial flows are all transfers of money, payments, credit card

information and authorization, payment schedules, e-payments, and credit related data.

d. Value Flows: At each stage there are physical flows relating to production, distribution; where, there is some addition of value to the products or services. Adding values to their products at each stage until it reaches the customers is known as value flow. The product that moves from one point to another which gains value is known as value flow.

e. Risk flows: Risks in supply chain maybe due to various uncertain elements like demand, supply, price, lead time, etc. Risks therefore can appear as any kind of disruptions, price volatility, and poor perceived quality of the product or service, process / internal quality failures, deficiency of physical infrastructure, natural disaster etc.

BENEFITS OF SUPPLY CHAIN MANAGEMENT

• **SCM lowers the cost of doing business:** It helps us to reduce the purchase cost thereby increasing the production. Directly purchasing from the production area saves money.

• **SCM builds the partnerships that can support future growth:** Maintaining relationships with the existing stakeholders in the supply chain helps in growth of the business.

• **SCM helps balance the supply of products with market demand:** Understanding our need and then going for supply and demand helps in sustainability of the chain.

• **SCM allows for more efficient and effective customer service:** It is occurring because customers receive their products quickly and as promised.

Challenges in Supply Chan Management

If the costs and expenses are controlled then the profits are maximized. This is the main aim of supply chain management. Operating costs can be reduced when the costs of raw materials and production go down. By observing those activities in the scope of supply chain management we can also identify the possible challenges and provide solutions to them.

1. Giving quality customer service: The SCM is mainly focused on the needs of the customers, because the right quantity and quality of the product for the right amount of money paid by them should be reasonable.

2. Reasonable Costing: The costs of raw materials, energy and labor have increased globally due to economic constraints. We have to overcome those constraints by giving

the customer's a quality product.

3. Risk Management: The constant change in the market, such as consumer demands, political agendas and global sourcing, would cause major issues to the operations. A preplanner risk management plan will help us to overcome from those reckless situations.

4. Poor supplier relationship: By creating a harmonious relationship with the partners or suppliers will help us to provide the customers with products of high standards in a timely manner.

5. Lack of qualified personnel: In recent days, finding a well talented, interested, and passionate personnel in this field is difficult. So, we must have an understanding about the duties and responsibilities needed.

6. Unforeseen Delays: Procurement of materials and products may be easy, but the delivery may not always be 100% on time, especially with time differences and a variety of shipping time frames. Always having buffer stocks can reduce these delays.

7. Fast-Changing Markets: There are technological advancements changing our markets every day, so it is quite difficult to stay in pace and adapt to the variety of innovations in the market. If we try to adapt the change we need to know about some logistics management software.

Conclusion

Supply chain management is an important part for every business so that it improves the effectiveness and efficiency in the management of resources. It also establishes good and prominent relations with the stake holders like suppliers and customers. It integrates and combines the entire business activities and take care of each and every step that ultimately helps in achieving satisfaction of the customers and goals of the business.

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Popular article

Gout: Disease and Prevention in Poultry

Diksha Kandpal

Department of Veterinary Pathology, Lala Lajpat Rai University of Veterinary and Animal Sciences, Hisar, Haryana

Corresponding author: diksha.kandpal@gmail.com

Abstract

Gout is a metabolic disease mostly affecting birds and humans characterized by urate crystal deposition and increased concentration of uric acid in blood causing hyperuricemia. Gout occurs either due to over production of uric acid or due to ceased excretion. In mammals the end product of nitrogen metabolism is urea unlikely to birds where the end product is uric acid and they lack enzyme uricase. Thereby birds are more susceptible to cases of gout due to accumulation of urate crystals. There are two recognized types of gout in birds, visceral gout and articular gout. Visceral gout is characterized by urate deposition on tissue surfaces, where it appears as a white coating. Articular gout, is characterized by deposition of urates in toes, joints, synovial membranes and tendon sheaths of joints. Multifactorial occurrence of gout has been identified including unbalanced diet deficiency of vitamins, improper hatchery and farm management and inadequate housing management. Gout is still a leading cause of mortality in poultry and posses economic setback to poultry industry. Proper vaccination against viral diseases targeting kidney is required, vitamin supplements, decreased use of antibiotics, maintain adequate temperature and proper ventilation and most commonly water deprivation needs to be checked. The elimination of uric acid crystals from body is necessary as these crystals deposit and causes inflammatory reaction. Therefore, prompt measures are necessary to prevent further occurrence of gout in poultry.

Keywords: Gout, Articular, Visceral, Water deprivation, Vitamin deficiency, Management

Introduction

Gout is a metabolic disorder characterized by either urate crystal deposition or increased concentration of uric acid in blood causing hyperuricaemia. Two predisposing factors responsible for gout occurrences includes, over production of uric acid or secondly, due to decreased excretion. Mammals and birds are the worst affected by gout. In mammals the end product of nitrogen metabolism is urea in comparison to birds the end product is uric acid additionally, they lack uricase enzyme making them more vulnerable to gout occurence. Thus, in poultry gout is defined as an entity of renal dysfunction. Accumulation of white chalky deposits over the visceral organs commonly kidneys, liver (perihepatitis) and heart (pericarditis) and in joint in chronic cases are common findings in poultry gout. Renal diseases have been established as major proportion in

development of gout in birds. In normal healthy bird, urates are excreted out from body through the urine. Dysfunction of the renal system decreases/ damages the excretion process, resulting in accumulation of excessive amounts of uric acid in body fluids and blood. Without proper elimination, uric acid forms monosodium urate crystals, which then create stones within the various parts of the urinary system, or accumulate in tissues and joints.

Gout, leads to deposition of uric acid crystals on joints or tissue surface in birds. Urate deposits are semisolid to solid white masses that causes inflammation in the area they accumulate, resulting in pain and immobility in poultry. Depending on site of lodgment of urate crystals, it can cause rigid toes, swollen joints, and difficult perching and neurological problems. There are mainly two recognized types of gout in birds, visceral gout and articular gout which commonly occur in the bird.

Visceral gout is characterized by deposition of urates on tissue surfaces, where it appears as a white coating completely covering the visceral organs. Urates also deposit within organs, such as the pericardium, peritoneum, and liver capsule, spleen and rarely on synovial surfaces of joints and tendons. Visceral gout is the most common form of gout affecting poultry. Visceral gout also results as a consequence of renal failure or as a terminal event with acute decompensation of chronic renal disease. Microscopically, urate deposits are often seen as basophilic spherical masses commonly referred to as feathery crystals or needle shape crystals, with inflammatory changes due to the rapid course of development. Progressive obstruction of the ureters by uroliths causes kidney atrophy at the site of urethral obstruction and compensatory hypertrophy of the undamaged portions of the kidney. Distended ureters are brittle containing calcium urate calculi or uroliths.

Articular gout, is characterized by deposition of urates in toes, joints, synovial membranes and tendon sheaths of joints. These deposits cause inflammatory swelling and pain and leads to immobility in birds. Articular gout is often caused by excessive protein in the diet, or as inherited defects affecting uric acid metabolism.

Causal factors of gout

Gout is caused by raised levels of uric acid in the blood (hyperuricemia), which may be due to its decreased excretion, either due to impaired filtration or altered excretion due to impaired metabolism of uric acid because of deficient enzymes. Another possible reason of occurrence of gout could be related to drug administrations' such as aspirin, mercuric salts, gentamycin etc. That are nephrotoxic in action. Kidney damage could also occur due to high calcium and vitamin D3, or possibly due to imbalance of calcium phosphorus ratio in the body suitably giving rise to gout. Other possible causal factor of gout includes, high amount of sodium bicarbonate, salt and protein in food, consumption of water with high amount of minerals such as calcium and copper. Water deprivation and poisoning by disinfectants (i.e., cresol and phenol) makes the poultry more susceptible to gout occurrences. Viral infection such as avian nephritis, infectious bronchitis (IB),

IBD and reoviruses predisposes poultry for gout occurrences. Deficiency of vitamins and minerals commonly vitamin A deficiency is associated with gout occurrences in poultry. Vitamin A deficiency causes occlusion and desquamation of the urethral ducts thereby favoring decreased elimination and uroliths formation. Beside these improper hatchery management, and poor housing management such as reduced ventilation, temperature, humidity plays role in setting up gouts in poultry.

Clinical signs

Grossly, joints may be enlarged, stiff, and painful, birds will be reluctant to walk and may be seen shifting weight from one leg to another. Increased thirst (polydipsia) is seen in affected birds. Birds often have reddened, swollen feet that progress to blisters and sores. Joint pain is most evident. If wings are affected, the bird may be unable to fly. Affected birds adopt a shuffling gait. Chalk-like white urate deposits on all the visceral organs, pericardial sac, liver capsule, kidney, etc Abnormal droppings presence of chalky urates in feces. Feather plucking, dull plumage, general debility and weight loss are other signs besides the other mentioned.

Prevention and management of gout

The following measures need to be practiced for minimizing the occurrence of gout in poultry and in commercial poultry farms. Proper management of diseases including updated viral vaccination program including diseases which primarily affects kidney there by exposing poultry for gout formation. Viral diseases causing kidney damage includes, infectious bronchitis (IB), viral nephritis and avian astroviruses. Complete and proper vaccination program in breeders and commercial flocks should be carried. In areas where IB is endemic, vaccine spray at hatchery level can be effective. Vaccination against nephrotropic strain of viruses has also proven to be beneficial in commercial poultry farms. Vaccination for avian astrovirus needs to be a mandatory part of breeder vaccine schedule, to prevent the transmission of virus to progeny. Fungal toxins particularly ochratoxin and aflatoxins affect liver and kidney thereby making mycotoxic management a priority for poultry. Proper screening of raw materials for mycotoxins, and judicious selection and inclusion of raw materials based on their mycotoxin levels is required. Poultry feed should be extensively checked for presence of mycotoxins especially during the harsh environmental conditions which favors development of mycotoxins in feed. Indiscriminate use of antibiotics in poultry management should be avoided. Some of the antibiotics are nephrotoxic in action causing kidney damage and making poultry susceptible for gout and various other diseased conditions.

Hatchery and farm management including proper poultry shed condition be maintained in terms of temperature, humidity, ventilation and proper feed and water management. Optimal incubation conditions should be provided. Ample numbers of waterers should be provided to encourage ad libidum water intake. Dehydration or water deprivation in poultry during winter and summer season should be regularly monitored. Decreased water intake predisposes birds to urates

formation. Balanced feed with respect to optimal calcium: phosphorus ratio need to be provided. Ideal electrolyte balance should be adopted. The sodium content in feed should be given due care. In cases of gout, provision of additional electrolytes through water, aids in flushing out uric acid crystals, thereby controlling mortality to certain extent. Use of jaggery (concentrated sugar) also seems to be beneficial. In areas with recurrent episode of gout, protein level in feed should not exceed the standard requirements. The raw materials should be carefully monitored for adulteration with urea and presence of mycotoxins, which might be one of the reasons for increased uric acid production.

Conclusion

Gout is still one of the leading diseases in poultry sector cause economic loss and loss of the good breeding stock. Occurrence of gout is multifactorial and majorly depends upon the management of the herd. Deficiency of vitamins, unbalanced diet presence of diseases predisposes poultry for gout formation. Water management and administration of proper vitamins and minerals are essential. Water requirements alter according to seasons, in winter because of cold water deprivation occurs and in summers increased temperature and increased perspiration leads to dehydration. Proper ventilation and well housing management be ensured for reduction of gout occurrence in birds. Adequate vitamins and minerals are supplied and indiscriminate use of antibiotics be avoided. Proper vaccination of the herd is done to protect against diseases particularly targeting kidney as the main target organs. Any practice that encourages flushing out uric acid crystals should be adopted and Breeder management along with adequate farm and hatchery management are crucial in preventing incidences of gout in poultry.

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Role of biotechnology in increasing the productivity of farm animals

Nanda Kumar Roy[1], Bilifang Daimary[2], Pranjal Moni Nath[3], Nur Abdul Kader[4], Sayed Nabil Abedin[5]

[1]PhD Scholar, Department of Livestock Production & Management, [2]PhD Scholar, Department of Livestock Products Technology, [3,4]PhD Scholar, Department of Veterinary Public Health, [5]PhD Scholar, Department of Veterinary Physiology, College of Veterinary Science, Assam Agricultural University, Khanapara, Guwahati-22

Corresponding author: kumarroynanda@gmail.com

Abstract

Biotechnology in animal production is widely used to increase the number of population of livestock animals to meet the requirement for protein demand in the world. By using biotechnology, it has become possible to improve the productivity of animals by increasing growth, improving quality of carcass and reproduction, nutrition and feed utilization, increased quality and food safety, improved health and welfare of animals and reduced waste through more efficient utilization of resources. Therefore, the biotechnology plays a significant role in increasing the overall productivity of farm animals.

Introduction

Livestock production is one of the fastest growing agricultural sectors in developing countries, where it accounts for more than a third of agricultural GDP. However, global warming, increasing land degradation, erosion of animal and plant genetic resources, livestock-mediated environmental pollution, and the threat of emerging infectious diseases pose several new challenges to sustainable animal production, particularly in developing countries. The key challenge is determining how to intensify livestock productivity in a sustainable manner to meet the increasing demand under the constraints of limited land, water and other natural resources. Current advancements in science and technology will have an important role to play in promoting the livestock sector. Biotechnology is the application of scientific and engineering principles that use living organisms or substances from these organisms to make or modify products, enhance plants or animals, or develop microorganisms for specific uses that are beneficial to humans. One of the benefits of biotechnology in animal husbandry is being able to provide increased livestock productivity.

Biotechnology in farm animals can help to improve the productivity in various ways namely by increasing the rate of reproduction, by improving the production of products, by promoting growth and improving nutrient intake efficiency and by increasing the quality of animal production. The main biotechnological applications that are applied effectively in farm animal production in the developing country are as follows:

A) Production of good quality and high yielding animals

The future productivity of a livestock farm is dependent on the quality of the animal. Biotechnological research is important in order to respond to the pressure of producing more food from animals to cater food requirement of the ever-growing human population. With the help of biotechnology, transgenic animals such as mice, rats, rabbits, pigs, sheep, and cows have been developed. Transgenesis is the technique that permits the manipulation of genes of one organism which can subsequently be introduced into genome of another organism of same or other species in such a way that the genes are not only expressed but also gets transmitted to its progeny. Transgenic animals thus produced will have enhanced growth rate and improved food quality. For example transgenic cow are developed to produce more milk containing specific human proteins that helps in the treatment of human emphysema. Cloned transgenic cattle produced increased amount of beta and kappa casein in milk fat and increased level of human lactoferrin, besides these cows have been known to produce more milk or milk with less lactose or cholesterol. Pigs and cattle have also been developed that have more lean meat percentage on them, sheep that yield more wool. Recently, researchers reported that transgenic pigs carrying plant gene has increased amount of unsaturated fatty acids in their muscle which produces a Healthy Pork.

B) Reproductive biotechnology in farm animals:

1) **Artificial insemination (AI):** Artificial insemination has become the most wide-spread biotechnology applied to livestock, especially in cattle production. Artificial insemination is simple, economical, and successful. It remains as one of the most important assisted reproductive technologies. The utilization of proven sire can be greatly increased by using AI. The success of AI is highly dependent on the viability of sperm used. Sperm cryopreservation is the technique applied for the sperm to be viable

for a longer time. It indicates to the long-term preservation and conservation of biological substance at very low temperature at about -196 °C in liquid nitrogen.

2) **Multiple ovulation and embryo transfer (MOET):** Embryo transfer in biotechnology refers to the process of assisted reproduction in which embryos are placed into the uterus of a female with the intent to establish a pregnancy. This technology enables achieving a greater number of calves from selected females than traditional means of animal production. By increasing the number of calves, MOET has the potential for genetic improvement by increasing the selection intensity on the female.

   Embryo transfer technique consists of three steps: superovulation by using follicle-stimulating hormones, embryos collection either surgically or without surgery and transfer of embryos to the recipients. The advantages of embryo transfer are the preservation and conservation of breeds, economical transport of livestock, disease-free herd creation, for rapid multiplication of the elite female breeding stock and for research applications

3) **Sperm sexing:** By using AI with sexed sperm, hundreds of thousands of calves have been born. Although this technology has been used for many species, the tremendous majority of pregnancies have been in cattle.
4) **Embryo splitting:** It refers to the formation of twins or multiples through the artificial microsurgical splitting of an embryo. After separation, the genetically identical embryos can continue to develop. The blastocyst stage of embryos may be cut into two equal halves by using an inverted microscope connected with a micromanipulator and a microsurgical knife before transferring to a surrogate female. Genetically identical animals can be produced by this method. This process seems to duplicate the natural process of the production of monozygotic twins.
5) **In-vitro embryo production:** Now bovine embryos can be produced by in-vitro fertilization technique. Primary oocytes were collected from antral follicles of ovaries, can be induced to lead the maturation process. However, in vitro maturation system must ensure that the resulting oocyte is capable of having normal fertilization and produces a zygote competent of developing to term after embryo transfer. The practical use of in vitro embryo production (IVEP) under field conditions is limited by high

production costs and the low overall efficiency. Therefore, IVEP must be improved before it can be widely used in cattle and buffaloes in developing countries.

6) **Embryonic stem cell:** Embryonic stem cells (ESCs) are stem cells derived from the undifferentiated inner cell mass of embryo which is harvested from the donor mother animal. Stem cells are pluripotent cells that have the ability to self-replicate and grow into specialized cells. It can be found at different stages of fetal development and are present in a wide range of adult tissues. Stem cells are manipulated in the laboratory in order to make them accept new genes that can then change their behaviour. This process includes removing the donor mother's ovaries and dosing her with progesterone, changing the hormone environment, which causes the embryos to remain free in the uterus. After 4–6 days of this intrauterine culture, the embryos are harvested and grown in-vitro culture until the inner cell mass forms egg cylinder-like structures.

C) **Biotechnology for nutrition of farm animals:** The major role of biotechnology on livestock production is increasing the livestock feeds through improving nutrient content or value as well as the digestibility of low-quality feeds like roughage through use of different chemicals for example feed additives. In animal nutrition, biotechnology can improve the plane of nutrition through protection of protein, amino acids and fat. Use of different enzymes to exploit the availability of nutrients from feed and to reduce the wastage of the feed and fodder, immune supplements to inhibit pathogenic bacteria to the animals, use of plant biotechnology to produce feed and fodder with good nutritive values, addition of antibodies in feeds can be used to protect the animals from the disease, genetic manipulation of rumen microorganisms to improve the animal health and growth.

Conclusion:

Biotechnology in animal production in developing countries has been applied only in a few areas such as conservation, animal improvement, healthcare (diagnosis and control of diseases) and augmentation of feed resources. Adopting biotechnology has benefitted the livestock entrepreneurs and small producers in terms of animal improvement and economic returns to them. However, developing countries has to address the issues relating to political commitment, trained manpower and infrastructure and funding in research. Concisely, investing in animal production and biotechnologies is necessary because it can bring social

sustainability, economic prosperity, food security and safety, rural wealth creation and health improvements especially to poor populations in the developing countries.

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Quality Assessment of Processed and Preserved Feed at Microbiological Level

Keshav Gaur[1], Monika Karnani[2*], Sheela Choudhary[3], Manju[2], Geeta Choudhary[1]

[1]M.V.Sc. Scholar, Animal Nutrition Division, RAJUVAS-PGIVER, Jaipur (Rajasthan)
[2]Assistant Professor,Animal Nutrition Division, RAJUVAS-PGIVER, Jaipur (Rajasthan)
[3]Professor and HOD, Animal Nutrition Division, RAJUVAS-PGIVER, Jaipur (Rajasthan)
Correspondence author - *dr.monikakarnani@gmail.com*

Abstract

In a country like India, where there is shortage of feed, the processed and preserved feed comes to the rescue. But presence of microbiological organisms in such food can become an obstacle in their use and would lead to deterioration of their quality. Therefore, meticulous assessment of processed and preserved feed including silage is necessary to overcome such problems.

Introduction

Animal feeds are formulated to provide the nutrients that the animals require for their optimal growth and reproduction. However, besides providing the chemical and nutritional constituents to achieve this growth, animal feeds may serve as a vehicle for the transmission of a wide variety of microorganisms to farm animals. These microorganisms can be acquired from multiple environmental sources during harvest (including dust, soil, water and insects), processing at the feed mill, transportation to or during their storage at the farm. Some of these microorganisms—i.e. bacterial pathogens—may be potentially harmful and they can produce disease to farm animals in a clinical or subclinical way at the intestinal level.

The quality of feed is assessed by its nutritional value, particle size, color, its safety after consumption and microbial quality. Among these, the nutritive value and the microbial quality are more important for all categories of animals while other factors vary according to the size, age and the physiological status of the animals.

In general, the processed and the preserved feed are being contaminated with microbes of different origins i.e. bacteria, virus, yeast or fungi. Among these the fungal contamination of feed is a matter of concern due to ubiquitous nature of fungi and their secretory products in the form of mycotoxins; which results in deleterious effect on almost all the animal species.

Feed may be contaminated during processing, storage or transport. Some microorganisms introduced during preservation and storage, primarily moulds, can negatively affect feed quality including reducing dry matter and nutrients, causing musty or sour odors, and producing toxins. Moldy raw materials are not appetizing and can considerably reduce feed consumption. Contaminated feed frequently causes zoonoses and for that reason, it is necessary to establish surveillance programs for microbiological feed hazards.

A wide range of microbes occurs naturally on, or as contaminants of forages, cereal grains, oilseed by-products and compound feeds. Animal feeds may get contaminated with harmful bacterial organisms like *Salmonella*, *Listeria* and *E. coli*. In *E. coli*; fecal sources and slurry have been identified as the primary routes of contamination both in pastures and compound feeds. Cereal grains and oilseed by-products are regularly contaminated with fungi occurring as plant pathogens or developing during storage.

Therefore, now-a-days incorporation of feed additives viz. antimicrobials, probiotics, prebiotics, symbiotic, organic acids such as propionic acid, butyric acids and phytochemicals during feed processing and preservation has been shown to improve the microbial quality of feed.

1. Bacterial Evaluation

The most common bacterial pathogens found in processed and preserved animal feeds are *Salmonella*, *Escherichia coli* and *Clostridium perfringens.* Each of these bacterial pathogens has the potential to colonize the animal's gastrointestinal tract (GIT) leading to either disease or contamination of the carcasses during processing at the abattoir. The potential contamination of the carcasses represents a risk for human health because food-borne pathogens can potentially be transmitted through the food chain by poultry products. Therefore, the microbiological evaluation of the feed ingredients and finished feeds becomes a key element to ensure that the feeds are not a source of contamination.

1. ***Salmonella spp.*** **-***Salmonella* is a group of bacteria known to cause disease in humans and animals, they belong to the family Enterobacteriaceae. *Salmonella* are gram negative, rod-shaped, facultative anaerobic bacteria with a peritrichous flagella that facilitates the movement of the bacteria throughout the digestive tract of the animals. *Salmonella* serovars are widely distributed throughout the environment and they are capable of producing a spectrum of diseases in animals (enteritis, septicemia, abortion and asymptomatic carriage). Among all the serovars, *S. Typhimurium* and *S. Enteritis* are the most common causes of salmonellosis in animal due to their ability to invade different hosts without causing illness. The most common causes of their occurrence in animal feeds are addition or inclusion of eggs and chicken meat-based product, MBM (Meat-cum-bone) meal, fish meal, barley among the cereals and also ingestion of pasture contaminated with fecal material or cattle slurry.
2. ***Escherichia coli*** **–***E. coli* is gram negative, facultative anaerobe, rod-shaped bacterium from the Enterobacteriaceae family. It is the most common facultative anaerobe species found in the GIT of both; humans and animals. It lives as a commensal organism that coexists with its host. Within the GIT, *E. coli* resides in the lumen of the colon and its excreted into the environment in fecal matter. Even though that most strains of *E. coli* are non-pathogenic and resides

harmlessly within the GIT, some strains have the potential to cause disease producing diarrhea (calf scour / colibacillosis), urinary tract infections and sepsis/meningitis. In Poultry, only certain strains are more capable to cause disease, and those strains are referred to as avian pathogenic *E. coli* (APEC). These APEC are mostly associated with extra-intestinal infections causing damage in the respiratory tract or systemic infections. The practice of applying slurry onto the pastures means that there is potential for the transfer of fecal *E. coli* to grazing animals and also *E. coli* can be grown in moist feeds preserved or stored in feed bunks. The *E. coli* contamination in cattle feeds signifies faeces contact with either feed directly or at production point.

3. ***Clostridial Spp.*** **–**The genus *Clostridium* is composed of large, rod-shaped, Gram-positive bacteria, from which most of them produce spores and are resistant to high temperatures and many disinfectants. The majority of the species are anaerobic; however, some species can grow under aerobic conditions or are aerotolerant. They are ubiquitous worldwide, being found in soil, wetlands, dust, animals, marine and fresh water sediments. *Clostridium* species are known for the numerous amounts of toxins they produce, around18% of all known bacterial toxins are produced by these bacteria. Of the 150+ species characterized in the genus, only 35 species are considered pathogenic, and from those 35, only 15 produce potent protein toxins. *Clostridium perfringens* (CP) is one of the most severe bacteria of this genus and known to produce Gangrenous dermatitis & Necrotic enteritis in poultry, enterotoxaemia in sheep and goat and the most common cause of gas gangrene in all the animal species. The contamination of the feed with these bacterial pathogens may occur at the harvest/transportation of the feed ingredients, processing at the feed mill or at any point during storage or transportation to the farm.

2. Viral Evaluation

FMD (Foot and Mouth disease) is known be caused by a single strand RNA virus-*Apthovirus* from the family picornaviridae. The disease is spread by inhalation and by ingestion of contaminated materials. Feeding of catering waste to pigs in United Kingdom leads to the outbreak of FMD. Therefore recently European Union banned, the feeding of catering waste to pigs containing meat products.

3. Fungal Evaluation –

Fungal contamination of processed and preserved feed are of great concern throughout the globe due to the harmful fungal secretory products in the form of mycotoxins (a secondary metabolite of fungi), which produces detrimental impacts on the health of almost all the livestock species. The ambient temperature and moisture content are the major factors for the fungal growth in the field of forages and cereals or during processing and storage of animal feed mostly grains and oilseed by-products. Like animal feed contamination is more during rainy season since it favors the growth of fungi. In some studies; use of propionic acid prior to storage has been found to prevent the fungal growth.

Some pertinent facts regarding growth of fungi in Processed & Preserved animal feed-

- Warm and humid climatic conditions (as in tropical country like India), proliferates Aspergillus spp. which is presumed to be as storage fungi Viz *Aspergillus flavus*, *Aspergillus parasiticus* (both produces Aflatoxins and most potent is Aflatoxin-B1) and *Aspergillus ochraceus* (produce Ochratoxins). Like; Maize gets infected with *A. flavus* prior to harvest and remain viable even during storage.
- *Penicillium* proliferates more in the temperate conditions.
- Fusarium spp. fungi can be grown in cereals of tropics and sub-tropics conditions viz. *Fusarium graminearum* produces oestrogenic Zearalenone mycotoxins in cereals and stored grains.

Table: Occurrence of fungal infestation among different feedstuffs and type of toxin produced

Fungal organisms	Infestation	Type of toxin produced
Aspergillus flavus; A.parasiticus	Peanut meal, Cottonseed cake, palm kernel cake, maize, compound feeds	Aflatoxins
A. flavus	Oilseed meals, compound Feeds	Cyclopiazonic acid
A.ochraceus; Penicillium viridicatum; P. cyclopium	Barley and wheat grains	Ochratoxin A
P. citrinum; P. expansum	Cereal grains	Citrinin
P. citreo-viride	Cereal grains	Citreoviridin
Fusarium culmorum; F.graminearum	Cereal grains	Deoxynivalenol
F. sporotrichioides; F.poae	Cereal grains	T-2 toxin
F. sporotrichioides; F.graminearum; F.poae	Cereal grains	Diacetoxyscirpenol
F. culmorum; F. graminearum; F. sporotrichioides	Cereal grains	Zearalenone
F. moniliforme	Maize kernels	Fumonisins; moniliformin; fusaric acid
Neotyphodium lolli	Grasses	Lolitrem alkaloids
Claviceps purpurea	Cereal grains	Ergot alkaloids
Leptostromiformis; Pithomyces chartarum	Pastures	Sporidesmin A

(**Source -**D'Mello, J.P.F., 2000. Anti-Nutritional Factors and Mycotoxins. In: Farm Animal Metabolism and Nutrition, D'Mello, J.P.F. (Ed.). CABI Publishing, Wallingford)

4. Prions Evaluation

Prions are infectious proteinaceous particle which are known to produce neurological problems diseases such as Bovine Spongiform Encephalopathy (BSE) or Mad cow disease in cattle, scrapie in sheep and goats, Creutzfeldt-Jakob Disease (CJD) in humans and chronic wasting disease in wild animals (deer, elk, moose, etc.).The occurrence was reported in animals; when processed animal proteins i.e. scrapie infected sheep meat and bone meal (MBM) was fed to cattle. These prion proteins are highly resistant to the normal sterilization process of rendering.

5. Silage Quality Evaluation

Silage refers to preservation of green succulent roughage by anaerobic fermentation; to make availability of green even during lean months of the year. Under optimum anaerobic condition, lactic acid bacteria grows and act on soluble sugar or carbohydrate portion of the fodder and crop to produce enough lactic acid for attainment of the pH upto the level of 4 (Acidic condition) i.e. favorable condition for ensiling. The freshly cut or lush green crop also favours the growth of undesirable microbes especially of *Clostridium* sp. During the process of ensilage, there will be change in microbial population; as the population of lactic acid bacteria dominates all other microbes particularly aerobic microbes. During ensilage either one of the two types of fermentation (homo- and hetero-fermentation) will takes place and ultimately determines the silage quality. The fermentation pattern of both the homo- and hetero-fermentation results in lactic acid, acetic acid, ethanol and CO_2; based on the type of lactic acid bacterial populations. Among these two fermentation types, the homo-fermentative more desirable; as maximum acidity could be obtained (lactic and acetic acid) which inhibits the growth of aerobic organisms, moulds and yeast and thereby protect the silage from spoilage. Wilting the crop before ensiling; is a common method of restricting fermentation, allowing the growth of lactic acid producing bacteria but inhibiting the activities of undesirable organisms such as *Clostridia* and *Enterobacteria.*

Determination and Quantification of Microbial Contamination

The assessment of microbiological organisms follows a standard protocol which includes the following steps –

1. Collection of representative feed samples
2. Segregation or isolation of microorganisms (bacteria, virus, fungi) by an appropriate and suitable methods i.e.
   - **For Bacteria –**
   - Complete enumeration by total plate count (both aerobic and anaerobic organisms)
   - Gram staining methods
   - Biochemical tests – IMVic tests (Indole test, Methyl red, Voges-Proskauer, Citrate test), catalase test, oxidase test, coagulase test, nitrate broth test, SIM (sulphur indole motility media) test, urease test, sugar fermentation test etc.

- **For Viruses–**
  - Culture-based virus isolation
  - Molecular techniques (PCR, RT-PCR) etc.

- **For Fungi –**

- LPCB staining methods (Lacto-Phenol Cotton Blue)
- Culture media isolation on SDA (Sabouraud Dextrose Agar), PDA (Potato-dextrose agar), DG18 (Dichloran-Glycerol Agar 18), CMA (Corn Meal Agar)
- TLC (Thin Layer Chromatography) – To quantify mycotoxins present in the feed samples. (TLC indirectly measure the extent of fungal contamination in processed and preserved feeds; which mainly occur during the post-harvest and storage periods)

3. Characterization and identification of the microbes isolates from the feed samples

The microbiological assessment using traditional or conventional methods provides less sensitive and less accurate result in addition to long experimental time requirement; hence, the modern techniques such as PCR (polymerized chain reaction) could be used to assess feed samples.

Conclusion

Since; presence of microbiological species in the feed samples could represent a potential risk for disease transmission to farm animals and also influences the feed quality. Like Mycotoxins affects animals by causing mutagenic, carcinogenic, teratogenic, neurotoxic, estrogenic and immunosuppressive changes, whereas proteolytic and lipolytic bacteria lead to disintegration of lipids and proteins changing the nutritive value of feed. Therefore, microbiological evaluation of the ingredients and finished feeds becomes a key element to ensure that the feed is not a source of contamination and at the same time this evaluation could also be used as an indicator of quality assurance and feed safety during its production until feeding the animals at the farm.

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Anatomical Methods for identification of meat

Vikas Kumar*, Neelam Kumari faran[1]

Assistant professor of Department of veterinary Anatomy* Assistant professor Department of, veterinary Parasitology[1], Arawali Veterinary College, Sikar

***Corresponding Author:** vikaspoonia341@gmail.com

Abstract

Adulteration of meat is "the fraudulent practice which involves substitution or mixing of flesh of cheaper variety which is objectionable for the reason of health, religion and economics". Mixing of meat of one species with another is punishable under the Prevention of Adulteration Act, 1973. On the basis of anatomical structure of different animal's species using for meat production, we can easily identify the meat species. The primary identification method for meat species is dental formula if teeth are attached with the carcass. Another anatomical technique for carcass identification is on the basis of vertebrae and ribs number present on the carcass and different anatomical structures present on the carcass

Introduction

Meat species specification is an utmost important field of quality control management in meat industry. It is more challenging and revolutionary task for us as a veterinarian because by this way we can ensure the quality of meat and also helps in conservation of law existing in different countries. These anatomical methods are very much important for accurate detection of meat species and their fraudulent substitution in another meat. Animal carcass can be differentiated on the basis of the dentition, number of bones, presence or absence of a specific structure on bones. These practices are also helpful in implementation of prevention of cow slaughter acts of different states of India, wild life conservation act, PFA acts of India and some other similar acts of the world.

The primary identification method for meat species is dental formula if teeth are attached with the carcass. The typical dental formulations are given in Table 1.

Table 1: Dental formula identification of different meat animal species

Species	Temporary	Permanent
Cattle/ sheep/ goat/ buffalo	2(0030/ 3130) = 20	2(0030/ 3133) = 32
Pig	2(3130/3130) = 28	2(3143/3143) = 44
Horse	2(3030/3030) = 24	2(3133/3133) = 40

Anatomical technique for carcass identification is on the basis of vertebrae, sternum and ribs number present on the carcass. specific numbering of vertebrae sternum and ribs found in different meat species are shown in **Table 2**

Type of vertebrae	Cattle and buffalo	Sheep and goat	horse	pig	poultry
Cervical vertebrae	7	7	7	7	15-17
Thoracic vertebrae	13	13	18	14-15	7
Lumber vertebrae	6	6	6	6-7	L+S fused 14
Sacral vertebrae	5	4	5	4	
Coccygeal vertebrae	18-20	18-20	15-21	20-30	5-6
Ribs, sternum and clavicle	26+1+0	26+1+0	36+1+0	28 to 30+1+0	14+1+1+2

Differentiations of horse meat and beef on the basis of anatomical structures. Table 3

Characteristics	Horse meat	Beef meat
Vertebrae Characteristics 1. Supraspinous processes of first six dorsal vertebrae 2. Transverse processes of last three lumber vertebrae	Well developed Articulate with each other	Not Well developed Not Articulate
Ribs	Narrower but more markedly curved	Comparatively thicker and less curved
Thoracic cavity	Longer due to 18 ribs	Smaller due to 13 ribs
Ulna bone	Extends half of the length of radius	Extends full length of radius
Acromion process	Absent	present
Deltoid tuberosity	Well developed	Less developed
Carpal bones	There are total seven bones	There are total six bones
Femur	Third trochanter present	Third trochanter absent
Fibula	Extends 2/3rd length of tibia	Fibula is small pointed projection

Sometimes to conserve the interest of consumers we will have to identify the meat of male and female animals of different species. For that purpose, we can identify the meat of male and female animals if the meat sample is presented in form of carcass or cuts. It may be differentiated by presence of gonads, udder and developed gracilis in females and bulbocavernosus muscle in male. The size of pelvic cavity in female animal's carcasses will be larger than male animals

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Meat borne bacterial zoonotic diseases

Pranjal Moni Nath[1*], Bilifang Daimary[2], Mrinmoyee Sarma[3], Nanda Kumar Roy[4] Debarun Borah[5]

[1]PhD, [3]M.V.Sc. Scholar, Department of Veterinary Public Health, [2]PhD Scholar, Department of Livestock Products Technology, [4]PhD Scholar, Department of Livestock Production and Management, [5]M.V.Sc. Scholar, Department of Animal Biotechnology, College of Veterinary Science, Assam Agricultural University, Khanapara, Guwahati-22

[*]**Corresponding author: pranjalnath69603@gmail.com**

Abstract

Raw meat may be a carrier of potential zoonotic organisms like *Escherichia coli*, *Bacillus anthracis*, *Brucella* spp., *Leptospira* spp., *Listeria* spp., *Salmonella* spp., *Mycobacterium* spp., *Campylobacter* spp., which can cause diseases both in animal and human population. These organisms are mostly isolated from animal species, but are also transmitted to human beings through various routes like consumption of contaminated meat and food with these pathogens, being in close or direct contact with animals etc. Meat borne zoonotic diseases may be controlled by adopting good hygienic practice during slaughtering, processing and preparation of food.

Introduction

According to WHO, zoonosis is any disease or infection that is naturally transmissible from vertebrate animals to humans. There are mainly two main modes through which zoonoses are transmitted from meat: (i) During transportation, unhygienic practices during slaughtering, skinning, dressing and processing of the food animals and its by product, transfer of harmful agents from animals/meat, meat products and the equipment, utensils and instruments used in the meat production to man. (ii) consumption of infected meat and meat products. Livestock act as the reservoirs for many food poisoning organisms such as Anthrax, Brucella, Tubercule bacilli, Salmonella, *Campylobacter jejuni* etc. The meat borne zoonotic diseases which are prevalent in India are anthrax, erysipelas, leptospirosis, listeriosis, tularemia, tetanus, salmonellosis etc. Inadequate cooking or consumption of raw meat are the main cause of contacting meat borne bacterial zoonotic diseases.

Anthrax

Anthrax is a bacterial zoonotic disease caused by the agent *Bacillus anthracis*. Anthrax primarily inhabits herbivorous wildlife and livestock and is usually fatal among these animals. High mortality rate occurs in human if not diagnosed and treated expeditiously. In humans, cutaneous anthrax is more common and gets the infection through direct contact of skin or mucosal membranes with *B. anthracis* infected animals when they are slaughtered or butchered or by handling by-products. Infection can also result from consuming raw or undercooked meat salvaged from anthrax infected animals. Inhalation anthrax rarely occurs naturally in humans although it can cause severe disease. It is acquired through inhaling *B. anthracis* spores aerosolized during contact with or processing of contaminated hides, bones, hair, or wool. The disease is still endemic in India.

In animals, there is rapid rise of temperature (42 °C), tarry color blood oozing out of natural orifices like anus, nose etc. and the animal dies suddenly. Vaccination of livestock accompanied by rapid monitoring of the disease outbreak is the major effective control program to limit environmental contamination and human exposure.

Brucellosis

Brucellosis is an endemic bacterial zoonotic disease in most of the developing countries which is highly contagious and transmitted by ingestion of raw or unpasteurized milk, undercooked meat from infected animals or close contact with their secretions in humans. Transmission in livestock occurs through mucosal contact with aborted fetuses and fetal membranes. *B. melitensis* and *B. abortus* are the two major species of concern in India. Among all, *B. melitensis* is the most virulent and common strain for man. In cattle *B. abortus* is the dominant species. It causes abortion, mastitis, reduces fertility, sterility and a substantial decline in milk production over an animal's lifespan. In human, non-specific signs including malaise, fatigue, arthritis, chills, sweats, fever, chronicity, recurring febrile conditions with joint pain, arthralgia, and weight loss are seen. Mass vaccination in domestic livestock is the key to prevent human brucellosis.

Leptospirosis

Leptospirosis or hemorrhagic jaundice is a bacterial zoonotic disease caused by the pathogenic helical spirochetes, *Leptospira*. Rodents (rats, mice, and moles) are the primary hosts but animals like dogs, cows, sheep etc. are also responsible for transmission of the disease. Humans get the infection after contact with infected food, water or soil by urine from these infected animals. Clinical signs include septicemia, fever, hemoglobinuria, jaundice, infertility and abortion in most animals. Fever, chills, headache, severe myalgia, conjunctival suffusion, anorexia, nausea, vomiting, and prostration are commonly seen in acute leptospirosis. In human it is also known as Weil's disease. High fever, vomiting, jaundice (yellow skin and eyes), red eyes, headache, chills, muscle aches, abdominal pain, diarrhea, rash etc. are the common clinical signs observed in human.

Listeriosis

The etiological factor of listeriosis in humans is the bacteria *Listeria monocytogenes* from intestines of domestic animals and man. Transmission of listeriosis occurs through direct contact with infective material, aborted fetus and contaminated soil. Human gets the infection by consuming contaminated raw chicken meat with listeria and through unhygienic conditions of the processing area, rather than directly from birds. Chicken meat is considered as carriers and also the prime reservoirs of Listeria. Symptoms associated with both humans and animals includes gastroenteritis, sepsis, and infections of the CNS (meningitis or myelitis), and also may lead to miscarriage.

Salmonellosis

Salmonella remains an important human pathogen and the most common food-borne bacterial disease in the world. *Salmonella typhi* cause typhoid in human and *Salmonella gallinarum* cause fowl typhoid in poultry birds. Salmonella is abundant in animal's intestines and may get transferred onto meat as a result of careless processing or improper hygiene. Salmonella can also be transmitted directly from infected animals or indirectly via its environment. Pigs, Cattle etc. acts as a reservoir for numerous serotypes Salmonella. It can grow rapidly in fresh meat due to the high amount of nutrients present in the meat. Salmonella also

exists in faeces and pastures. Salmonella causes diarrhea, fever lasting for up to 7 days, anorexia, dehydration, reduced milk production, miscarriages, or the presence of toxins in blood.

Tuberculosis

It is an important bacterial zoonotic disease. *Mycobacterium tuberculosis* and *Mycobacterium bovis* are the major causes of tuberculosis that infect many animal species. Cattle, sheep, pigs, goat, poultry etc. are mostly susceptible to tuberculosis. As humans and animals are closely associated in the same environment, this infection becomes a major public health concern in developing countries. Transmission occurs in humans through direct contact with infected animal with TB, consumption of under cooked beef and ingestion of raw or unpasteurized milk and milk products. TB symptoms in human may include fever, cough, greenish or bloody sputum, chest pain, cavitation and hemoptysis, night sweat, weight loss etc.

Campylobacteriosis

Campylobacter jejuni is one of the leading causes of bacterial gastro-enteritis in the world and is frequently associated with handling and consumption of contaminated poultry meat. It is commonly found in the guts of birds and mammals. Transmission may occur during the slaughter process. Humans may also get the infection from feces of infected wild animals. 90% of the disease is caused by *C. jejuni* and rest is mostly by *C. coli*. Both species are pathogenic to human. Host ranges include both farm animals (cattle, sheep, poultry, pigs) and wild animals (birds and mammals). Irritable bowel syndrome is a consequence of this disease.

Escherichia coli

There are five main categories under the family *Enterobacteriaceae.* But from the zoonotic point of view, Shiga Toxin producing *E. coli* (STEC) is the only *E. coli* that cause severe disease in humans. STEC are introduced in the environment mainly through faecal contamination. Symptoms observed in STEC infections are abdominal cramps, bloody diarrhea, usually without fever.

Prevention and control of meat borne bacterial zoonotic diseases

Prevention of meat borne bacterial zoonotic diseases needs tactics to interrupt several routes of transmission. Appropriate surveillance and monitoring systems for meat borne bacterial pathogen should be designed and epidemiological data on risk factors, incidence of meat borne bacterial zoonotic diseases etc. should be documented. Awareness should be raised among general public pertaining to safe meat handling and various public health interventions could be a corner in preventing and controlling meat borne bacterial zoonotic diseases outbreak. Food handlers should adopt good personal hygienic practices. Cooking and storage of meat should be done at proper temperature. Strict legal regulations and control of meat product manufacture should be implemented. In addition to these, strict biosafety and biosecurity measures should be implemented to prevent and control meat borne bacterial zoonotic infections.

Conclusion

Meat borne bacterial zoonotic diseases are prevalent all over the world. It is because of lack of accurate techniques for diagnosis, under reporting system and lack of proper knowledge about the diseases. Outbreaks of meat borne zoonotic diseases are mainly observed due to poor hygienic practices, improper ante-mortem and post-mortem inspection, consumption of undercooked meat, improper slaughter technique and lack of reliable qualitative and quantitative epidemiological data on disease burden. So, it is utmost important to have good education about diseases, strict biosecurity measures in livestock farm, maintenance of proper meat hygiene practices, regular inspection and effective surveillance program for the prevention of these diseases.

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Fluid therapy, Composition & Indications of Commonly Used Fluids in Veterinary Practice

Nripendra Singh[1], Raj Kamal Yadav[2], S.V Singh[3], J.P Singh[3]

[1]M.V.Sc. Scholar, Department of Veterinary Anatomy & Histology, [2]M.V.Sc. Scholar, Department of Veterinary Medicine, [3]Assistant Professor, Department of Veterinary Medicine, College of Veterinary Science & Animal Husbandry ANDUAT Kumarganj Ayodhya 224229

***Corresponding Author:** nripendra.singh838@gmail.com

Fluid therapy refers to administration of fluids to compensate the loss of fluids from the body due to a variety of conditions leading to dehydration. Fluid loss in the body can lead to shock and can become fatal if unattended to. The purpose of fluid therapy is to correct dehydration or overhydration, electrolyte imbalance and /or acid -base imbalance. It is also indicated to correct acidosis/alkalosis, treat shock, give parenteral nourishment or even stimulate organ function such as kidney.

Fluid volume and type

The type of solution is to be dictated by history, clinical signs and laboratory examination. The volume of fluid is determined the need for maintenance as well as the need for replacement of lost fluid. For normal maintenance, a thumb rule of 65 ml / kg /24 hr for adults and 130 ml / kg /24 hr for young ones is calculated. Based on this, a normal mature dog of 20 kg would require 1300 ml for 24hr period. Replacement of fluid loss must be in addition to the maintenance requirement.

- To calculate fluid loss, one must estimate the degree of dehydration.

Degree of Dehydration	Clinical Sign
4%	History of fluid loss, leathery skin, mucous membrane still moist and evidence of thirst.
6%	Skin still leathery, when lifted the skin will peak and return to normal slowly, hair coat dull,mucous membrane dry but the tongue still moist
8%	Skin will show lack of pliability and elasticity, the skin loses turgor (when lifted will peak and stay, mucous membrane and tongue dry, eyeballs will be soft and sunken
12%	Signs of circulatory collapse
15%	Symptoms of Acute shock

Fluids & its composition		Indications
Normal Saline	Sodium Chloride 0.9%	• Expand circulating blood volume • Severe sweating • Vomiting • Pyloric obstruction • Abomasal disorder
Dextrose Normal Saline	Sodium Chloride 0.9% & Dextrose 5%	• Dehydration • Vomiting • Heat stroke • mild diarrhoea
Balanced Electrolyte Solutions	Ringer's Solution (NaCl 0.9g + KCl 0.03g CaCl2 0.03g + D W 100 ml)	• Dehydration • Acidosis • Alkalosis • Electrolyte losses
	Lactated Ringer's Solution (As for Ringer's solution + Sodium lactate)	• Mild to moderate acidosis with dehydration
	Dextrose 20g + NaCl 0.6g + KCl 0.04g + CaCl2 0.027g + Na lactate 0.31g	• Dehydration • Ketosis • Mild to Moderate Acidosis
Sodium bicarbonate solutions	Sodium bicarbonate 1.3% (Isotonic)	• Acidosis
	Sodium bicarbonate 5% (Hypertonic)	• Severe acidosis
Mixture of isotonic KCl2 (1.1%) and Dextrose saline		• Metabolic alkalosis
Dextrose Solutions	Dextrose 5% (isotonic)	• High fever • Starvation • Decreased water intake
	Dextrose 20% & 25% (Hypertonic)	• Parenteral nutrition • Ketosis • Hypoglycemia • Surra
Amino acid solution	-	• Parenteral nutrition • Liver disorders • Hypo-proteinemia • Extensive burns
Plasma expanders	Dextran -70, 500ml (Dextran 6% in normal Saline/5% Dextrose) Dose: 10-20 ml/kg/day/IV	• Shock • Hemorrhage • Burns • Severe dehydration • Surgical operations.
	Haemocoel, 500ml (Polymer form degraded gelatin 3.5% + Electrolytes Na+K+Ca+Cl)	• Hypovolemic shock • Hemorrhage • Burns • Endotoxic shock
Mannitol 20%	Dose @ 0.5g/ kg IV	• Cerebral Oedema

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Organic Poultry Production: Constraints and possibilities in North East region

Dr Nanda Kumar Roy[1], Dr Bilifang Daimary[2], and Dr Neelakshi Deka

[1]PhD Scholar, Department of Livestock Production & Management, [2]PhD Scholar, Department of Livestock Products Technology, [3]PhD Scholar, Department of Veterinary Parasitology, College of Veterinary Science, Assam Agricultural University, Khanapara, Guwahati-22
Corresponding author: kumarroynanda@gmail.com

Abstract

Currently, poultry industry is the fastest growing sector of India's agriculture. In the last few years, Poultry industry has transformed from backyard poultry farming to commercial farming. Now days, Increased awareness for health and wellbeing among human beings and consumers are more concerned about the quality, source and conditions under which their food is grown. Hence, organic poultry farming has become as an approach to address these issues. Organic poultry farming is the emerging system of rearing in all over the world. Organic farming allows exhibiting the normal behaviour and also provides welfare to birds that make the birds to exhibit their natural resistant against diseases.

Introduction

FAO/WHO Codex Alimentarius Commission defines organic farming as "a unique production management system which promotes and enhances agro-ecosystem health, including biodiversity, biological cycles and soil biological activity, and this is accomplished by using on-farm agronomic, biological and mechanical methods in exclusion of all synthetic off-farm inputs". Increased awareness for health and wellbeing among human beings has contributed to change in human preferences from conventionally produced food to organically grown food. Organic livestock farming is becoming popular at rapid pace worldwide due to ever increasing demand of organic milk, meat and eggs products and increased consumer awareness regarding quality of milk, meat and egg products. Due to the presence of various pesticides, insecticide, chemicals, drugs and hormone residues, life style related problems or issues like diabetes and cancer has increased. Due to intensive and mechanised agriculture, rate of cancer is much higher in developed countries in comparison to developing ones. The increasing demand for organic meat has encouraged nations to produce organic poultry products. Organic livestock farming is most suitable to our Indian conditions because of indigenous technical knowledge and practices followed by Indian farmers but organic poultry production is still lagging behind. The poultry population in India

is huge and a small shift from current conventional poultry farming into organic poultry farming can create a huge market for domestic use as well as export.

Status of Organic Farming in India:

Currently, India has 10th ranks among the top ten countries of the world in terms of cultivable land under organic certification. The certified area includes 15% cultivable area with 0.72 Mha and rest 85% (3.99 Mha) is forest and wild area for collection of minor forest produces. The total area under 71 organic certifications is 4.72 Mha (2013-14) out of north eastern region of India comprises 69.45 thousand hectares. Many North Eastern state Governments have promoted organic agriculture in the region. Sikkim has aimed to make the entire state 100% certified organic by the end of this year (2015). With regards to production, India produced around 1.24 mt of certified organic products which includes namely sugarcane, cotton, oil seeds, basmati rice, pulses, spices, tea, fruits, dry fruits, vegetables, coffee and their value added products. The production is not limited to the edible sector but also produces organic cotton fiber, functional food products etc. Among all the states, Madhya Pradesh has covered largest area under organic certification followed by Himachal Pradesh and Rajasthan.

Concept of organic poultry farming:

In recent days there has been an increased health concern over quality of milk, meat and egg products due to the presence of various pesticides, insecticide, chemicals, drugs and hormone residues. Due to this organic livestock farming is increasing at rapid pace worldwide with faster growth in demand of organic milk, meat and eggs products. Organic livestock farming is most suitable to our Indian conditions because of indigenous technical knowledge and practices followed by Indian farmers. In order to make organic livestock and poultry farming successful there is a need to take care of certain issues, like health management, record keeping, breeding strategies, certification, cost of production and cost of inputs etc. Increased consumer awareness of food safety issues and environmental concerns has contributed to the growth in organic farming over the last few years, although it only represented around 3 per cent of the total agricultural area. Now-a-days quality and health conscious consumers are increasing and they need environmentally safe, chemical residue-free healthy foods, along with product traceability and a high standard of animal welfare. These can be ensured by organic production methods. Organic farming can provide quality food without adversely affecting the soil health and the environment. Organic livestock farming should not necessarily be interpreted to mean that the foods produced are healthier, safer or all natural.

The International Federation of Organic Agriculture Movements (IFOAM) has formulated four broad principles of organic farming, they are:

1. **Principle of Health:** Organic agriculture should sustain and enhance the health of soil, plant, animal, human and planet as one and indivisible. Health is the wholeness and integrity of living systems. It is not simply the absence of illness, but the maintenance of physical, mental, social and ecological well-being.
2. **Principle of Ecology:** Organic agriculture should attain ecological balance through the design of farming systems, establishment of habitats and maintenance of genetic and

agricultural diversity. Those who produce, process, trade, or consume organic products should protect and benefit the common environment including landscapes, climate, habitats, biodiversity, air and water.

3. **Principle of Fairness:** Organic agriculture should build on relationships that ensure fairness with regard to the common environment and life opportunities. Fairness is characterized by equity, respect, justice and stewardship of the shared world, both among people and in their relations to other living beings.

4. **Principles of Care:** Organic agriculture should be managed in a precautionary and responsible manner to protect the health and well-being of current and future generations and the environment. It should prevent significant risks by adopting appropriate technologies and rejecting unpredictable ones, such as genetic engineering.

Basic requirements for organic poultry farming:

1. **Housing:** The main objective of the organic housing and management standards is to permit poultry birds to exhibit all their natural behaviour patterns and experience minimal stress. Poultry birds should have access to the outdoors, exercise areas, shade and direct sunlight. Appropriate clean, dry bedding and shelter designed to allow for natural maintenance, comfort behaviours and opportunity to exercise should be there for poultry birds. Protecting birds from predators is one of the major concerns of housing. Birds should be reared under deep litter system. Artificial light can be used in poultry farms according to the time prescribed by the certification agencies. Birds must be grown for usually a period of 81 days of age in the organic meat sector.

- In France the maximum size of house is 400 m^2 with range areas on both sides.
- In U.K. it is wooden houses 2M x 5M x 1.5 M height on skids moved by tractor.
- Density requirement in France is 11 birds/M^2, maximum threshold for broilers in mobile home is a maximum of 16 birds or 30 kg per M^2.
- Minimum free range – 2 M^2/bird, under EU Standards it is 2.5 M^2 per bird.

2. Breeding: In organic farming, Birds should be purchased from production units that follow organic standards or should be purchased from farms where parents are raised under organic conditions. Vaccination against common diseases is allowed, however vaccines must not be genetically modified. Non organic poultry can be introduced only under only after obtaining information from accredited body under certain conditions like operating organic poultry farm for the first time, introducing a special breed, renewal of the herd in the farm etc.

3. Feeding: Organically grown feed of good quality should be fed to the birds. Not more than 20% feed should come from non-organic sources. All ingredients must be certified as organic, except vitamin and mineral supplements. Organically produced concentrated balanced feed ration should be given. Home grown protein sources like peas, beans and rapeseed can be utilized. Peas can be included at the rate of 250-300g/kg for meat birds and 150-200g/kg for laying hens. Sprouted pulses are a good source of vitamins so they can be preferentially used to replace synthetic amino acids. Trace minerals incorporated in the diets should be preferably organic in nature. The quota of essential amino acids can be met through feeding Organic soybean, skim milk powder, potato protein, maize gluten etc. Overfeeding

must be avoided. A continuous access and ample supply of drinking standard quality water free from residues should be given. Feed used must not contain animal products or any hormone to promote growth, urea or manure, feed or forage to which any antibiotic, including ionophores has been added and any feed, additives or supplements in violation of the Food and Drug Administration.

4. Health Management: Organic poultry producers must establish preventative health care practices which includes:

- By selection of breeds that are suitable for site specific conditions and resistant to prevalent diseases and parasites.
- Establishment of appropriate housing and pasture conditions.
- Proper sanitation and disinfection practices to minimize the occurrence and spread of diseases and parasites.
- Providing feed ration sufficient to meet nutritional requirements.
- Generally it is accepted that mortality rates are likely to be higher in birds kept under range. The estimated mortality rate is 10% for organic table birds.

Use of antibiotics should be avoided; however vaccinations are permitted only when diseases are expected to be a problem. All vaccination used in poultry should have prior permission from organic council. Use of alternate medicine such as homeopathy and Ayurveda should be encouraged for treating diseases. Probiotics, prebiotics and plant extract can be used in organic poultry farming to improve the growth and health status of poultry birds as an alternate source of antibiotics. Hormonal treatment that are therapeutic in nature can be carried out under supervision but growth stimulants are strictly prohibited.

5. Record keeping: It is important to maintain record in organic poultry farming to make it available to the certifying body during inspection. A systematic documentation of all activities, observations and inferences from time to time for future references is advised. The types of records maintained are as following:

- Registers indicating source of animals purchase
- Parenteral origin and source breeding records
- Source of organic feed ingredients
- Feed supplements and feed additives purchased
- Organic feed formulation, organic poultry pasture record
- Inventory of health care products, sanitation products
- Monthly flock records of organic egg layers, organic meat poultry, organic poultry slaughter/sales
- Summary and monthly organic egg packing /sales record
- Other management records and materials used.

6. Transportation: The birds should be transported very carefully. Birds must not be transported for more than 100 kms or 2 hours by road. There should be no stress, injury, hunger, malnutrition, fear, discomfort, pain, disease or suffering during transportation.

7. Slaughter of birds: There should be minimum stress and suffering during slaughter of birds according to organic standards. Hygienic packing of poultry products while maintaining standards of organic council is of utmost importance. Use of chemicals while packing is strictly prohibited. Separate rooms for washing, slaughter and bleeding, feather removal etc are mandatory.

8. Waste management: The waste from the farms should be properly disposed with minimum soil and water degradation.

The problem in adoption of organic farming in north east India is summarized as follows:

- Lack of market
- Lack of training on organic practices
- Inconvenience of organic techniques
- Non-availability of organic inputs
- Lacking of price advantage
- High cost of organic inputs
- Lack of financial, technological and infrastructural support
- Small holding size
- Remoteness of the region
- Climatic condition, low temperature low mineralization
- Difficulties in managing of insect pest and diseases in organic condition
- Supply of quality organic seeds

Prospect of Organic farming in North Eastern Region of India:

When the organic, movement was started, the NEH states were identified as one of the promoting zone for organic farming. These states were selected because the land was almost virgin and the crops were grown virtually organic. There is tremendous scope for organic agriculture in the north eastern region of India, because the use of inorganic fertilizers and chemicals is least in the region. Farming on the hills remained low input–low yield based and the average yield of most of the crop remained far behind. It is assumed that the difference in production gap due to adoption of organic agriculture is expected to be negligible. Moreover, the region receives plentiful rainfall (2400 mm/year) accounting for around 10 per cent (42.50 mhm) of the country‘s total precipitation of 420 mhm leads to profuse production of biomass, which may be utilized as a valuable organic nutrient sources for sustainable crop production.

Some of the favourable features for organic farming in NEH region are:

1. **Crop-livestock integrated/mixed farming:** Livestock and poultry of this region depend on crops and crop by products for their feed and fodder requirements and return nutrients to the crop via manure for the sustainability of the system. Further non-vegetarian food habit of indigenous population is the strength of livestock and poultry sector to develop. Hence, proper and effective integration of these resources would be the first step towards organic farming.

2. **Large native population and preference for products derived for local breeds of livestock and poultry:** The major proportion of livestock and poultry of this region are of local type, which is considered to be sturdy, can grow under harsh environmental conditions, disease resistant and require low input in terms of nutrition. These characteristics are important for selection for organic production. Further, the demand and preference of meat/egg obtained from local birds, by the consumers of this region is an added advantage towards promoting native population in organic farming system.
3. **Low input livestock/poultry rearing system (traditional):** The livestock/poultry rearing system of this region is unique and different from other parts of the country. The farmers aim at getting medium output from nearly zero input and mostly based on locally available resources.
4. **Indigenous technical knowledge in animal husbandry practices:** The region is storehouse of indigenous technical knowledge (ITK) in agriculture and allied sector. Still, several plants are being used in the treatment of animal for infectious and non-infectious diseases. Use of turmeric in food and milk in drinking water for coccidiosis, use of arsenicum album in drinking water for Infectious Bursal Disease, vinegar for water sanitization, garlic for chronic respiratory disease, red chilly for duck plague etc. are the example of such practices in traditional way of poultry farming.

Conclusion:

Market for organically produced foods including of animal origin is on the increase world over. The demand for organic products has created new export opportunities for the developing countries. Also the domestic consumers are now increasingly looking for better quality in food products. In NE region, though organic livestock production has not yet been properly started, but NE region can be explored as a destination for organic livestock and poultry production if proper attention is given in terms of development and dissemination of organic farming technology to nature loving rural peoples of the area. Very little work has been done in the area of organic poultry farming in NE India. Policy bodies, research institutions, the SAUs and other development agencies should involve with the research and development work on organic poultry farming.

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